

# **Requirements for feedback to save energy:**

## **A comparison between professionals in small to medium sized enterprises and consumers**

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## **Abstract**

A lot of research has been done with consumers about features of successful feedback on saving energy, but little has been done for professionals. Therefore this study examines whether the literature on feedback for consumers is also applicable for professionals in small to medium sized enterprises [SME's]. Also, user characteristics of these professionals and their opinions towards potentially user engagement raising concepts are examined. To achieve these goals semi-structured interviews with fifteen professionals within SME's and fifteen consumers were conducted. The results mostly show similarities in features for feedback but differences in the requirements for these features. Also, new relevant features were found. Further, professionals and consumers have similar motivations, and professionals are positive about concepts that may raise user engagement. This study adds new information about feedback for SME's to the literature and concludes that the literature on consumers is applicable for professionals when considering the relevant features for feedback. However, when designing a feedback system, the literature is not applicable due to a lot of differences in the requirements for these features.

## **Samenvatting**

Er is veel onderzoek gedaan naar kenmerken van succesvolle feedback om energie te besparen bij consumenten, maar weinig bij bedrijven. Deze studie onderzoekt daarom of de literatuur over feedback van consumenten ook toepasbaar is voor werknemers in midden en klein bedrijven [MKB's]. Daarnaast worden ook de gebruikerskenmerken van deze werknemers and hun mening ten opzichte van concepten die de betrokkenheid van gebruikers vergroten onderzocht. Om deze doelen te bereiken zijn semigestructureerde interviews gehouden met vijftien werknemers en vijftien consumenten. De resultaten laten voornamelijk overeenkomsten zien in de kenmerken van feedback maar verschillen in de eisen voor deze kenmerken. Ook zijn er nieuwe relevante kenmerken gevonden. Verder hebben werknemers en consumenten dezelfde motivaties, en zijn werknemers positief over concepten die gebruikersbetrokkenheid vergoten. Deze studie voegt nieuwe informatie toe aan de literatuur over feedback voor MKB's en concludeert dat literatuur voor consumenten toepasbaar is voor werknemers wat betreft relevante kenmerken voor feedback.

Echter, voor het ontwerp van een feedbacksysteem is de literatuur niet toepasbaar doordat er veel verschillen zijn in de eisen voor deze kenmerken.

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# 1. Introduction

## *1.1 Strategies for saving energy*

After the energy crisis in the 1970s, there were rising concerns about the depletion of fossil fuels (Abrahamse, Steg, Vlek & Rothengatter, 2005). Finding new resources to produce our energy formed a solution for the depletion. Nowadays, there is a broader goal in the form of minimizing the emission of CO<sub>2</sub> as a result of the burning of fossil fuels. This search for renewable sources of electricity is one of the ways one can deal with depletion of fossil fuels. However, another way is to consciously choose one's appliances while keeping in mind how they can contribute to overall consumption (Fischer, 2008). Thus, both the search for renewable sources and conserving electricity are part of sustainable electricity consumption (Fischer, 2008).

When looking at how our energy consumption can be decreased, there are multiple methods for this to be achieved. Poortinga, Steg, Vlek and Wiersma (2003) distinguish three types of energy-saving strategies: different use of products, improving the energy-efficiency of products and shifts in consumption. By using different products, one changes his behaviour in order to reduce energy consumption in a direct way, for example using a product less. When the energy-efficiency of products is improved, the use of energy is reduced in a direct way through technical improvements. For example, Omer (2008) suggests that by designing buildings in a particular way, they are more economical in their energy use. Shifts in consumption, on the other hand, are an indirect way for energy-saving through behavioural change (Poortinga et al., 2003).

Another method to decrease energy consumption may lie in the development of a new smart grid. This smart grid is a transformation of the existing electricity grid because the latter has multiple shortcomings, such as a unidirectional nature and loss of energy that is not converted into electricity (Farhangi, 2010). Because of these shortcomings, but also because of energy sustainability, the growing energy demand, concerns about the environment, quest for service quality and managing the bulk power energy, the existing grid is transformed to a new electricity grid (Moslehi & Kumar, 2010). This new electricity grid, known as a 'smart grid' or 'intelligent grid',

is expected to account for the shortcomings of the existing grid (Farhangi, 2010) and will turn the old grid into one that will function more intelligently (Moslehi & Kumar, 2010). This intelligent grid is expected to have several characteristics, such as optimizing assets empowering and incorporating the user (Momoh, 2009). It also facilitates two-way communication between utility and the consumer, integration of all types of energy storage and resources, and integration of renewable resources such as wind and solar energy (Moslehi & Kumar, 2010). In this grid, the use of smart meters can help reduce energy consumption. Eftymiou and Kalogridis (2010) define a smart meter as “an advanced meter (usually an electrical meter, but could also integrate or work together with gas, water and heat meters) that measures energy consumption in much more detail than a conventional meter” (p. 238). According to Marvin, Chappells and Guy (1999) smart meters could help the consumer manage their energy use more efficiently, as data from these meters can be used to improve the feedback users get of their energy consumption (McKenna, Richardson & Thomson, 2012). This is supported by studies of Darby (2006) and Wilhite, Høivik and Olsen (1999) who showed feedback on energy consumption behaviour can help save the use of energy.

### *1.2 Feedback*

However, conserving electricity may be a difficult task according to Fischer (2008) as electricity is untouchable, abstract and invisible. Because of this invisibility, it also means a consumer receives little feedback on his consumption. Therefore, improved feedback may serve as a support to sustainable electricity consumption. For example, an approach within human-computer interaction (HCI) attempts to motivate users toward sustainable energy use behaviour with the use of technologies that give real-time continuous feedback about the consumers' energy use (He, Greenberg, & Huang, 2010). People with different motivations will often receive identical feedback. However, individuals are not motivated in the same way but rather are in different stages of willingness, readiness and ableness. Therefore, they are in different stages of motivation that go with different kinds of feedback. In the motivational framework proposed by He et al. (2010), five different stages are distinguished with different goals and recommendations for feedback, which can be found in table 1.

Table 1. *Five different stages of motivational framework of He et al. (2010).*

Stage	Goal	Recommendation
1. Precontemplation	Acknowledge one's problematic energy behaviour.	Provide one with neutral personalized feedback that displays both the consequences and benefits from the present behaviour.
2. Contemplation	One is aware of the problem, but not ready to take action	Provide pros of sustainable energy behaviour and cons about non-sustainable energy behaviour and encourage small energy actions.
3. Preparation	Support one with a plan	Encourage consumers to set their own quantitative and specific goals by multiple methods and applying their own knowledge and expertise.
4. Action	Reinforce sustainable energy action positively.	Provide positive performance feedback immediately and in multiple ways when progression is made.
5. Maintenance	Maintain sustainable energy use behaviour.	Transforming energy actions into habits.

As can be seen in table 1, different motivational stages go with different sorts of feedback (He et al., 2010). Fischer (2008) states feedback will be successful if it catches the attention of the consumer, if it activates various motives and when it links specific actions to their effects. It also seems different kinds of categories are more successful in saving energy. Darby (2001) argues there are different categories of feedback which differ in the degree of immediacy and control by the consumer (Darby, 2006). For example, direct feedback which is given immediately to the user by means of a meter or associated device without first processing it (Darby, 2001). This is in contrast with indirect feedback, which is presented to the user after the raw data is being processed externally, such as bills from the utility company (for more see Darby, 2001). Considering energy savings, direct feedback appears the most promising type (Darby, 2001). Projects concerning direct feedback produced savings

of 5% or more. Direct feedback combined with improved billing also seems promising (Darby, 2006). Wilhite and Ling (1995) also showed more informative bills result in energy savings around 10%.

Research with consumers and households shows feedback also differs when considering the content or design and appearance of the feedback given. When considering the content of feedback, feedback can be given on behavioural units (Wilson, Bhamra & Lilley, 2010), electricity consumption, costs or the impact of the consumption on the environment (Fischer, 2008). Feedback can be broken down into different types of information, such as energy type, rooms or zones, appliance or temporally (Wilson et al., 2010). When the feedback is broken down, the link between action and effect becomes greater through educational awareness (Darby, 2006; Fischer, 2008). The user can also be motivated when the energy consumption is compared. Comparisons can be historic, where actual consumption is compared with prior consumption (Darby, 2006; Fischer, 2008), most of the time compared with the same period in the previous year and temperature corrected (Fischer, 2008). There can also be a normative comparison when a household's energy consumption is compared to other households (Darby, 2006; Fischer, 2008), for instance on regional or national average, households similar in type of house, size or application stock, and houses in the neighbourhood (Fischer, 2008). These comparisons may lead the user to get competitive or ambitious. The frequency of feedback plays a role as well. Fischer (2008) states feedback is more effective when given immediately following an action. This was previously stated by Van Raaij and Verhalen (1983). Wilhite and Ling (1995) add that energy consumption becomes more visible and increases the consumer's understanding of the consumption and costs, and awareness, when feedback is given short after the specific activity. Also, when feedback is given frequently, this has positive effects on energy conservation (Abrahamse et al., 2005). Furthermore, when the feedback is given for a longer time, persistence effects are more likely to occur (Fischer, 2008).

When considering the design and appearance of feedback, according to Wood and Newborough (2007), action is not promoted by the content of the information alone, but rather by the way the information motivates the user. Therefore, the presentation of feedback information is a key factor to get the consumer engaged (Wilson et al., 2010). According to Fischer (2008) feedback can be given through different media, such as electronic media (i.e. computers, internet or else) and written

material (i.e. brochures, direct mailing, bills or else). Electronic media have the advantage of being flexible, can process data quickly and present actual data. On the other hand, these media are more difficult to deal with for people not used to electronic media. A paper bill however, compared to additional written material, is read more carefully and raises more interest in the consumer (Fischer, 2008). The form in which feedback is represented determines the consumers gaining attention and ongoing use (Fitzpatrick & Smith, 2009). On either an electrical or written medium, the feedback can be presented either by text or graphics (Wilson et al., 2010). Comparisons between households mostly make use of horizontal lines or bell curves (Fischer, 2008). When the energy use is broken down into application or comparison over time, text, bar or pie charts and load curves are used. Wilhite et al. (1999) showed sometimes a pie chart is preferred over a bar chart. Furthermore, it showed when the feedback device is placed at a location chosen by the individual, this makes accepting and incorporating the feedback in the routine more likely (Wilson et al., 2010). Also, the ambience of the device alone is ineffective and ambiguous to convey energy consumption (Fitzpatrick & Smith, 2009).

### *1.3 Firms*

Although a lot of research mentioned above about energy savings and feedback is done with consumers and households, little is known about energy savings in firms. Households and firms are two totally different contexts. According to Gifford (2007) context is important for human behaviour and the connection between the two is studied in environmental psychology. Contexts offer both opportunities and constraints for behaviour (Mowday & Sutton, 1993). As one is in a different context when one is at work than when one is at home, the opportunities and constraints may be different, and therefore behaviour might be different. DeCanio (1993) states: “it is important to remember that a firm is a collection of individuals, brought together under a complex set of contracts both written and unwritten, but the firm itself is not an entity acting with a single mind” (p. 906). Therefore, we may not simply extend the conclusions of the studies done with consumers in households to professionals in firms. This is further supported by the statement of Siero, Bakker, Dekker and Van den Burg (1996) who state that in a household, expenditures related to the use of

energy are experienced more directly than in the workplace. Also, when employees make efforts to save energy, they usually only indirectly profit from it.

Pérez-Lombard, Ortiz and Pout (2008) state office and retail buildings together are those with the biggest consumption. In the USA, 3.2% of the total energy consumption takes place in office buildings; in Spain and the UK this is 2.7% and 2% respectively. Abdelaziz, Saidur and Mekhilef (2011) state 37% of the world's total delivered energy is consumed by the industrial sector alone. They conclude this sector can improve energy savings by management, technologies and policies/regulations. Knight (1999) concluded 20 to 60% of all the electrical consumption in buildings is represented by lighting. By taking advantage of daylight, one can reduce lighting consumption with 50 to 80% (Bodart & De Herde, 2002). Pérez-Lombard et al. (2008) concluded office buildings have three key energy end users that together account for 85% of the energy use, which are heating, ventilation, air-conditioning [HVAC], lighting and appliances such as computers.

However, firms do not invest in energy saving because of uncertainty about technological process in the future and investments are irreversible, at least partly (Van Soest & Bulte, 2001). For Dutch firms, energy efficiency plays an important role in their decision to invest (De Groot, Verhoef, & Nijkamp, 2001). However, only a small part of the firms has information about investment possibilities in energy saving technologies. Further, it seems that in small firms there is less knowledge about both already employed and new technologies. These small firms therefore spend relatively little on these technologies. For all firms in the survey of De Groot et al. (2001), it can be said that other, more attractive investments serve as a barrier to not invest in energy saving technologies. This is confirmed by Gruber and Brand (1991), who showed one of the main reason not to realize more energy-saving measures in small to medium enterprises [SME's] is because they want to spend the money on more important investments. They also showed that in SME's, information on which measures are right to save energy is missing. Additionally Gruber and Brand (1991) showed already having efficient production plants, uncertainty about energy costs in the future, waiting for new technical solutions and the right personnel not being available, are reasons for SME's not to realize energy-saving measures. Kannan and Boie (2003) add that due to lack of expertise, initiation and financial limitations there is limited effort to introduce energy management, by which energy efficiency is gained. A research done by Schleich and Gruber (2008) in Germany showed the

investor/user dilemma can form a barrier to energy efficiency as well. The investor/user dilemma serves as one of the most important barriers in multiple sub-sectors. This dilemma indicates neither the company that is renting an office space, the tenant, nor the landlord are motivated to invest in energy efficiency. Also, in a third of the sub-sectors of the survey of Schleich and Gruber (2008), such as in retail trade, wholesale trade, and gastronomy, lack of information about their energy consumption pattern serves as a barrier.

As firms have to cross many barriers for energy savings, one can try a different approach by increasing awareness and knowledge about energy use through feedback (Wilhite et al., 1999). In a research of Siero et al. (1996) it was shown employees in a metallurgical company save more energy when they receive comparative feedback than employees who only receive information about their own performance. This effect lasted even half a year after the intervention, and was accompanied by changing intentions or attitudes.

#### *1.4 User requirements*

As has become clear in previous paragraphs, feedback can be given in many different ways and there are various features relevant for successful feedback. However, for firms only something is known about comparisons. Therefore, more relevant features of feedback for firms should be investigated. These features can then be integrated in a feedback system and firms can start saving energy through changing their behaviour. However, when designing a feedback system for energy consumption, users' wishes on how they want to receive feedback should be known. Identifying these wishes can be done by identifying the user requirements, which are goals or functions the user desires the expected system to achieve (Amyot, 2003). A user requirement focuses on the user rather than the system (Maiden, 2008). User requirements should be distinguished from system requirements as user requirements do not specify the properties of a system, which system requirements do (Maiden, 2008). System requirements might lead to the achieving at least one user requirement, but it expresses ideas that should be embodied in the system under development, rather than ideas of the user about a system (Amyot, 2003; Maiden, 2008). This distinction should be made because a system or product will be successful when the needs and requirements of the users are known when developing the system (Maguire

& Bevan, 2002). When a user is involved as the source of information, this is related to the project success (Kujala, Kauppinen, Lehtol & Kojo, 2005). Also when a user is involved at an early stage in the development of a system, this leads to a better quality of requirements. Kujala et al. (2005), however, state that involvement of the user from the very beginning is rare. Hall, Beecham and Rainer (2002) showed that, indeed, developers rarely speak with users or customers. Potts (1993) also showed when software professionals have inadequate knowledge of the users' work, this may lead to significant misunderstandings about the purpose of the system.

However, a system will not only be usable if the wishes of the user are identified, but also if the user going to interact with the system is understood (Castro, Acuña & Juristo, 2008). This can be achieved by presenting personas to software developers. Personas allow for programmers and other members of a design team to learn about specific user characteristics and thereby the design team is continuously reminded the user is not like themselves (Wickens, Lee, Liu, & Gordon Becker, 2004). Pruitt and Adlin (2006) describe personas as follows: "Personas are fictitious, specific, concrete representations of target users" (p. 11). Personas represent real people during the design process, however, they are themselves not real but hypothetical archetypes of actual users (Cooper, 1999). According to Pruitt and Grudin (2003): "Personas are fictional people. They have names, likenesses, clothes, occupations, families, friends, pets, possessions, and so forth. They have age, gender, ethnicity, educational achievement, and socioeconomic status. They have life stories, goals and tasks." (p. 1). Although the name and personal details of the persona are made up, the description of the persona is based on results of a study. By using personas important user characteristics are personified (Sinha, 2003).

In a technique proposed by Castro et al. (2008), behavioural variables form the base of a persona. This technique can be used to understand the users of a feedback system in firms. To ensure enough user characteristics can be derived in this study, the unified theory of acceptance and use of technology' (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) is used (see figure 1). Although this model attempts to explain an individual's intention to use technology by indentifying underlying factors of intention, in this study, this model is not used to that end at all. The constructs of the model are used to give a description of the current situation in firms when it comes to technology.

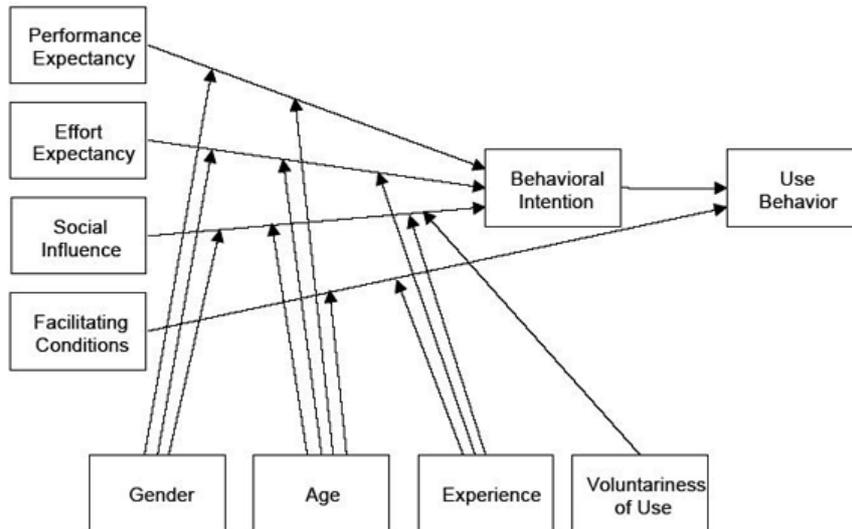


Figure 1. The ‘unified theory of acceptance and use of technology’ (UTAUT)

Figure 1 gives an overview of all the constructs part of the UTAUT model. The constructs ‘performance expectancy’, ‘effort expectancy’ and ‘social influence’ are considered determinants of intention to use (Venkatesh et al., 2003). ‘Performance expectancy’ refers to the degree one believes that by using the system, one can perceive gains in job performance. ‘Effort expectancy’ is considered the degree of ease with which the system can be used. The degree to which one perceives the fact that others believe that one should use the system as important is covered by the construct of ‘social influence’. The determinants that consider use behaviour are ‘facilitating conditions’ and ‘behavioural intention’. ‘Facilitating conditions’ are defined as the degree to which one believes the technical or organisational infrastructure exists to support the use of a system. ‘Behavioural intention’ means what it says; the intention to use technology.

### 1.5 Purpose of the study

As has become clear, a lot of research is done for relevant features of feedback for consumers. It seems these features roughly can be divided in features concerning the content of the feedback and the design of the feedback. When concerning firms, no such extensive research is done. The only research done with feedback for firms by Siero et al. (1996) showed comparative feedback is a relevant feature for firms. However, according to the literature of consumers there are much more relevant

features for successful feedback. But as mentioned before, the results of consumers may not simply be extended to professionals. This shows as Siero et al. (1996) showed comparative feedback for professionals leads to saving energy, while Fischer (2008) found no effect on consumption at all in twelve studies with consumers. The goal of this study is therefore to examine whether the literature on feedback for consumers such as Fischer (2008) is also applicable for professionals in SME's. As the literature distinguishes relevant features and requirements within these features, this distinction will be made in this study as well. Also, a distinction will be made in relevant features for the content, design and display of the feedback for both professionals and consumers. In order to find out whether the literature on consumers is applicable for professionals, user requirements will be used to explore the users' wishes. Therefore this study will also give a more practical advice on what a feedback system for saving energy for professionals should like.

According to Jacucci et al. (2009) involving users in conservation and waste reduction is essential for potentially saving energy. To get users involved, users should become engaged and turn into active players. By considering social and psychological aspects, this challenge can be faced. Therefore, in this study user characteristics of the users within firms are investigated. As He et al. (2010) argue, users may be in different stages of motivation that go with different stages of feedback. Thus, identifying user characteristics of professionals helps programmers in designing a feedback system applicable for users in a firm (Wickens, et al., 2004).

However, by determining user characteristics only the challenge of interaction design is faced (Jacucci et al., 2009), but no solution is given. A solution should pay attention to engagement as it is a term for sustained impact of any feedback system. According to Reich and Benbasat (1990) assigning a 'champion' to promote an idea is an important factor in the successful implementation of a new system. There are also games such as Practically Green that help try to help motivate people to change their behaviour in daily choices that will help save energy. This gamification, "the use of game design elements in non-game context" (Deterding, Dixon, Khaled, & Nacke, 2001, p. 10) can improve user engagement and experience (Deterding, Sicart, Nacke, O'Hara, Dixon, 2011). Both using a 'champion' or game can thus serve as solutions to help increase the engagement of professionals and help them turn into active players. Therefore, the opinions of professionals towards these aspects are also investigated, just as for a specified energy bill as it raises interest in users (Fischer, 2008).

The most important external stakeholder for the Master thesis is IPSUM, a Dutch company that offers help to SME's in managing their energy use. IPSUM wishes to change the behaviour of these enterprises and thereby achieve sustainable improvements in energy consumption. By using continuous feedback, the enterprises should be able to change their energy consumption. To change the behaviour of their clients, IPSUM uses a feedback loop. The feedback starts with the client having continuous insight in his energy use. Based on his energy use, IPSUM formulates several points on which the client can save energy. The progress of the implementation of the targeted actions is tracked. The results of these actions are rated and ranked, and eventually visualized. By using the visualization, the client gets coached and finds himself again at the point where he gets continuous insight. From this point, the targeted actions change when they have led to good results. When this is however not the case, the client has to continue his targeted actions. Either way, after visualization, the client goes through the process again and comes in the feedback loop. In this feedback loop, the client must receive feedback about the targeted actions he is carrying out. Most likely this is the point where the results of the targeted actions are visualized. Concluding, the clients of IPSUM will receive feedback and this study will provide insight into the relevant features and requirements for this feedback.

A second external stakeholder for this Master thesis is LochemEnergie, a Dutch cooperation that started a project to generate and supply renewable energy. Through this project, they aim to accelerate the transition from fossil and nuclear energy resources to renewable energy sources. This project combines green energy and a smart grid. The smart grid is used to optimize the local energy net by advanced control and prediction techniques, which is a project under development by the Computer Architecture for Embedded Systems [CAES] group of the Faculty of Electrical Engineering, Mathematics and Computer Science of the University of Twente in the Netherlands. In the project of LochemEnergie, the residents of Lochem can participate in the project and generate their own energy through the use of solar panels. The residents taking part in this project are interested in either green energy, in the project, or just want to save energy. In this project, the consumers will receive feedback. This should be appropriate so they can handle the new way of energy use and production in an appropriate way. The research of requirements for consumers is done by another student from the University of Twente.

## 2. Methods

### 2.1 Subjects

For this study, fifteen professionals (eleven men, four women), aged between 27 and 61 ( $M = 44.6$  years  $SD = 10.8$ ), were interviewed between April and May 2013. All the professional subjects practiced different professions; an overview can be found in Appendix A. All the subjects worked in a SME, and therefore the term ‘firm’, ‘company’, ‘professional’ or a similar description from now on in this study refers to SME’s or their employees. From the fifteen professionals, four were recruited through BAS Energie, as they are currently their clients. IPSUM works with BAS Energie, and their clients will eventually also become clients of IPSUM. All the other subjects interviewed were involved in the starting up of IPSUM, partners of IPSUM or otherwise connected to IPSUM’s director.

Also, fifteen consumers (twelve men, three women), aged between 40 and 75 ( $M = 54.27$ ,  $SD = 8.17$ ) were interviewed between April and June 2013. All the fifteen consumers were recruited through LochemEnergie as they are subjects of their projects. The consumers were interviewed by a different student of the University of Twente.

### 2.2 Materials

In this study, a voice recorder on a smart phone was used to record all the interviews. Further, Atlas.ti was used to code all the transcribed interviews and SPSS 18 was used for descriptive statistics of user characteristics.

### 2.3 Design

The relevant user requirements were elicited by qualitative research. Qualitative research has the advantage of having a flexible and open approach (Verhoeven, 2007). Furthermore, the experience of the person participating in the study is central. Another advantage is that different interviews and perceptions can be compared, which is called triangulation (Dooley, 2001). Therefore, interviews were conducted with professionals. Compared to group or pair sessions, an advantage of

individual session is that there is a lot of time and attention for the subject (Visser, Stappers, Van der Lugt, & Sanders, 2005). This results in detailed information of the subject. Also, the interview can take place at a site chosen by the subject, such as his or her workplace or home. However, individual interviews are time-consuming and may lead the subject to feel inhibited as it seems that he or she is tested.

Notwithstanding these disadvantages, an interview serves as a way to discover opinions and facts of potential users in requirements elicitation and results in an extensive dataset (Paetsch, Eberlein & Maurer, 2003). Therefore, conducting interviews fits the best in coming up with an answer to the research question.

A semi-structured interview based upon a topic list was used during this study. The interview consisted of five parts with different topics (see Appendix B). These topics were determined on forehand and a 'psychological order' was used (Baarda, de Goede, & Teunissen, 2009). This means the easy questions were asked in the first part of the interview; the introductory questions such as age and profession. Also, all subjects were asked about their knowledge of energy saving and the extent to which they were already concerned with energy saving, and for IPSUM-specific; knowledge about the policy, feedback and actions already done in the company. After this first part with easy questions, the more difficult questions were asked in the other four parts. The second and third parts contained questions based on a list with topics found to be important features of feedback according to the literature on consumers. In the third part, also printed examples of different types of graphs were used, as according to Gulliksen, Goransson, Biovie, Blomkvsit, Persson and Cajander (2003) paper sketches should be used to elicit requirements, but also to support the creative process.

The fourth part of the interview focused on user characteristics. For this part, the UTAUT model (Venkatesh et al., 2003) was used to form the interview. Although this model attempts to explain an individual's intention to use technology by indentifying underlying factors of intention, in this study, this model is not used to that end at all. The variables of the model are used to give a description of the current situation in firms when it comes to technology. All the determinants of the model mentioned earlier, were transformed into questions (see Appendix C). The questions for this part of the interview were presented to the subject on paper. Some of the questions were presented to the subject in the form of a five point Likert scale. All of the other questions were open questions.

The fifth and last part of the interview consisted of several questions in which concepts that may raise user engagement were questioned. First, the subjects' opinion about an energy champion was questioned. An energy champion may be appointed by IPSUM in a company to promote energy savings. Second, the subjects' opinion was questioned about an energy saving game which may be used in the company to save energy. Third, and last, the opinion of the subjects about a specified energy bill IPSUM wants to use was questioned.

#### *2.4 Procedure*

Before the interview, all subjects were notified by email about the two topics of feedback in the interview (see Appendix D). In the e-mail they were asked to think about these topics and write down some of their ideas so they could be treated during the interview.

The interviews with professionals were almost all conducted in the company of the subject itself, however, only one interview took place in a home situation. The subjects were greeted, after which the interviewer started with the interview. First, a short introduction about the interviewer and the project were given. After that, the progress of the interview was treated and the subject signed the informed consent (see Appendix E). After these introductory questions, the points the subject had come up with him- or herself were treated for both the content and design of the feedback. When a subject did not come up with a lot of ideas, or no ideas at all, the interviewer introduced a list with a few topics important according to the literature used in this study, and these were treated. The interviewer questioned all of these points, and based on the answer that was given by the subject, sometimes more explanation was necessary and further questions were asked. Next, the subject had to answer the questions based on the UTAUT model on paper. After that, several questions were asked about some concepts that can raise user engagement. The interview, which can be found in Appendix B, took about 45 to 60 minutes and was recorded anonymously after the subject signed the informed consent to end of the interview.

#### *2.5 Data analysis*

The results of the conducted interviews were manually transcribed in Word 2007. After this, the transcribed interviews were transported into Atlas.ti, which was

used to code all of the interviews. As the interview consisted of certain topics treated in a certain order, the transcripts of the interviews also contained these topics. Therefore, the choice was made to use a template analysis (Baarda et al., 2009). When using this analysis, one determines whether a quotation can be placed in a certain template. A template was created based upon the topics of the interview. Both researchers, one for IPSUM and one for a similar project for LochemEnergie, worked on creating the template fitting the interviews of both the professionals and consumers. The template used during coding the interviews with the professionals can be found in Appendix F. Although the participants were asked about the display of the feedback by using graphs, and questions were asked about the axis, the answers on the questions about the axis were not put in the template as this did not lead to reduction of the data, while this is the goal of coding (Baarda et al., 2009). Therefore, only meaningful quotes were coded in the template, such as which graph has the preference.

To account for inter-reliability, 10% of the interviews from this study, which is equivalent to 2 interviews, were also coded by the student carrying out the research for LochemEnergie and another Human Factors and Media Psychology student. By using Cohen's kappa the inter-reliability was calculated, which resulted in 0.867 (see Appendix G), indicating the inter-reliability is almost perfect (Landis & Koch, 1977).

After the interviews with the professionals were all coded, firstly, personas were developed to structure and aggregate the results (Vyas, de Groot & van der Veer, 2006). The personas were formed using the Personas\* Technique of Castro et al. (2008). The first step in this process was to state hypotheses before conducting the interviews. However, the decision to use personas was made after the interviews were conducted and transcribed. Therefore, making hypotheses afterwards may be influenced by knowledge about the data. Thus, no hypotheses were formed and the first step was actively skipped. The second activity was to identify the behavioural variables after processing the interviews in Atlas.ti. Several variables were derived from the interview, mostly from the introduction and final part of the interview, such as knowledge about energy saving and actions to save energy. After the variables were identified, the subjects were mapped on the ranges of these variables, which is activity three. For each variable a range of possible answers was formed, for example the range of knowledge about energy saving ranges from 'little' to 'substantial'. For

each subjects it was determined where he or she should be mapped on the range. Next, in step four, the ranges of the behavioural variables were examined to identify whether some subjects occur more than once together on a range or variable and could form a group. By finding these groups, significant behaviour patterns were identified, for example the group with reasonable pre-existing knowledge about saving energy, also carries out substantial actions to save energy. By forming this behavioural pattern, the source of the persona is formed according to Castro et al. (2008). After that, the fifth step was taken, and a document was put together which specifies the behavioural characteristics of all the subjects that are grouped together in a persona by using the transcripts of the interviews. In step six, these characteristics were checked to see whether they were fully defined and complete. As this was the case, activity seven was carried out, which means data collected in step five, was used to come up with a narrative of the persona, which specifies the attitudes, needs and problems of the personas. In this step, the answers on the questions of the UTAUT part were also taken into account. For the questions with a five point Likert scale the mean and standard deviation were calculated while the open questions served as extra explanation for the closed questions. Although the Personas\* Technique of Castro et al. (2008), consists of four more activities, all these activities are combining the persona with usability mechanisms. As this is not the goal of using personas in this study, and thus these last steps go beyond the scope of this study, they were not carried out.

Next, the relevant requirements per persona were formed using the MoSCoW method. In MoSCoW, the 'M' stands for 'must have' and is used for requirements that are explicitly needed (Tudor & Walter, 2006) The 'S' means 'should have', and indicates a requirement is important, but not essential. The 'C' then means 'could have', and signifies requirements that would be beneficial, but could just as easily be left out. Finally, 'W' means 'won't have', and is used to indicate requirements that, after deliberation, can be excluded in favour of more important ones. The requirements were divided into four categories, namely the content, design and display of the feedback and concepts that can raise user engagement. To determine which requirement fell into which category of MoSCoW the following steps were taken.

First, an overview of the number of subjects per persona that spoke about a requirement was made. The number of times they spoke about a requirement is not

taken into account as during the interview the subject may repeated the questions in the interview and therefore speaking multiple times about a requirement does not indicate that one finds this more important than another requirement. Also, because this first step served as a way to determine to what extent subjects want a requirement and thereby determining the importance of a certain requirement, only subjects that spoke positive about a requirement were taken into account, while subjects that spoke negatively about a requirement were not. Had negative responses been taken into account, this would result in misleading results. For example, when do taking this in account, a requirement may get the score of a must have rather than a won't have, as would be the case with the requirement for displaying usage in a metaphor for the second persona. After computing a total score of the number of subjects that spoke about a requirement, a cut off score was used to determine the MoSCoW score. For the first persona, which consists of 7 subjects, the following cut off was used: 0 - 1 won't have, 2 - 3 could have, 4 -5 should have and  $\geq 6$  must have. An overview of the subjects that spoke about a certain requirement can be seen in Appendix H tables 1, 2 and 3. As the second persona consists of 8 subjects, another cut off was used, namely: 0 - 2 won't have, 3 - 4 could have, 5-6 should have and  $\geq 7$  must have. An overview can be found in Appendix I tables 1, 2 and 3.

Although negative quotations were not taken into account in the previous step, these quotations should be incorporated in prioritizing the requirements. Therefore, the strength of quotations was taken into account. Some subjects spoke very positively and some very negatively about a certain requirement. As both should be taken into account, all quotations about a certain requirement were judged on a scale ranging from -2 to 2, with -2 very negative, -1 relatively negative, 1 relatively positive and 2 very positive. When someone did not mention the requirement at all, a score of 0 was assigned. This, for example, means when talking about the frequency of the feedback an answer such as: "I don't want daily, that will drive me crazy" (Subject 6, p. 3) (see Appendix L for original Dutch quotes) the topic 'daily feedback' in the requirement 'frequency' is scored with -2. A statement about displaying usage such as "Yes yes yes, that seems to be the base of the story to me" (Subject 10, p. 3) is scored with a 2. In Appendix H, tables 4, 5 and 6 and Appendix I, tables 4, 5 and 6 one can see an overview for both personas of the strength of quotations. The average strength of quotations was calculated by summing up all the scores for a requirement and afterwards dividing this total score by all the subjects in a certain persona. Although

for almost every requirement at least one person did not speak of it and a score of 0 was assigned, these persons were included in the calculation for two reasons. The first reason is, although these persons did not mention the requirement at all, it cannot be assumed they are positive or negative about it and therefore it should not be left out. Second, in some cases only one subject spoke about a certain requirement. If all the other subjects in that persona were not included in the calculation this leads to the requirement being a must have according to the MoSCoW model. As the personas contain 7 and 8 subjects respectively, only one of them mentioning a requirement should not lead to the requirement being a must have. To transform the average strength of quotations into a MoSCoW score, a cut off is used based on the scores ranging from 0 to 2. The negative point of -1 and -2 are not taken into account while computing the cut off score because it results in a negative average being a could have, while a negative average should always be a won't have requirement. This lead to the following cut off score: 0 - 0.50 won't have, 0.51 - 1.00 could have, 1.01 - 1.50 should have and  $\geq 1.51$  must have.

The third, and last step, included computing an overall MoSCoW score using both the MoSCoW score based on the number of people that spoke about a requirement and the strength of the quotations. Both those MoSCoW scores were weighted evenly. This means for example displaying usage in CO2 in the second persona is calculated as following:  $(2 * 1 + 2 * 1) / 2 = 2$ . In calculating the mean between these both MoSCoW's, it did not always result in whole numbers, but also decimals. Therefore, the following cut off score was used to determine the overall MoSCoW: 0 -1.49 won't have, 1.50 - 2.49 could have, 2.50 - 3.49 should have and  $\geq 3.50$  must have. An overview of these scores for the first persona can be found in Appendix H, tables 7, 8 and 9 and for the second persona in Appendix I, tables 7, 8 and 9.

### 3. Results

#### 3.1 Introduction

First, a description of the way in which the personas were built up will be shown. Second, two personas are described. For both personas, first a background in developing the persona is given, after which the persona itself is presented. After that, the requirements for the content, design and display of the feedback are presented by using a short and concrete MoSCoW table. Also, a MoSCoW table for the concepts that can raise user engagement is used to give a clearer view on whether, for example, an energy champion, is rather a must, should, could or won't have. After that, the personas of the professionals and their requirements are compared to the personas, requirements formed after research with consumers.

After coding and analysing the data, two personas could be formed representing the study sample of firms. Using the Personas\* Technique of Castro et al. (2008), several variables were identified relevant for forming two different personas. Eventually, the most important variable the personas are based upon is the reason to save energy. When talking about saving energy, one of the subjects stated that “The most important reason for a company is of course always economical always important” (Subject 11, p. 1), while another subject stated:

The most important reason, look in the end everything relates to money, but it is about aware energy consumption. Being socially responsible, again, heating with the windows open is nonsense. But if you think: ‘that is the way it goes’, it means that you are giving up on doing well. And at the moment that you, look, money is a drive in the end, but also how durable you are for your children and grandchildren, if you are getting any. It should not be after me the deluge, the footprints you leave must be as green as possible. (Subject 5, p. 2)

These citations give a good reflection of the base of the personas. The subject of the first citation is combined with six other persons in the persona ‘money saver’ all stating to save energy mostly because it saves money, while the person of the second citation is combined with seven other subjects in the persona ‘environmentalist’. All these subjects in general acknowledge money may be a drive in the end, but are mostly motivated to save energy in order to save the environment. Although there is a

clear difference between the reasons to save energy, the subjects within the two personas also have similarities on other points such as pre-existing knowledge about energy saving and their current actions to save. When the two personas are mapped on the answer ranges of these variables, it also seems the personas differ from each other, as can be seen in figure 2.

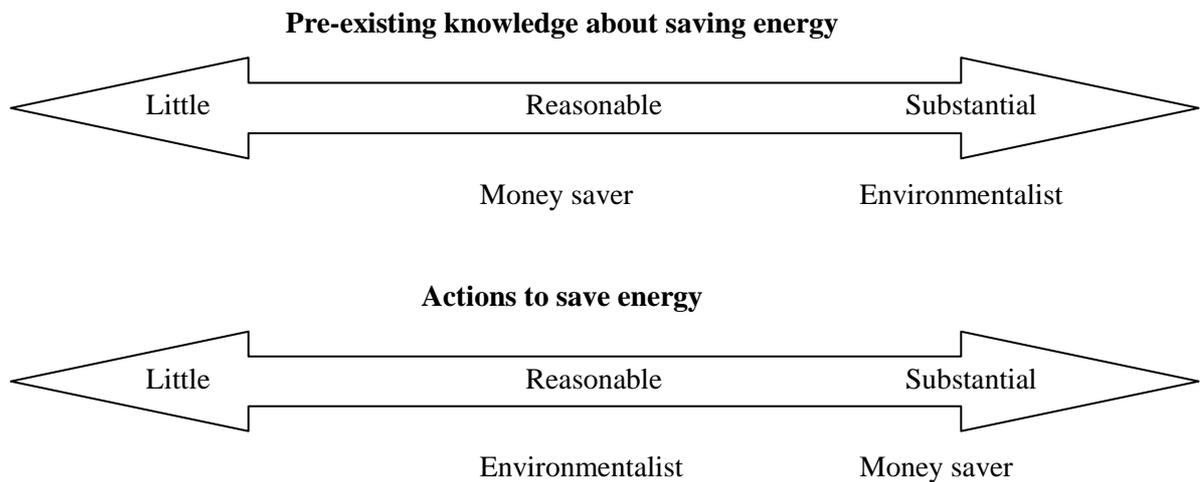


Figure 2. Range of variables forming the base of the personas

The fact these personas are different on the variables presented in figure 2 is an additional justification for the current distribution. Apart from these points that came up during the interview, also user characteristics based on the questions of the UTAUT part were used in the personas (see paragraph 3.2.1 and 3.3.1).

Although the personas give a good first view on the target group of firms and the characteristics of these persons, a persona on itself does not give an appropriate answer on the wishes for requirements of the feedback. Therefore, the MoSCoW technique according to Venkatesh et al. (2003) is used to prioritize the requirements. A table is used for each persona which contains all the requirements for that persona ordered from must have to won't have. In this result section, only short MoSCoW tables will be used to keep a good overview on the results. More extensive MoSCoW tables can be found in the Appendix J for persona 1 and Appendix K for persona 2. These tables will provide a more concrete answer on the question what both the content and design of the feedback should look like, while the short versions used in the result section will give a good first impression of the requirements. In the

extensive MoSCoW tables, the requirements subjects pointed out as being the most important to them, when asked to make a top 3 or 5, are incorporated.

In all the MoSCoW tables, different shades of grey are used to indicate whether a requirement is a must, should, could or won't have. The following shades are used:

	Must have requirement
	Should have requirement
	Could have requirement
	Won't have requirement

### 3.2 Persona 1: Money saver

#### 3.2.1 Background information of the persona

As mentioned before, the first persona is based upon persons all motivated to save energy in order to save money. According to a subject, saving energy is done because: "That only has to do with operating efficiency." (Subject 2, p. 3). The persona is based upon seven subjects from the study sample, of which four are female and three male, with an age ranging from 27 to 41 ( $M = 38.71$ ,  $SD = 7.23$ ).

When considering the characteristics which came up using the questions base on the UTAUT model, first of all, it seems more than half of the persons are in possession of a computer, laptop and smart phone, as can be seen in table 2.

Table 2. Possessions of devices in persona 1. A "X" means the subject is in possession of this device while a "-" means the subject is not in possession of that device.

	Computer	Laptop	Mobile (ordinary)	Mobile (smart phone)	Tablet	Smart thermostat box	Other
Subject 1	X	-	-	X	-	-	-
Subject 2	X	X	X	X	X	-	-
Subject 7	X	-	-	X	-	-	-
Subject 9	-	X	-	X	X	-	-
Subject 11	X	X	X	-	X	X	-
Subject 13	X	-	-	-	-	-	X

Subject 14	-	X	-	X	-	-	X
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Note: Other devices are devices such as printers and desk phones.

Table 3 gives an overview of the descriptive statistics on the constructs of the UTAUT part of the interview. It is important to note that although these questions were based on the UTAUT model, the questions are solely used to describe current use of technology and devices and not at all to give a judgement on the acceptance of the feedback system.

As can be seen in table 3, all the subjects in this persona were fairly positive on each of the constructs asked in the questionnaire. Based on these results one can conclude the participants in this persona use their devices very frequently and are very experienced in using them. They also find their devices very useful and not difficult to handle at all. They also experience little pressure of others. Noteworthy is that the participants indicate they have reasonable knowledge of, and skills with the devices. Further it is noteworthy that all the participants indicate they will use a new device when they have one.

Table 3. *Mean and standard deviation (SD) for constructs of the UTAUT model for persona 1. The constructs were scored on a five point Likert scale, with 1 the lowest and 5 the highest.*

Construct	Mean	SD
Frequency	4.71	0.49
Experience	4.00	0.58
Voluntariness of use	4.43	0.53
Performance expectancy	-	-
Effort expectancy	4.71	0.49
Social influence	4.36	1.12
Facilitating conditions	3.71	0.49
Behavioural intentions	5.00	0.00

Note. The mean and SD of both social influence and facilitating conditions are calculated based on two questions.

Note. As the question for the construct performance expectancy was open, no mean and SD could be calculated.

### 3.2.2 *Persona description*

Carmen is 39 years old and works as a secretary in a medium sized enterprise. Carmen is mostly motivated to save energy because of economic reasons, namely because it saves money; in saving energy, she saves money, which is profitable for the company. Saving money results in a better operating efficiency and rental costs also decrease. Although Carmen is mainly motivated to save energy because it saves money, she also believes that saving energy is good for the environment. However, this is not the most important reason to save energy; it is rather a secondary motivation. Carmen thinks she has a reasonable amount of knowledge on how to save energy, for example that some devices are more efficient than others and it is better to use a LED light bulb or energy saving lamp than regular ones. When Carmen leaves her office at the end of the day, or for lunch, she switches off all her electronic devices and lighting.

During her work, but also in her private situation, Carmen uses her computer, laptop and smartphone almost all the time. Carmen thinks she is very experienced in the use of these devices. She started using the devices because she needs them for work and her employer provided the devices to her. However, Carmen does feel little pressure of others in her environment to use these devices but is rarely affected by this pressure. She has no difficulty handling the devices as she finds all the devices she uses user friendly. She finds she has a reasonable amount of knowledge and skills with these devices and thinks this has a reasonable amount of influence on the use of these devices. Carmen expects to keep using her devices at her work and in her private situation. She also expects when having a new device in the future, she will start using it.

### 3.2.3 *Requirements for the content of the feedback*

In table 4 below, a more concrete, but short answer why subjects want to see the requirements concerning the content of the feedback can be found and what this requirement has for implications. In this table, requirements are categorized by using the MoSCoW method. A more extensive MoSCoW table for these requirements can



*Figure 3.* Reprinted from [businesswomen] (n.d.). Copyright Fotoedgaras. Retrieved from <http://www.stockfreeimages.com/9054972/Businesswoman.html>

be found in Appendix J table 1. This table gives a more extensive answer on the motivations for certain requirements, and also distinguishes different wishes within a requirement by using the MoSCoW method, such as seeing energy usage in euros or as a metaphor.

Table 4. *Short overview of all the requirements for the content of the feedback ordered from must haves to won't haves for persona 'money saver'.*

User requirement	Motivation	Implications
Display energy usage	Unawareness of current usage and retracing behavioural effects.	Usage must be displayed in euros, and should be displayed in kWh and CO2. Metaphors could also be used.
Display savings made in the past	Increases awareness and shows results of one's actions.	Savings must be displayed in euros, kWh/CO2 as option
Break the feedback down	Different buildings provide different characteristics concerning breakdown of feedback.	Present feedback per device above all, and take into account different characteristics of buildings and companies.
Make comparisons with own usage	Comparisons with own usage serves as a way to save energy	Include comparison with previous year, quarter or period.
Direct feedback	Direct feedback makes steering and responding possible	Show every action immediate without a notification
Give feedback frequently	Different needs and annoyance boundaries were found.	Allow for the user to choose the preferred feedback frequency.
Make comparisons with others	Makes contextualization of own usage possible.	Internal comparisons should be included, external could be.
Looking back	Opinions differ from looking back five years, to one year	Provide a history of at least five years of earlier feedback.
Concrete feedback	Feedback should be easy, simple and applicable.	Provide feedback tailored to the subject and its situation.
Edit information	Subjects want to change the information that is given to them in the feedback.	Give subjects the possibility to change the information through a configuration option.

Indirect feedback	Some subjects will not look at feedback continuously, so they prefer getting it indirectly.	Add option to provide feedback indirectly.
Create database	Coupling with database allows for retracing important events.	Use database that allows notes on, and links with feedback.
Calculation examples	Calculation examples help save energy.	Add calculation examples for better energy management.
Compare own usage to mean	Comparison with mean is not useful if consistency of mean is unknown.	Do not compare usage to a mean with unknown consistency.

Note: As there must be a frequency to give the feedback, this is considered as a must have although this is not per se said by the subjects.

### 3.2.4 Requirements for the design of the feedback

Based on the interviews, a few requirements for the design of the feedback could be formed. Just as with the MoSCoW table for the requirements for the content of the feedback, table 5 below gives an overview of the motivations and implications per requirement for the design of the feedback. A more extensive MoSCoW table can be found in Appendix J table 2.

Table 5. *Short overview of all the requirements for the design of the feedback ordered from must haves to won't haves for persona 'money saver'.*

User requirement	Motivation	Implications
Medium	Feedback via email allows free choice of when to see it, while an app would increase availability.	Provide feedback through email as the preferred option. Creating an app could also be an option.
Simulate	Simulation, tips and advice help saving energy.	Include a simulation option in the shape of a tip/advice.
Intervene	When a boundary is crossed, intervening increases awareness	Let the user set a boundary, and when crossed, notify the user.
Switch devices on/off	Switching devices on or off will result in more savings.	Include possibility of an automatic on/off system per device.

Standard format	Content is more important than changing the display; standard formats work best.	Design a standard format that is simple and concise, and use this to provide the user with feedback.
Influence the medium	Influencing the medium allows for inclusion of wishes and expectations.	Make it possible to influence the medium by clicking in it.
Influence of display	Subjects wish the feedback to be displayed according to their wishes.	Provide an option to personalize the interface for the user.

Note: As there must be a medium to give the feedback, this is considered as a must have although this is not per se said by the subjects.

### 3.2.5 Requirements for the display of the feedback

During the interviews, several requirements came up for the display of the feedback. In a more extensive MoSCoW table (see Appendix J table 3) the graphs per requirement are ordered using the MoSCoW method. However, as this table is too bulky for this results section, table 6 only gives a short overview on the way each requirement for the content of the feedback should be displayed.

Table 6. *Short overview of all the requirements for the display of the feedback for persona ‘money saver’.*

User requirement	Motivation	Implications
General	Graphics and tables are the most useful and direct way of showing feedback.	Have the feedback displayed in graphics, tables or both.
Display energy usage	Charts are preferred over graphs, and double lines or bars over singles.	Usage should be displayed in a line chart, preferably with two lines.
Display savings made in the past	Graphs with double lines are preferred to show savings.	Display savings in a graph with double lines or bars.
Display broken down feedback	Pie charts are seen as the clearest image.	Display broken down feedback in a pie chart.
Display comparisons	Bar graphs with two bars are preferred.	Display feedback that is using comparisons in a bar graph.
Display feedback history	No clear wishes on graphic display.	Use graphs rather than for example tables.

### 3.2.6 Requirements for user engagement

Table 7 down below gives an overview of the concepts that potentially raise user engagement using the MoSCoW method.

Table 7. Overview of all the concepts potentially raising user engagement ordered from must haves to won't haves for persona 'money saver'.

User requirement	Motivation	Implications
Energy bill	Subjects are very positive about the energy bill as the specific information in it will help them to save energy. People are however concerned the bill becomes too big and contains too much information.	Design the energy bill by using a dropdown menu.
Energy champion	Most of the subjects are positive about having an energy champion in their company. They think this 'champion' can provide others with information. However, they do want saving energy to stay a collective responsibility rather than a one person's task.	Assign an motivated person that has a good position in the company as champion. His or her function is not important.
Energy saving game	The subjects think that the energy saving game will help grow the awareness amongst the employees. However, some of them think that the type of person plays a part in whether he or she will start playing the game.	Include a competitive element in the game while designing it. It may be possible to connect the energy champion with the energy saving game in a way.

### 3.3 Persona 2: The environmentalist

#### 3.3.1 Background information of the persona

When analysing the data, it was notable all subjects in this second persona had the same reasons for saving energy. On the question why he saves energy a subject answered:

Because I think it is a shame. It are not the costs because I do not know if they matter, because if I have to take a turn with my car to drive up here and put the lights off, it will probably cost me more than leaving the lights on. But that I don't know. But I think that is rubbish, I think it is a shame. People must put the lights off when they leave as last. It does occur that people work here till deep in the night, so before I start cursing I look if there is really nobody here, and then I find it. I find it a shame, it is really a waste. (Subject 12, p. 1)

Overall, eight persons could be categorized as the one above; subjects finding the environment, footprints and durability important. All the subjects in this persona are male with an age ranging from 27 to 61 ( $M = 49.75$ ,  $SD = 11.16$ ).

Most of the subjects in this persona have a computer, laptop, smart phone tablet or other devices such as a desk phone, as can be seen in table 8.

Table 8. *Possessions of devices in persona 2. A "X" means the subject is in possession of this device while a "-" means the subject is not in possession of that device.*

	Computer	Laptop	Mobile (ordinary)	Mobile (smart phone)	Tablet	Smart thermostat box	Other
Subject 3	-	X	-	X	-	-	X
Subject 4	X	X	-	X	X	X	X
Subject 5	X	X	X	X	X	X	X
Subject 6	X	X	-	X	X	X	-
Subject 8	X	X	-	X	X	-	X
Subject 10	-	X	-	X	X	-	-
Subject 12	X	-	-	X	-	-	-
Subject 15	-	X	-	X	-	-	X

Note: Other devices are devices such as printers and desk phones.

Table 9 gives an overview of the descriptive statistics on the constructs of the UTAUT part of the interview. Just as with the first persona, these statistics only represent opinions of subjects about their current devices and are solely used to describe the current use of technology and devices. These statistics should not at all be used as an indication of the acceptance of the feedback system.

When analysing the constructs of UTAUT, it seems the subjects use their devices frequently and are very experienced in the use of it (see table 9). They find

their devices very useful and not difficult at all in handling them. They say to experience no pressure at all of others in their environment to use those devices and therefore never let this pressure influence them. They indicate their skills with, and knowledge of these device is reasonable, which they think has reasonable influence in them handling the devices. All the subjects indicate they will start using a new device when they get one.

Table 9. Mean and standard deviation (SD) for constructs of the UTAUT model for persona 2. The constructs were scored on a five point Likert scale, with 1 the lowest and 5 the highest.

Construct	Mean	SD
Frequency	4.50	0.53
Experience	4.13	0.35
Voluntariness of use	4.38	0.52
Performance expectancy	-	-
Effort expectancy	4.63	0.52
Social influence	4.56	0.83
Facilitating conditions	3.56	0.75
Behavioural intentions	5.00	0.00

Note. The mean and SD of both social influence and facilitating conditions are calculated based on two questions.

Note. As the question for the construct performance expectancy was open, no mean and SD could be calculated.

### 3.3.2 Persona description

Victor, 50 years old, works as a senior partner at a medium sized enterprise. Victor is mainly motivated to save energy because he is concerned about the environment. According to him, it is important to use energy in a conscious way, not only for the environment, but also for later generations. Durability, moral issues and social responsibility play a important role in Victor's motivations to save energy. Although saving energy leads to saving money, this is not the most important reason for Victor to save energy. In his job, Victor has



Figure 4. Reprinted from [manager] (n.d.). Copyright Bowie15. Retrieved from <http://www.stockfreeimages.com/8431646/Manager.html>

already been involved in several projects concerning energy. Therefore, Victor already has a lot of pre-existing knowledge about how to save energy, particularly about how one should save energy, alternative energy recourses and innovative methods to save energy. In his company, Victor does a reasonable amount to save energy. However, because energy is not one of the largest costs, he does not prioritize this. Presently, his main attempts to save energy concerns switching off electronic devices and lights. Victor expects that in the future he will be more focused on saving energy, as the issue of saving energy becomes a more and more important issue.

In his work, Victor uses a computer, laptop, smart phone and tablet, but also a desk phone. He sometimes uses them for private situations as well. He started using these devices because he needs them for his work but also because he finds the use of it efficient. He uses them almost always and is very experienced in the use of it. Victor finds the handling of these devices not difficult at all as his devices are easy for him and he has a lot of earlier experiences with these devices. However, he judges his skills and knowledge about his devices as reasonable rather than very good. He thinks that his knowledge and skills have a reasonable amount of influence on him handling the devices. He finds the devices very useful and also expects to keep using them at work. Victor experiences no pressure of others in his environment at all and as he never experiences it, he also never let this pressure influence him. Victor expects that if he gets a new device, he will definitely start using it.

### 3.3.3 Requirements for the content of the feedback

As well as with the first persona, the MoSCoW technique is used to give an appropriate answer on how the subjects wish to see the content of the feedback. In table 10 below, the motivations and implications of these requirements are displayed. A more extensive MoSCoW table can be found in Appendix K table 1.

Table 10. *Short overview of all the requirements for the content of the feedback ordered from must haves to won't haves for persona 'the environmentalist'.*

User requirement	Motivation	Implications
Display energy usage	Showing current usage increases awareness.	Usage must be displayed in euros and it should also be displayed in kWh.

Display savings made in the past	Previous savings should be displayed, as these results can encourage behavioural change.	Savings should be displayed in euros, and could also be displayed in kWh and CO2.
Break down the feedback	Subjects want the feedback broken down into spaces for specificity, and groups for showing large consumers.	Break down feedback per space, and take into account varieties in company housing.
Make comparisons with own usage	Comparisons with own usage makes effects and differences more visible.	The feedback should compare own usage with the previous year.
Make comparison with others	Comparisons with others serve as a way to gain insight and make it possible to see how one is doing compared with others.	Compare own usage and savings with colleagues and other companies, or other companies when settled in a general building.
Looking back	Discarding of data is a pity. Looking back at previous feedback can be used for comparisons.	Make it possible to look at all previous feedback, but add a filter option.
Direct feedback	Continuous feedback increases and stimulates motivation.	Include the option to continuously see feedback.
Give feedback frequent	Feedback once a day or once a week is the least burdensome.	Provide feedback once a day or once a week.
Indirect feedback	Indirect feedback makes it possible to get a clear look on savings.	Allow for feedback to be received both directly and indirectly.
Edit information	Editing information allows for selecting information of interest.	Add an option for users to edit the way information is presented.
Stimulate	Positive feedback and rewards stimulates saving energy, which may lead to persuasion.	Bring the feedback in a positive way and offer rewards to persons that are performing good.
Taken into account company, functions and user	People with different functions most likely also have different wishes.	Give the user options to configure the feedback to their wishes.
Concrete feedback	People want the feedback to be simple, concrete and to the point.	Make feedback not too technical, but useful and applicable.
Create database	Coupling to a database increases the level of detail on feedback.	Use a database in which notations can be made and linked to the feedback.

Note: As there must be a frequency to give the feedback, this is considered as a must have although this is not per se said by the subjects.

### 3.3.4 Requirements for the design of the feedback

Based on the interviews, a few requirements for the design of the feedback could be formed. In table 11 below these requirements are organized by the MoSCoW method. A more extensive table can be found in Appendix K table 2.

Table 11. *Short overview of all the requirements for the design of the feedback ordered from must haves to won't haves for persona 'the environmentalist'.*

User requirement	Motivation	Implications
Medium	Feedback through email or computer is useful due to daily use, applications offer direct access, and online feedback or feedback by a website is seen as accessible.	Make use of Internet for the feedback system, and give subjects the option to choose the online medium they prefer the most.
Simulate	Simulating potential savings will help create insight among employees.	Simulate savings in the form of a tip or advice both before and action after an action.
Intervene	Intervention after crossing a boundary is useful, though the subject should keep control.	Make it possible to intervene when a boundary is crossed and notify the user.
Switch devices on/off	Switch devices on or off helps save energy.	Create an intelligent system that can switch devices on/off, while leaving control to the user.
Influence the medium	Influencing results in incorporating personal wishes and motivates.	Make it possible to influence the medium by clicking in it.
Standard format	A standard format is preferred as influencing is not that important	Offer a standard format for the feedback system.
Influence of display	Changing the display of feedback upholds motivation.	Offer users the possibility to change the display of the feedback.
Intelligent feedback system	People wish that the feedback system will think for and with them.	Build intelligence in the feedback system so it becomes an intelligent system.

Note: As there must be a medium to give the feedback, this is considered as a must have although this is not per se said by the subjects.

### 3.3.5 Requirements for the display of the feedback

Also, a few requirements came up for the display of the feedback during the interviews, as can be seen in table 12 below. These requirements are not displayed using the MoSCoW method. However, in the more extensive table for these requirements, which can be found in Appendix K table 3, the MoSCoW method is used.

Table 12. *Short overview of all the requirements for the display of the feedback for persona ‘the environmentalist’.*

User requirement	Motivation	Implications
General	Graphs are preferred due to visual orientation.	Display the feedback, regardless which information, in a graph.
Display energy usage	People have more affinity with bar graphs then line charts.	Display usage in a bar graph.
Display savings made in the past	People have no clear preference how their savings should be displayed.	Use a bar graph to display the savings, similar to usage.
Display broken down feedback	The dropdown menu, pie chart and table are most preferred.	Display broken down feedback in a dropdown menu, pie chart or table.
Display comparisons	The subjects tend to prefer bar graphs over line charts for comparisons	Display comparisons in bar graphs, especially double bar graphs.
Display feedback history	There are no clear wishes about displaying feedback history.	Display in graphs as these seem to be preferred.

### 3.3.6 Requirements for user engagement

Table 13 down below gives an overview of the concepts potentially raising user engagement using the MoSCoW method.

Table 13. *Overview of all the concepts potentially raising user engagement ordered from must haves to won't haves for persona 'the environmentalist'.*

User requirement	Motivation	Implications
Energy champion	Subjects are positive about a energy champion. Some state that by assigning an energy champion in the company, someone in the company gets the responsibility for the energy problem. This energy champion will help others change their behaviour. However, people do think saving energy should become a collective responsibility and having an energy champion might serve as an excuse to doing nothing by other employees.	Designate the tasks of the energy champion to someone with a higher function in the company, however not the manager, but for example someone with a facility function. Further should the person be enthusiastic and not authoritarian. It should be taken into account that the energy champion should involve all other employees in the process as well.
Energy bill	People are positive about the energy bill as they find it interesting to see how much each device uses. The bill will help make energy costs more tangible.	Make the energy bill in the form of a dropdown menu so the bill does not become enormous.
Energy saving game	Some of the subjects are positive about having an energy saving game as they state people might get motivated by the game. However, people do wonder whether others are going to play the game as they have to work at work and not play a game.	When designing an energy saving game, add a competitive element in it and make it possible for people to win something. Make sure that the game will not become childish.

### 3.4 Comparing professionals with consumers

#### 3.4.1 Results of consumers

As mentioned before, a similar requirements analysis is done for LochemEnergie with consumers. This research is done by another student of the master Human Factors and Media Psychology. During the interview, these consumers were asked the same questions as the employees. Also some additional questions were asked about the project of LochemEnergie, topics such as generation of energy and

solar panels. Just as the professionals, the consumers could also be divided into personas, as can be seen in table 14.

Table 14. *Overview of characteristics for the personas for consumers.*

Persona	Characteristics
1. Innovators / Early adopters	<ul style="list-style-type: none"> <li>Most knowledge about saving energy</li> <li>Most actions to save energy</li> <li>Environment important in saving energy</li> <li>Problems with technical systems</li> <li>Saving energy is a goal</li> </ul>
2. The technology user	<ul style="list-style-type: none"> <li>Average knowledge about saving energy</li> <li>Average actions to save energy</li> <li>Environment important in saving energy</li> <li>Interest, trust, knowledge and curiosity in technical aspects</li> <li>System should support the user</li> <li>Saving energy is no goal</li> </ul>
3. Later early adopters	<ul style="list-style-type: none"> <li>Least knowledge about saving energy</li> <li>Least actions to save energy</li> <li>Costs important in saving energy</li> <li>Favourable of automation</li> </ul>

When considering the personas, most of the subjects (n=7) were grouped in the persona ‘Innovators / Early adopters’, while the persona ‘Later early adopters’ only consist of three persons.

Just as with the professionals, a list of requirements per persona for consumers was made. Figure 5 below gives an overview of the key requirements per persona for the content of the feedback, and figure 6 and overview of the requirements for the design of the feedback.

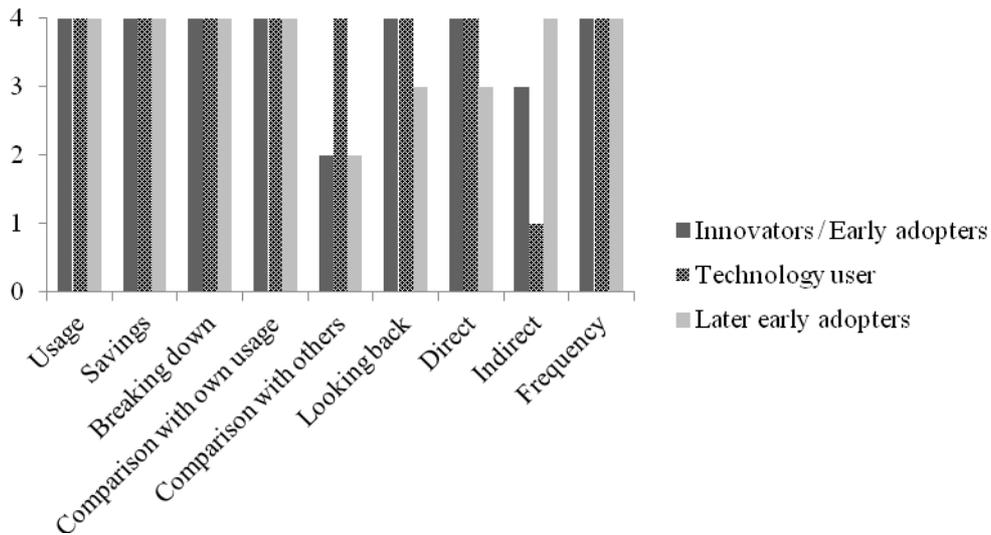


Figure 5. MoSCoW scores for the key requirements for the content of the feedback

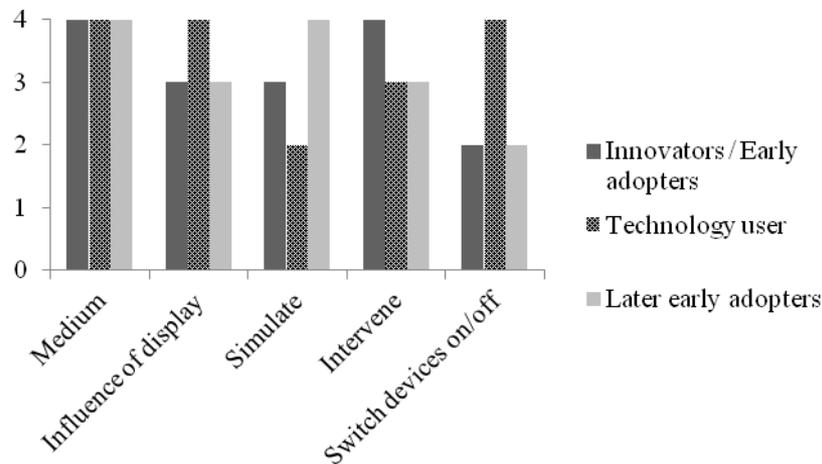


Figure 6. MoSCoW scores for the key requirements for the design of the feedback

### 3.4.2 Comparing personas

To compare the results of the firms with households, first one can take a look at the personas which are formed based on the data. When comparing the results of the professionals with consumers, it is notable that in both study samples a distinction can be made in the main reasons to save energy. In two of the three personas derived from the study sample of consumers, the main reason to save energy is the environment, which is the same main reason as the persona ‘the environmentalist’ in the study sample of firms. Although these personas have their concern for the environment in common, the personas of consumers seem to be more concerned with the environment compared to the ones of professionals. The third persona of the

consumers is based upon the main reason that saving energy leads to saving costs, which is in line with the ‘money saver’ persona of the professionals. Both these personas have in common placing financial benefits one the first place to save energy, while placing the environment at the second place.

A striking difference can be found in the number of subjects the personas are based on. In the sample of firms the main reasons to save energy are almost equally divided, a little more than half of the subjects save energy for the environment, while a little less than half of the subjects save for financial benefits. However, the distribution in the sample of consumers is much more unevenly distributed. Only 20% of the subjects save for financial benefits, while 80% puts the environment on the first place to save energy.

Furthermore, it seems that when keeping the main reasons to save energy in mind, a similarity in the pre-existing knowledge of the subjects can be found. In both the study samples of firms and households, the subjects motivated to save energy because of the financial benefits have the least pre-existing knowledge about saving action. When considering the actions of the subjects, a difference is found between subjects of firms and households. While professionals motivated to save energy because of the environment have a reasonable amount of actions to save energy and professionals motivated because of financial benefits have a substantial amount of actions, this is not the case for the consumers. In fact, it seems to be reversed; the consumers saving energy for money have the least actions, while the subjects saving for the environment have average to substantial actions.

Last, an overall difference in the personas between professionals and consumers seems to be that in the sample of consumers the subjects are more distinguished in their opinion about automation than the professionals.

### *3.4.3 Comparing requirements*

Next, a comparison between requirements can be made between firms and households. Figure 7 below gives a good overview of the similarities and differences between the key requirements for the content of the feedback for professionals and consumers per persona.

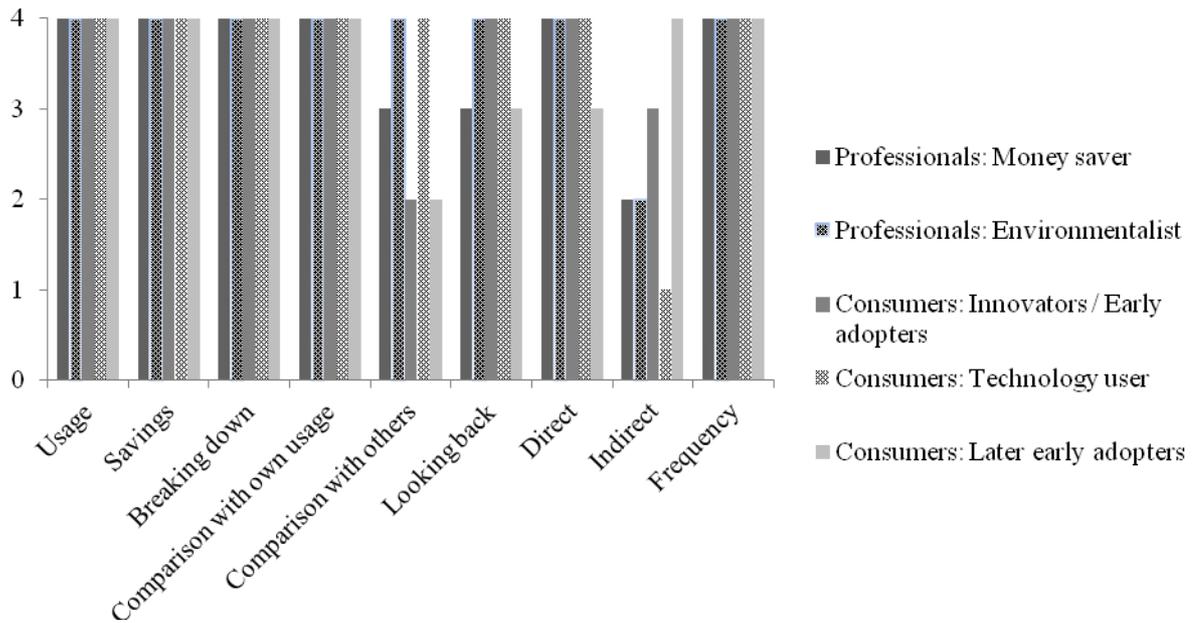


Figure 7. MoSCoW scores for requirements for the content of the feedback for professionals and consumers.

When analysing the differences found between the personas, it becomes clear the requirement ‘comparisons with others’ is more important for the professionals than for the consumers, as two of the three personas of the consumers find this requirement to be a could have. Although there is no big difference between looking back for professionals and consumers, it becomes clear professionals have more interest in looking at all the earlier given feedback, while the consumers have more interest in looking back two to four years. Further, figure 7 shows that for all the professionals and a big group of the consumers, ‘direct feedback’ is a must have requirement. It is notable that one persona of the consumers finds ‘indirect feedback’ as a must have.

What further strikes the eye, is that for the requirements ‘display energy usage’, ‘display savings made in the past’, ‘break feedback down’, ‘make comparisons with own usage’ and ‘give feedback frequent’, no differences can be found between the personas. Both the personas for professionals and consumers all indicate these requirements as must haves for feedback. However, when taking a closer look at each of the requirements, a few differences appear. When considering the requirement ‘display energy usage’ it seems that for professionals displaying usage in euros is more important than for consumers, while for consumers displaying usage in kWh is more important. This also applies for the requirement ‘display

savings made in the past'. When looking at the requirement 'break feedback down' it seems that the consumers have a clearer idea on how they want the feedback to be broken down, while the employees do not. For consumers, breaking feedback down per device is a must have, which is a should have for the 'money saver' persona of the professionals. For the 'environmentalist' persona of professionals, breaking down per space is a should have. When considering the requirement 'make comparisons with own usage', it becomes clear both professionals and consumers find this a must have requirement. However, they differ in the time frame in which they want to compare their own usage. Consumers want to compare their own usage in shorter time frames than professionals. Last, also for the requirement 'give feedback frequently' the consumers seem to have a more clear idea on the frequency of their feedback compared to the professionals. For 'the money saver' persona, no must or should have frequency comes up, and for 'the environmentalist' persona only one should have frequency, namely once a day, comes up. However, for all the personas of the consumers, a clear must have frequency comes up, namely feedback on demand.

Figure 8 down below gives an overview of the key requirements for the design of the feedback.

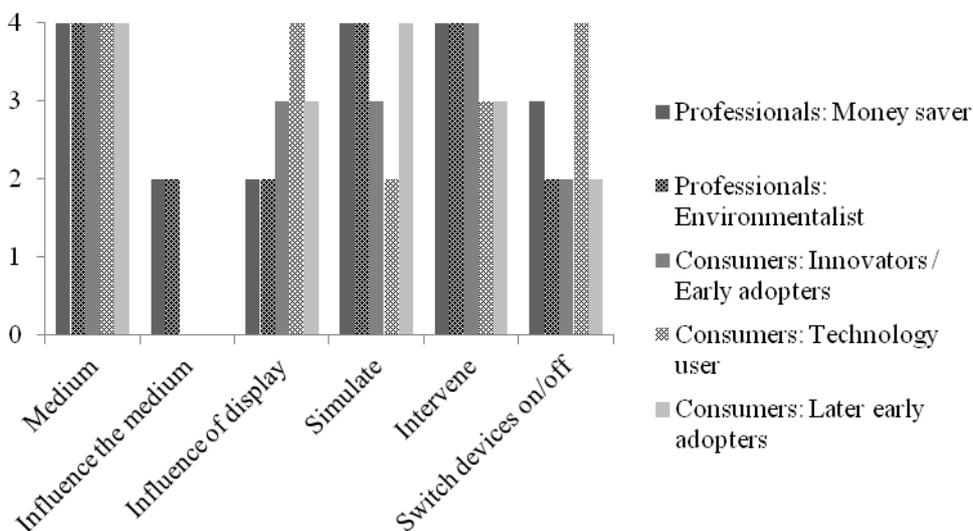


Figure 8. MoSCoW scores for requirements for the design of the feedback for professionals and consumers.

A striking difference is found in the requirement 'influence the medium'. During the interviews with employees, a clear difference between influences the medium or the display emerged during the interview. Clearly, no such thing happened

during the interviews with the consumers. Further, it shows consumers consider influencing the display to be more valuable. It also seems professionals are more favourable of simulating actions than is the case with consumers. When looking to more concrete wishes for this requirement, it becomes clear both professionals and consumers want the simulation before an action is done. However, professionals also want the simulation afterwards and have a clearer view on how this simulation should be presented, namely in the form of a tip or advice. Although there is a difference in the personas in intervening, both professionals and consumers want the feedback system will intervene in their usage by giving an alert of notification when an boundary internally set is crossed. Further it seems that, except for two personas, for one persona of professionals and two of consumers, switching devices on or off is not favourable at this moment.

Furthermore, it is notable that at first glance all the personas do not differ in the medium. However, as there must be a medium which provides the user with feedback, this is always a must have. When taking a closer look at the mediums personas prefer, it becomes clear again consumers have a better view on which medium they prefer compared to professionals. Overall, the consumers seem to prefer a computer, smart phone, tablet or application as medium. Professionals also seem to prefer this kind of medium, however, they rather find this could have than should or must have. Overall, all the personas seem to want a medium which makes use of Internet and is accessible on devices such as a phone or computer.

Also a comparison can be made in the way subjects want their feedback displayed. Figure 9 gives an overview the two best possible graphical options per requirement.

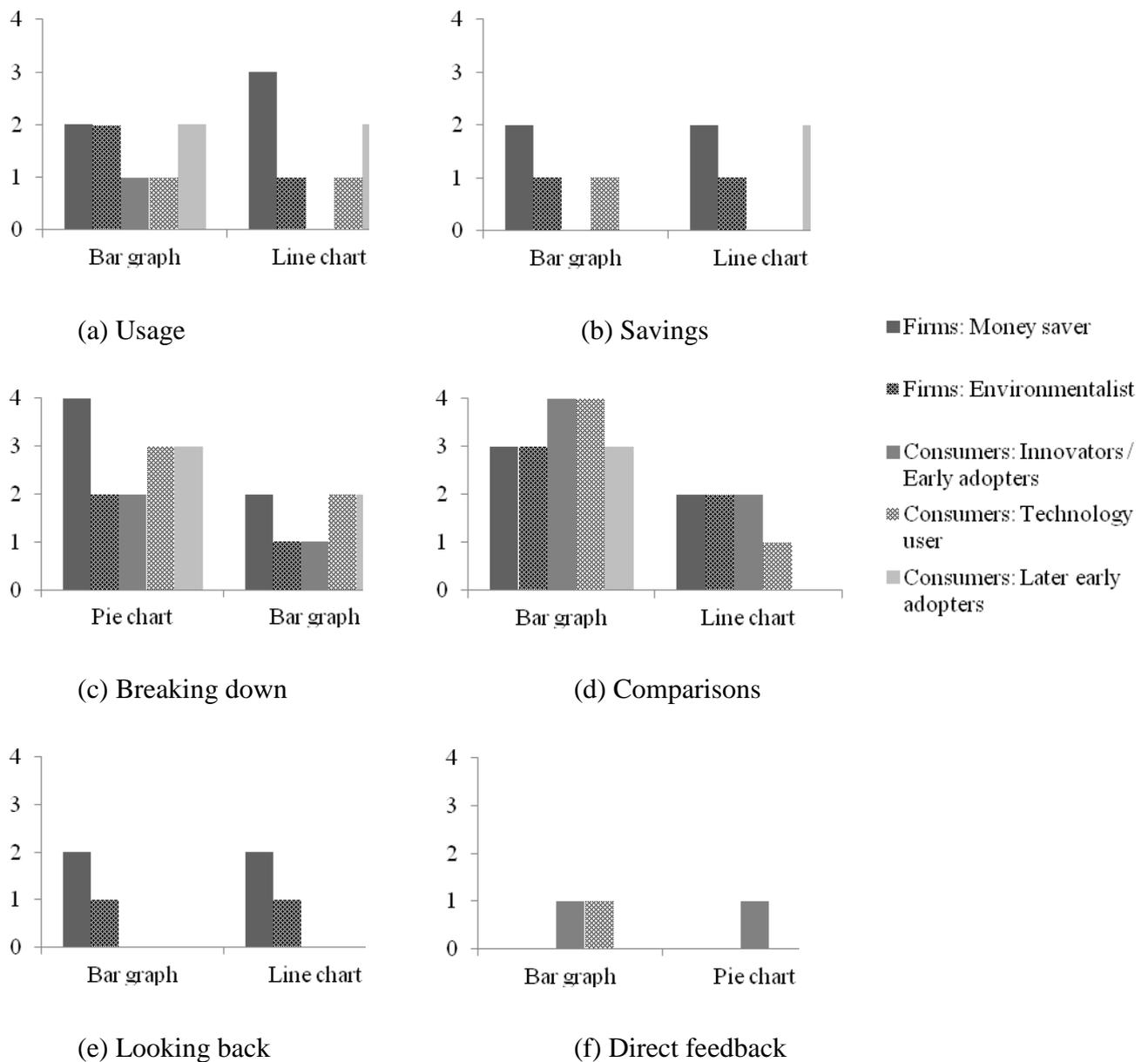


Figure 9. The two best graphical options per requirement for each persona of professionals and consumers.

When analysing figure 9, it can be concluded the subjects for both professionals and consumers do not have a clear image of what they want their feedback to look like. Only for the requirement ‘breaking feedback down’, a pie chart seems to be the best option, while for ‘comparisons’ the best option seems to be a bar graph. It is striking none of the professionals spoke about what they want direct feedback to look like in a graph, and also none of the consumers spoke about how

they want to see their history of feedback.

## **4. Discussion and conclusion**

### *4.1 Discussion*

The purpose of this study was to examine whether the literature on feedback for consumers is also applicable for professionals. Also, this study examined the user characteristics of professionals in SME's and their opinions towards concepts potentially raising user engagement. So far, only a practical approach has been used in the form of user requirements. However, in order to determine whether the literature on consumers is also applicable for professionals, these practical user requirements are not sufficient. Therefore, these practical user requirements will now be used to form a baseline for relevant features and requirements within these features in order to enable a comparison with the literature. This study is one of the first qualitative studies to examine this. This discussion will first treat similarities, differences and new features found for the content of feedback, after which the same is done for the design and display of feedback. After that, the user characteristics and concepts that can raise user engagement will be discussed.

#### *4.1.1 Content*

##### *4.1.1.1 Similar features*

When considering the content of feedback, the study shows several features are equally relevant for professionals and consumers, namely usage, breaking feedback down, comparisons with own usage, direct feedback and frequency. All these features were also found to be relevant by Darby (2006), Fischer (2008) and Fitzpatrick and Smith (2009).

Within some of these features, there are certain requirements for both professionals and consumers in which they are similar or differ. Starting with the requirements for 'comparing with own use' for professionals and consumers are the same as both want comparisons with a same period in the previous year which is in line with Fischer (2008). Thus, the literature of consumers is also applicable for professionals at this point. Next, for 'breaking down', professionals and consumers

have the same requirements, both want their feedback broken down per device, which is in line with findings of Fischer (2008) and Fitzpatrick and Smith (2009). However, professionals also want their feedback broken down per space, which is also in line with Fischer (2008). Thus, for this feature and its requirements, the literature of consumers is partly applicable for professionals as a appliance-specific breakdown is sometimes too specific for professionals.

However, the requirements for 'usage' differ as professionals prefer this displayed in euros followed by kWh while consumers prefer kWh followed by euros. Although at first glance it seems the results of Fitzpatrick and Smith (2009) on consumers are applicable for professionals as they also found a preference of euros over kWh, after ending their study the participants preferred kWh of euros, which is opposite of our findings with professionals. Therefore, the requirements for usage found in the literature of consumers are not applicable for professionals. Another difference in the requirements is found in the feature 'frequency'. Although professionals have no clear image on how frequent they want to receive their feedback, all want the feedback to be pushed to them, while consumers want feedback on demand. The finding for professionals is partly in line with the literature as Abrahamse et al. (2005), Fischer (2008) and Fitzpatrick and Smith (2009) all showed frequent feedback works best. As this does not apply to consumers, the finding of consumers is not in line with the literature. Overall, although the professionals have no clear image, the literature of consumers concerning frequency is applicable, as a frequency of once a day or week seem to fit their wishes the best.

#### 4.1.1.2 Different features

There are not only similarities in the relevance of certain features, differences were also found. When considering the feature 'comparison with others', which is acknowledged as a relevant feature of feedback (Fischer, 2008; Fitzpatrick & Smith, 2009), professionals find this feature more relevant than consumers. This is in line with the literature as Siero et al. (1996) found comparisons with other increases energy saving for professionals, while this is not yet shown for consumers (Fisher, 2008). An explanation for this difference is the fact that comparing with others leads to competition (Fischer, 2008). For professionals, having an advantage in this competition over others is important (Henderson, 1983), and as saving energy can be

considered as an advantage, comparing with others is more important for professionals. When considering the requirements for 'comparing with others', it seems that the requirements of professionals are not in line with the literature for the most important reason that professionals want to compare with professionals and consumers with consumers. However, professionals want to compare with companies that are in some way similar or in the neighbourhood, which is in line with normative comparisons for households (Fischer, 2008). Thus, the literature for comparing with others for consumers is not applicable for professionals.

Another difference between professionals and consumers is found in indirect feedback. Firms have less interest in indirect feedback than households. Indirect feedback does not meet the requirements firms set for their feedback, while direct feedback does. Consumers have other requirements and both direct and indirect feedback meet these requirements, which is already shown by Darby (2006) to be the base for sustained requirement reduction. This combination does not work for firms as their requirements are already met with only direct feedback

Features only relevant for professionals were found as well. All these features were also found in literature on consumers. First, professionals want to edit the information given to them, and second they wish certain variables, such as kind of company or function, to be taken into account when giving feedback. Both are in line with Fischer (2008) who showed that when feedback options are in accordance with the wishes of a user, this results in a 'best case' of saving energy through feedback. Third, professionals want feedback to be concrete and easy to understand. This is in line with the literature on consumers, as Fischer (2008) also showed consumers want feedback to be easily understood (Fischer, 2008). Fourth, professionals want to be stimulated to save energy, for example by using rewards. This finding fits the study of Abrahamse et al. (2005) as they showed rewards also form an extrinsic motivator for a consumer to save energy. Overall, the literature on consumers for these features is applicable for professionals as well.

#### 4.1.1.3 New features

Also, new equally relevant features for feedback for both professionals and consumers are found in this study are not mentioned yet in the literature, namely 'previous savings' and 'looking back'. Both these features can be considered relevant

for feedback as they serve as a way to increase motivation to save energy. These features help the user to see what has either already been accomplished in attaining a particular goal or what still remains to do to attain this goal, which increases the motivation to attain that goal (Koo & Fischbach, 2008). As both previous savings and earlier feedback can increase the motivation by letting the user see he is highly committed or lacks in progress, these features must be considered as relevant features. However, in these features differences in the requirements were found as well. For ‘previous savings’ a similar pattern as for ‘usage’ was found as professionals prefer euros followed by kWh and consumers prefer kWh followed by euros. This finding indicates professionals and consumers want to see their usage and savings in similar ways and therefore the wishes of consumers are not applicable for professionals. When considering ‘looking back’ it shows firms prefer looking into all feedback, while households prefer two to four years. As this feature is new as well, no literature is available. However, it shows for the requirements of this feature professionals and consumers differ from each other and wishes are not interchangeable.

Table 15 provides an overview on whether the features for professionals mentioned above are similar (X), different (-), similar in feature but different in requirements (O), or entirely new (N) compared to the literature on consumers.

Table 15. *Overview of similarities and dissimilarities in features for content of feedback.*

Usage	Savings	Breaking down	Comparison with own	Comparison with others	Looking back	Direct	Indirect	Frequency	Edit information	Take variables in account	Concrete	Stimulate
O	N	O	X	-	N	X	-	O	X	X	X	X

#### 4.1.2 Design and display

##### 4.1.2.1 Similar features

When considering the design, the study shows the medium is a relevant feature of feedback, which is in line with the findings of Fischer (2008). Both professionals and consumers have similar requirements for the medium, namely a medium that makes use of the Internet and is accessible on different type of devices. This is in line

with the results found by Abrahamse, Steg, Vlek and Rothengatter (2007) who stated Internet is an effective medium as it is suitable for reaching a large number of households. As Internet is also used by professionals in firms, this also is applicable for firms.

When considering the display of the feedback, apart from breaking down and comparisons no clear wishes for certain graphs come forward. When considering comparisons, both firms and consumers want to see them in a bar graph, while they want broken down feedback in a pie chart. Both findings are in line with Fischer (2008), and also Wilhite et al. (1999) found a pie chart is preferred when feedback is broken down. Thus, the literature on consumers for the display of feedback is applicable for professionals as well.

#### 4.1.2.2 Different features

A difference between professionals and consumers is found in the features 'influencing the display' and 'influencing the medium'. Professionals consider influencing the medium and influencing the display equally important, while consumers only find the latter important. However, the professionals' wishes are less profound than those of consumers. The fact that consumers value influencing more than professionals do can be explained by that most users want to personalize a menu design, however a small group does not recognize the value of customizing their design (Findlater & McGrenere, 2004). As the results of this study show content is more important for professionals, and therefore they do not value a personalized design as much as consumers do, the results are in line with the literature.

#### 4.1.2.3 New features

Also, a new equally relevant feature for feedback for both professionals and consumers is found that is not mentioned yet in the literature, namely 'intervening'. This study shows for both firms and households this is an important feature. By adding this feature it means the feedback becomes more automated. There are different stages of automation, and the feature 'intervening' can be considered to be in the first stage of automation proposed by Parasuraman, Sheridan and Wickens (2000), namely information acquisition. In this level, the user is forced to remain in the loop and make active choices (Wickens et al., 2004). As feedback is successful when a

consumer interacts with the feedback (Fischer, 2008), intervening as the first stage of automation is a relevant feature for feedback for both firms and consumers. The requirements for this feature are similar for professionals and consumers. Therefore, wishes of professionals and consumers are interchangeable.

Also ‘simulating’ is found to be relevant for professionals but less for consumers. Although this feature is not yet mentioned as a relevant feature in the literature, it should be because according to Fischer (2008) studies using additional information such as energy-saving tips are the ones turning out to be the ‘best cases’. The difference between firms and consumers can be explained by them both being in a different stage of motivation (He et al., 2010). The results show firms are aware of the problem, but may not be ready to take action. Therefore, they profit from encouragement for small actions that save energy. Consumers may be in a higher stage and thus have little less need for advice on how they can save energy. Thus, professionals need more guidance in saving energy than consumers and therefore ‘simulate’ is a more relevant feature for firms than households

Next, the results show ‘switching devices on/off’ is a relevant feature for some of the personas in companies and households, while it is not for others. This feature is not mentioned in the literature for feedback before as it is automation in the fourth stage of Parasuraman et al. (2000), which is the control and action execution where the human’s action or control is replaced by automation. Thus, it seems switching devices on or off is no part of feedback and thus not relevant. It is rather an option for a feedback system.

Further, an intelligent feedback system is found to be a relevant feature for professionals. To the best of our knowledge, the literature on feedback does not mention an intelligent feedback system. However, this desire is in line with the growing interest in Ambient Intelligence [AmI] (Augusto, 2008). AmI can be used to build a system so it can take decisions for users to benefit them, based on real-time information gathered and historical data. The growing interest in AmI can also explain the divergent wishes to switch devices on or off.

Table 16 provides an overview on whether the features for professionals mentioned above are similar (X), different (-), similar in feature but different in requirements (O), or entirely new (N) compared to the literature on consumers. Both ‘switching devices on or off’ and ‘intelligent feedback system’ were not taken into

account because they are rather options for a feedback system than features for feedback.

Table 16. *Overview of similarities and dissimilarities in features for design and display of feedback.*

Medium	Influence the medium	Influence of display	Simulate	Intervene	Display
X	-	-	N	N	X

#### 4.1.3 User characteristics

In this study it became clear professionals have reasonable to substantial knowledge on how they can save energy, which is in contrast with Kannan and Boie (2003) and Schleich and Gruber (2008). This difference may be due to the fact that the issue of saving energy becomes more and more important with the years and therefore the literature may not reflect the current knowledge now existing in firms.

Further, professionals save energy for financial benefits or the environment which are the same motivations found for consumers. Our results are therefore in line with Hargreaves, Nye and Burgess (2010) who found similarly motivated consumers. Thus, professionals and consumers have the same motivations. However, a clear difference between professionals and consumers in this study is found in the distribution of these motivations. Consumers are much more motivated to save for the environment than for money, while for firms this is equally distributed. Both are in contrast with the distribution of motivation in the study of Hargreaves et al. (2010) who found financial benefits as the most important reason to save energy. Thus, we can state that the division of motivation found in this study is not in line with the literature. The professionals have as much normative and environmental concerns as they have cost or hedonic reasons, while consumers have more normative and environmental concerns (Steg, 2008). People with cost or hedonic reasons will stop saving energy when this behaviour is no longer cost-effective or attractive. Therefore, an important difference is professionals may stop earlier with energy saving than consumers will. Thus, although a feedback system for firms and households may have similarities in the features, there should be a difference considered professionals and consumers are differently motivated. To make the feedback successful, the different

motivations should be taken into account and feedback should be adjusted to the different motivational stages, see He et al. (2010). The feedback for professionals should focus more on motivating compared to consumers.

#### *4.1.4 User engagement*

This study showed professionals are positive about assigning a person as 'energy champion' as he or she can provide them with information. Therefore, our results fit with Chakrabarti (1974) and Howell and Higgins (1990) who state a 'champion' is the person in an organization able to promote a new idea. Professionals are also positive about playing an energy saving game as it will help grow the awareness and create motivation. This is in line with Stevens (2013) who showed the game Practically Green helps to motivate people and by playing this game companies made sustainability a priority as they recognized its importance. Also, professionals are positive about an improved energy bill with more specific information. For consumers such a bill has already been proven to lead to energy savings (Wilhite & Ling, 1995). As an energy bill is considered to be indirect feedback (Darby, 2006), this is in contrast with earlier findings in this study as indirect feedback is not an important feature for professionals. As a contrasting view is created on whether indirect feedback is a relevant feature of feedback for professionals, one might argue that indirect feedback is a relevant feature of feedback for professionals. Just as for consumers, a combination of direct and indirect feedback may serve as the base for sustained demand reduction (Darby, 2006).

#### *4.2 Conclusion*

Overall, most of the literature on relevant features for the content of feedback for consumers is also applicable for professionals. However, differences were found in the features 'comparing with others' and 'indirect feedback'. The study also showed 'previous savings' and 'looking back' to be new relevant features for the content of feedback. Although the features for the content of the feedback on consumers are applicable for firms, this is not the case for the requirements for these features. For the design of the feedback, the literature known on medium for consumers is applicable for professionals, just as for the display in certain graphs. However, differences are found in 'influencing the display' and 'influencing the medium'. For the design of the feedback, this study mostly discovered new features

that are not yet recognized in the literature. While the findings for ‘intervening’ are interchangeable for professionals and consumers, this is not the case for ‘simulating’ feedback for which the requirements are not interchangeable.

With regards to the user characteristics, a reasonable to substantial amount of knowledge was found to be present amongst professionals. Also, similar motivations to save energy were found in both professionals and consumers, that are in line with the literature. However, for professionals the motivations are differently divided than for consumers or in the literature. Further, assigning an ‘energy champion’, introducing a game by which users can save energy and a specified energy bill are a good idea to get users engaged.

In general, the relevant features for feedback found in the literature on consumers are applicable for professionals. However, when designing a feedback system, the literature for consumers should not form the base for firms as both have divergent requirements for features.

#### *4.3 Limitations*

A number of critical remarks can be made with respect to this study. First, to prioritize the requirements found by analysis of the results, a cut-off score was used to determine the MoSCoW category of each requirement. However, there is little literature on how the MoSCoW method should be used and whether a cut-off score for determining a category is a valid way to determine a requirement’s category. Thus, the question arises whether the categorization used in this study to prioritize the requirements is valid. In this study it was chosen to make the distance between the four categories even, however, if these cut off scores were changed, this most likely would have effect on the prioritization of the requirements. When different cut off scores were used, for example cut off scores that were uneven instead of even, some of the requirements may belong in other categories than they do now. This is most likely the case with requirements that are now won’t or could haves. Some of the requirements that are must haves are mentioned by every interviewee and therefore will remain must have requirements. Although Brennan (2009) states the MoSCoW method is useful for ranking and scoring requirements and a scale should be established for scoring each requirement, in the future, a similar research should not use a quantitative way of determine requirements but approach it in a qualitative way.

This can for example be done by asking subjects to rank requirements in the MoSCoW categories.

Second, in this study a comparison between professionals and consumers is made. However, the consumers in this study may not be fully representative of the target group 'consumers'. As this sample is selected from a group of people already very involved in energy saving, there is little variation in their experience with regards to energy savings. Therefore, it should not be assumed this sample is a good reflection of the average consumer. When using a more divergent group of consumers they will be more representative of the average user. Thus, future research should use a good reflection of the user group consumers.

Third, this study gives a first glance on the relevant features for firms for feedback on how to save energy. However, these features are based on a small sample size (n=15). Therefore, it is not possible to generalize these results for a large group of SME's. Future research should thus try to examine relevant features with a larger sample size. When using a larger sample size the research allows for a more diversity within the professions of the subjects. Or, if one wants to determine the feedback per profession or professional field, a group of for example CEO's or economist could be interviewed.

Fourth, in this sample size, the results of one interview were partly not usable, so it seemed afterwards, the subject was oriented on wishes for a feedback system as consumer rather than as employee of a firm. Therefore, the parts not applicable for firms, which were also coded by the student carrying out the research for LochemEnergie and another Human Factors and Media Psychology student, were excluded from the analysis. However, by excluding some results of this interview, it may result in requirements being either a could have while maybe, when the whole interview was concerned with firms, a requirement would be a should have.

Fifth, during this study, a semi-structured interview was used to elicit the requirements for feedback. Although some topics are fixed in advance, there was also room for the subjects to brainstorm. As mentioned before, as there is a difference between the firms and consumers in experiences with saving energy, the (lack of) pre-existing knowledge may influence their chance to brainstorm. Also, one's personality may play a role in the interview. Some subjects are more creative and open, and therefore will generate more ideas than the ones not creative.

Sixth and last, although questions about fixed topics were asked to the subjects, not every subject spoke about each requirement because either one did not think about it or someone finds it obvious. In analysing the interviews and forming the requirements, this sometimes resulted in no clear image for a requirement. For example for frequency almost every subject gave a different answer and thus no clear frequency came up. Therefore, requirements that are now, for example, won't have, are in fact more important, however, as only one person spoke about it, the importance of this requirement is distorted.

#### *4.4 Implications*

In conclusion, this study gives a first comparison of relevant features between professionals and consumers. The results of this study add new information to the literature as it showed that although there are similarities between professionals and consumers, there are also differences that should be taken into account. Also, new features that were found in this study should be taken into account to be part of successful feedback. The results can also serve as a baseline for designing a feedback system for firms, rather than basing its design on current literature which is usually focused on consumers or households. The features found in this study, and more specific the requirements for these features, can be used to build a feedback system that will help professionals save energy and cross the current barriers in SME's for saving energy.

However, there is still a gap in the literature concerning saving energy through changing behaviour in companies, while there is a lot of literature for consumers. Therefore, an important recommendation is further research should be done within companies in how to change behaviour in order to save energy. Also, more research should be done about relevant features of feedback to be successful for companies. Last, as this study focused on SME's, future studies may also focus on researching large companies. Future research should make use of qualitative research as it produces rich data that helps filling the gap in the literature.

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## Appendix A: Professions per participant

Table 1. *Professions per participant*

Participant	Profession
1	Assistant operations manager / Assistant manager
2	Retail manager
3	Project manager
4	Chairman supervisory board / Managing director
5	Director
6	Director / Major shareholder
7	Secretary / PR and marketing assistant
8	Tax advisor / Senior manager
9	Commercial manager
10	Custom manager
11	Quality engineer
12	Director / Partner
13	Salon assistant
14	Consultant
15	Managing consultant

## Appendix B: Interview

### Introductie

- Introductie over mezelf
- Uitleg masterthese en opdracht voor LochemEnergie / (IPSUM)
- Verloop van het interview uitleggen
  - Verwachtingen van mijn kant
  - Duur (+/- 45 min / 60 min)
- Vermelden dat het interview wordt opgenomen (enkel audio)
  - Benoemen dat alles anoniem wordt verwerkt
- Teken en van informed consent
- Aangeven dat er de mogelijkheid is om de resultaten te ontvangen per mail wanneer er groen licht is voor mijn masterthese
- Vragen?

### Inleidende vragen

#### Algemeen

- Geslacht en leeftijd
- Wat weet u al van energie besparing?
- Wat doet u al om energie te besparen?
- Wat is voor u de belangrijkste reden om op uw energieverbruik te letten?

#### IPSUM

- Wat weet u al van het beleid van IPSUM?
- Wat weet u van de manier waarop IPSUM energie wil besparen?
  - Wat weet u al van de manier waarop IPSUM feedback wil geven?

#### LochemEnergie

- Wat weet u al van de LochemEnergie organisatie?
- Wat weet u al van energie opwekken binnen het slimme net project van LochemEnergie?
- Wekt u al uw eigen energie op, en zo ja, hoe? En wat is hier de belangrijkste reden voor?
- Wat zou u ervan vinden om zonnepanelen aan te schaffen voor op uw eigen dak?
  - Wat zijn hierin uw overwegingen (geweest)?
- Wat zou u ervan vinden om zonnepanelen te huren in het zonnepark?
  - Wat zijn hierin uw overwegingen (geweest)?
- Zijn er specifieke doelen die u nastreeft qua energieverbruik en/of opwek?

### Interview

## Deel 1: Hoe ziet de feedback er qua inhoud uit?

### Terugkoppeling mail

Behandelen van de punten die zelf zijn bedacht. Hierna zelf inschatten of er (wanneer er nog geen punten zijn bedacht, vanwege bijvoorbeeld tijdgebrek) nog een kleine brainstormsessie nodig is.

- Welke feedback/informatie zou u willen ontvangen over uw energieverbruik?

### Vragen

Als de geïnterviewde een van de onderstaande punten niet noemt, moet naar de volgende punten worden gevraagd:

- **Gebruik:** Moet de feedback informatie over gebruik weergeven?
  - Vorm gebruik: gebruik in kWh / geld / CO<sub>2</sub> uitstoot
- **Besparingen:** Moet de feedback informatie over besparingen weergeven?
  - Vorm besparingen: besparingen in de vorm van geld / CO<sub>2</sub> / aantal bomen dat is gespaard / uren dat apparaat aan had kunnen staan
- **Opbreken:** Hoe moet de feedback worden opgebroken?
  - het hele huis, per verdieping, per kamer, per elektriciteitsgroep of per apparaat.
- **Vergelijkingen:** Moet de feedback gebruik maken van vergelijkingen met eerder energie gebruik?
  - Met eerder eigen gebruik: met eerder gebruik in dezelfde periode qua temperatuur / dezelfde periode qua week in het jaar / met een baseline / de vorige dag
  - Met gebruik van anderen: (Met wie?) met andere huishoudens die qua eigenschappen van het huis op elkaar lijken / met andere huishoudens die zelf kunnen worden uitgekozen zoals de burens, of familie ergens anders
- **Terugkijken:** Hoe ver wilt u eerdere feedback terug kunnen kijken?
  - Niet, Één week, één maand, één jaar, alles..?
- **Direct/in-direct:** Op welke manier wilt u uw feedback ontvangen; direct, namelijk direct na gebruik feedback over uw gebruik, of indirect, namelijk nadat de data is verwerkt (in de vorm van een rekening van de energiemaatschappij) of op aanvraag?
- **Frequentie:** Hoe vaak moet er feedback worden gegeven?
  - na elke actie die wordt uitgevoerd, een paar keer per dag, 1x per dag, een paar keer per week, 1 per week, op aanvraag, ...?

### *LochemEnergie*

- **Opwek:** Moet de feedback informatie geven over hoeveel energie is opgewekt?
  - **Vorm opwek:** kWh / geld / uren dat apparaat aan had kunnen staan / ...
- **Afstemming opwek en gebruik:** Zou u uw energie gebruik willen afstemmen op het aanbod van de op dat moment geproduceerde energie?
  - **Invloed:** hoeveel invloed zou u hier zelf op willen hebben?
  - Zelf regelen, automatisch en zelf controleren, volledig automatisch
  - **Overwegingen:** Wat zijn hierin uw overwegingen?

- **Motivatie:** Welke dingen motiveren u/zouden u kunnen motiveren om hiervan gebruik te maken?
- **Feedback:** Hoe wilt u dit terug zien in de feedback?
- **Energie-uitwisseling:** Zou u uw opgewekte energie willen leveren aan anderen in uw omgeving op momenten dat u die energie zelf niet nodig heeft en andersom?
  - **Wie:** (directe burens/ vrienden/ heel Lochem / etc.)?
  - **Overwegingen:** Wat zijn hierin uw overwegingen?
  - **Motivatie:** Welke dingen motiveren u/zouden u kunnen motiveren om hiervan gebruik te maken?
  - **Feedback:** Hoe wilt u dit terug zien in de feedback?
  - Zien wat u in het net stopt / zien wat u uit het net haalt
- **Elektrisch vervoer:** Zou u gebruik willen maken van elektrisch vervoer? Denk hierbij aan een eigen elektrische auto.
  - **Oplaadpunten:** Waar zouden de oplaadpunten zich moeten bevinden?
  - **Netontlasting:** Wat zou u ervan vinden als uw auto, wanneer deze aan een oplaadpunt staat, wordt gebruikt om het net te ontlasten wanneer dat nodig is? Als een soort externe opslag plaats van de opgewekte energie in Lochem.
  - **Overwegingen:** Wat zijn hierin uw overwegingen?
  - **Motivatie:** Welke dingen motiveren u/zouden u kunnen motiveren om hiervan gebruik te maken?
  - **Feedback:** Hoe wilt u dit terug zien in de feedback?
  - Auto en huis gescheiden / gediend als opslagplaats / verbruik
- **Ordering:** Kunt u een ordening maken van de punten die u net heeft genoemd, met het punt dat u het belangrijkste vindt bovenaan?

## Deel 2: Hoe ziet de feedback er qua presentatie uit?

### Terugkoppeling mail

Behandelen van de punten die zelf zijn bedacht. Hierna zelf inschatten of er (wanneer er nog geen punten zijn bedacht, vanwege bijvoorbeeld tijdgebrek) nog een kleine brainstormsessie nodig is.

### Vragen

Als de geïnterviewde een van de onderstaande punten niet noemt, moet naar de volgende punten worden gevraagd:

- **Medium:** Via welk medium moet de feedback worden gegeven?
  - Smartphone, tablet, e-mail, post, online, via sms, in de rekening, of wellicht een object dat beweegt/verandert van vorm)
- **Interface**
  - Invloed: Wilt u invloed kunnen uitoefenen op het medium / device dat de feedback verschaft? Wilt u de manier van weergave aan kunnen passen aan hoe u dat fijn vindt?
  - Waar op wilt u invloed kunnen uitoefenen?
  - Plaatjes veranderen in tekst / achtergrond kleur veranderen / ...

- **Ingrijpen:** Moet de interface iets voor u doen wanneer uw energieverbruik door u aangegeven grenzen overschrijdt?
  - Alert (piepen) of daadwerkelijk schakelen.
  - En hoe en door wie moeten deze grenzen gedefinieerd worden?
- **Simuleren:** Moet de interface kunnen simuleren dat er iets wordt gedaan, zodat u kunt zien wat u in dat geval bespaard zou hebben?
  - Besparingen hadden kunnen worden gedaan door de wasmachine later aan te zetten.

### Vormgeving

Hier willen we per besproken punt waarop dit van toepassing is de vormgeving gaan bespreken. Dit gaan we doen aan de hand van enkele concrete vormgeving voorbeelden, zoals grafieken, diagrammen, tabellen en tekst.

- Gebruik
- Besparingen
- Opbreken
- Vergelijken
- Terugkijken (tijd op de as)

#### *Lochem Energie*

- Opwek
- Afstemming opwek en gebruik
- Energie uitwisseling
- Elektrisch vervoer

### Ranking

Wanneer alle punten zijn behandeld:

Kunt u een top 3 of top 5 maken van de punten die voor u het meest belangrijk zijn voor de feedback? Zowel qua inhoud als qua vormgeving?

#### Deel 3: UTAUT

Geef participant de UTAUT vragenlijst.

#### Deel 4: Specifieke vragen

#### *IPSUM*

Vanuit IPSUM zijn er nog een aantal specifieke vragen voor hun klanten, die zou ik nu graag willen behandelen.

#### Energy champion

Vanuit IPSUM bestaat het idee om een energy champion aan te wijzen in de bedrijven die bij hen klant zijn. Deze energy champion is de persoon die actief bezig is/gaat met de energie consumptie.

- Wat weet u al van energy champions?
- Wat vindt u ervan om zo'n persoon aan te wijzen in het bedrijf?
- Wat voor een persoon moet deze taak op zich nemen?
  - Persoonlijkheidskenmerken?
  - Functie in het bedrijf?

- Enz.

#### Energy saving game

(Enkel wanneer dit nog niet eerder ter sprake is gekomen)

Vanuit IPSUM bestaat het idee om eventueel een spel te maken waardoor u, als werknemer, actief bezig kunt zijn met energiebesparen in uw bedrijf.

- Wat vindt u ervan om zelf mee te kunnen besparen door middel van een spel?
- Wat voor een spel zou u verwachten/voor u zien?
  - Wat voor een elementen bevat dit?
  - Hoe ziet het er uit?

#### Energie rekening

Vanuit IPSUM wordt er sowieso een online energierekening aangeboden. Deze energierekening wordt opgedeeld per apparaat.

- Wat vindt u van deze opdeling? Zou u dit anders willen?

#### *LochemEnergie*

Vanuit LochemEnergie zijn er nog een aantal specifieke vragen, die zou ik nu graag willen behandelen.

#### Energiebesparing competitie

- Wat zou u ervan vinden om mee te doen aan energiebesparing competities met uw omgeving?
  - Hoe zou zo'n competitie eruit moeten zien?
  - Tegen wie zou u willen strijden? Familie, vrienden, wijk, lochem?
  - Welke informatie zouden anderen hierbij over uw stroomgebruik mogen inzien?
  - Wat zou de prijs voor de winnaar moeten zijn?

#### Energiebesparing spel

- Wat zou u ervan vinden om zelf actief mee te kunnen besparen door middel van een spel?
- Wat voor een spel zou u verwachten/voor u zien?
  - Wat voor een elementen bevat dit?
  - Hoe ziet het er uit?

<b>Afsluiting</b>
-------------------

- Bedanken voor de medewerking
- Herhalen dat de gegevens anoniem verwerkt zullen worden
- Heeft u nog vragen?
- Hoe vond u het om aan dit interview deel te nemen?

## Appendix C: UTAUT questionnaire

U kunt uw antwoord aangeven door een kruisje te zetten in het hokje dat op u van toepassing is. Bij de open vragen kunt u uw antwoord onder de vraag uitschrijven.

### Welk van de volgende apparaten bezit u?

Computer	
Laptop	
Mobiel (gewoon)	
Mobiel (smart Phone)	
Tablet	
Slim thermostaat kastje aan de muur	
Andere apparatuur die hier op lijkt	

Indien u andere apparatuur die hier op lijkt heeft aangekruist, geef dan hieronder aan welke apparatuur:

De volgende vragen gaan over het algemeen gebruik van alle apparaten die u bezit bij elkaar genomen.

### Hoe vaak gebruikt u de apparaten in uw bezit?

Nooit	
Zelden	
Soms	
Vaak	
Altijd	

### Waar gebruikt u de apparaten voor?

### Hoe ervaren bent u met het gebruik van de apparaten?

Helemaal niet ervaren	
Niet erg ervaren	

Redelijk ervaren	
Zeer ervaren	
Uitermate ervaren	

**Om welke reden(en) bent u de apparaten gaan gebruiken?**

**Hoe nuttig vindt u de apparaten?**

Helemaal niet nuttig	
Niet erg nuttig	
Redelijk nuttig	
Zeer Nuttig	
Uitermate nuttig	

**Waar verwacht u deze apparaten in de toekomst te gebruiken?**

**In hoeverre vindt u het gemakkelijk of moeilijk om met uw apparaten om te gaan?**

Helemaal niet moeilijk	
Niet erg moeilijk	
Redelijk moeilijk	
Zeer moeilijk	
Uitermate moeilijk	

**Wat vindt u hier gemakkelijk of moeilijk aan?**

**In hoeverre voelt u druk van anderen in uw omgeving om deze apparaten te gebruiken?**

Helemaal geen druk	
Weinig druk	
Redelijke druk	
Veel druk	
Zeer veel druk	

**Hoe vaak laat u zich beïnvloeden door deze druk?**

Nooit	
Zelden	
Soms	
Vaak	
Altijd	

**Hoe schat u uw vaardigheden en kennis over deze apparaten in?**

Helemaal niet vaardig	
Niet erg vaardig	
Redelijk vaardig	
Zeer vaardig	
Uitermate vaardig	

**Hoeveel invloed denkt u dat dit invloed heeft op het gebruik van de apparaten?**

Helemaal geen invloed	
Weinig invloed	
Redelijke invloed	
Veel invloed	
Zeer veel invloed	

**Wanneer u in het bezit bent van een nieuw apparaat, bent u dan van plan hem te gaan gebruiken?**

Nee	
Misschien	
Ja	

## **Appendix D: Introduction mail**

Geachte heer/mevrouw,

Mijn naam is Suzanne Vosslamber en ik volg mijn master Human Factors en Mediapsychologie aan de Universiteit Twente. Voor mijn masterthese heb ik vanuit IPSUM de opdracht gekregen om onderzoek te doen bij hun klanten over energiebesparing. Het doel van IPSUM is om hun klanten energie te laten besparen door middel van feedback. Deze feedback kan op en via verschillende manieren worden gegeven en het is dus belangrijk dat de manier waarop dit wordt gedaan past bij de wensen van de klanten van IPSUM. De opdracht van mijn masterthese is dan ook om door middel van interviews een beeld te vormen over hoe de feedback volgens de klanten van IPSUM er uit moet komen te zien. Binnenkort zal ik contact met u opnemen om een afspraak te maken voor een interview, maar ik zou alvast willen vragen om over een aantal punten na te denken. Het eerste punt gaat over hoe de feedback er qua inhoud uit moet zien. Denk aan wat voor een soort informatie u zou willen ontvangen, wanneer, etc. Het tweede punt gaat over hoe u wilt dat de feedback moet worden vormgegeven? Denk hierbij bijvoorbeeld aan via wat voor een medium u feedback wilt ontvangen. Als u uw ideeën over deze punten op papier zet, kunnen deze (en andere punten) tijdens het interview worden behandeld.

Als u bij voorbaat al vragen hebt, kunt u met mij contact opnemen via e-mail (XXX) of telefoon (XXX).

Met vriendelijke groet,

Suzanne Vosslamber

## **Appendix E: Informed consent**

### **INFORMED CONSENT**

#### **Toestemmingsverklaring**

voor deelname aan het wetenschappelijk onderzoek:

Ik stem ermee in deel te nemen aan dit onderzoek. Ik ben me ervan bewust dat deelname aan dit onderzoek geheel vrijwillig is. Ik begrijp eveneens dat ik mijn medewerking op elk tijdstip stop kan zetten en de gegevens verkregen uit dit onderzoek kan terugkrijgen, laten verwijderen uit de database of geheel laten vernietigen, zonder dat ik daarvoor een reden hoeft te geven. De volgende punten zijn aan mij uitgelegd:

1. Het doel van dit onderzoek is om na te gaan wat mijn persoonlijke wensen zijn ten aanzien van een smart feedback systeem over mijn energie opwek en/of gebruik.
2. Mijn deelname als proefpersoon bestaat uit een ongeveer 1 uur durend interview.
3. De gegevens verkregen uit dit onderzoek zullen volledig anoniem verwerkt worden en kunnen daarom niet gekoppeld worden aan mijn deelname.
4. De onderzoeker zal alle verdere vragen over dit onderzoek beantwoorden voorafgaand of na afloop van het interview.

(Geïnterviewde)

Voor- en achternaam:

Handtekening:

Datum:

(Interviewer)

Voor- en achternaam: Suzanne Vosslamber

Handtekening:

Datum:

## Appendix F: Coding template

1. Inleiding
  - 1.1 Kennis energiebesparing
  - 1.2 Acties energiebesparing
  - 1.3 Reden energiebesparing
2. Inhoud
  - 2.1 Gebruik
  - 2.2 Besparingen
  - 2.3 Opbreken
  - 2.4 Vergelijken
    - 2.4.1 Eigen gebruik
    - 2.4.2 Anderen
  - 2.5 Terugkijken
  - 2.6 Direct/indirect
  - 2.7 Frequentie
  - 2.8 Overig
3. Vormgeving
  - 3.1 Medium
  - 3.2 Interface
    - 3.2.1 Invloed uitoefenen
    - 3.2.2 Waarop invloed
  - 3.3 Interface doet iets
  - 3.4 Simuleren
  - 3.5 Ingrijpen
  - 3.6 Weergave in ...
    - 3.6.1 Gebruik
    - 3.6.2 Besparingen
    - 3.6.3 Opbreken
    - 3.6.4 Vergelijken
    - 3.6.5 Terugkijken
    - 3.6.6 Direct-indirect
  - 3.7 Overig
4. Ipsum
  - 4.1 Wat weet u al van het beleid?
  - 4.2 Wat weet u al van de manier van feedback geven?
  - 4.3 Energy champion
  - 4.4 Energy saving game
  - 4.5 Energie rekening
5. Overig
6. Ordening
  - 6.1 Nummer 1
  - 6.2 Nummer 2
  - 6.3 Nummer 3
  - 6.4 Nummer 4
  - 6.5 Nummer 5

## Appendix G: SPSS output Cohen's kappa

Table 1. *SPSS output of Cohen's kappa*

		Value	Asymp. Std. Error <sup>a</sup>	Approx. T <sup>b</sup>	Approx. Sig.
Measure of agreement	Kappa	,867	,053	11,150	,000
N of valid cases		165			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

## Appendix H: Tables for persona ‘money saver’

Table 1. Strength of quotations per participants per requirement for the content of the feedback. The scores range from -2 (very negative) to 2 (very positive). When a participant did not say anything at all a score of 0 was assigned. A \* stands for a requirement mentioned in the top 3 or 5 most important requirements.

Requirement	Strength of quotations								
	1	2	7	9	11	13	14	Average	MoSCoW
<i>Usage</i>	2*	1*	1*	2	2*	2*	2*	1.71	4
Only in comparison	0	2	0	1	0	0	0	0.43	1
Euro's	2	1	0*	2	2	2	2	1.57	4
kWh	2	-2	2	0	2	2	0	0.86	2
CO2	0	-2	0	1	2	2	1	0.57	2
Metaphor	0	0	0	2	0	0	2	0.57	2
<i>Savings</i>	2*	0	1*	2	2	2*	1	1.43	3
Euro's	2	0	1	2	2	2	2	1.57	4
kWh	1	0	0	0	2	2	0	0.71	2
CO1	0	0	0	2	2	2	0	0.86	2
Metaphor	-1	0	0	2	-1	-1	2	0.14	1
Other	0	0	0	0	0	0	0	-	-
<i>Breaking down</i>	2	2	-2	2	2*	2	2	1.71	4
Whole building	0	0	2	0	0	0	0	0.29	1
Location	0	1	0	0	2	0	0	0.43	1
Wing	0	0	0	0	0	0	0	-	-
Floor	2	0	0	0	2	0	0	0.57	2
Department	0	0	0	0	2	0	0	0.29	1
Space	-1	0	0	2	0	2	-1	0.29	1
Office	0	0	-1	0	0	0	2	0.14	1
Group	0	0	0	0	2	0	2	0.57	2
Person	0	0	0	2	0	0	0	0.29	1
Device	2	0	0	2	2	2	-2	0.86	2
Square meters	0	0	2	0	0	0	0	0.29	1
Electrical outlet	0	0	0	0	0	0	0	-	-
<i>Comparison</i>	2*	2*	2	2	2*	2	2	2.00	4
Own usage	2	2	2	2	2	2	2	2.00	4
Usage of others	0	2	1	2	1	-1	-1	0.57	2
Mean	-1	0	0	0	0	0	0	-0.14	1
Standard	0	0	0	0	0	0	0	-	-
Target	0	0	0	0	0	0	0	-	-
<i>Comparison with own usage</i>									
Three years	2	0	0	0	0	0	0	0.29	1
Last year	0	0	0	2	2	2	2	1.14	3
Season	0	0	0	2	0	0	0	0.29	1

Quarter	2*	0	2	0	0	0	0	0.57	2
Last month	0	0	0	0	0	0	2	0.29	1
Period	0	0	2	0	0	2	0	0.57	2
Mean	0	0	0	0	0	0	0	-	-
Group	0	0	0	0	0	0	0	-	-
Take into account variables	0	0	-1	2	0	-1	2	0.29	1
<i>Comparison with others</i>									
Country average	0	0	0	0	0	0	0	-	-
External	0	0	0	2	1	0	0	0.43	1
Internal	1	2	0	2	0	0	0	0.71	2
Others in the same building	0	0	0	0	0	0	0	-	-
Anonymous	0	0	0	0	0	0	0	-	-
Looking back	1*	0	0	2	0	0	2	0.71	2
Everything	0	0	-1	0	1	0	0	0.00	1
Five years	0	0	0	2	2	0	2	0.86	2
Two to three years	0	0	2	0	0	2	0	0.57	2
One year	2	2	0	0	0	0	2	0.86	2
Per quarter	0	1	0	0	0	0	0	0.14	1
Direct	1	1	2	2*	2	2	2	1.71	4
Indirect	1	1	0	-1	2	0	0	0.43	1
<i>Frequency</i>									
Free to choose	0	0	0	2	0	0	0	0.29	1
On request	0	0	1	0	2	0	0	0.43	1
Once a year	0	2	0	0	0	-2	0	0.00	1
Once a quarter	3	2	0	0	0	0	0	0.57	2
Once a month	0	0	2	0	0	2	0	0.57	2
Once a week	0	0	0	2	0	0	2	0.57	2
Once a day	0	0	0	-1	0	-2	-2	-0.71	1
Multiple times a day	0	0	0	0	0	0	0	-	-
With every actions	0	0	0	0	0	0	0	-	-
<i>Own contributions / other</i>									
Edit information	0	-2	0	2	0	1	0	0.14	1
Stimulate	0	0	0	0	0	0	0	-	-
Take into account company. function and user	0	0	0	0	0	0	0	-	-
Database	0	0	0	0	2	0	0	0.29	1
Calculation examples	0	2	0	0	0	0	0	0.29	1
Concrete feedback	2	0	1	2	0	0	0	0.71	2

Note. A number with \* means the participant named that requirement in the top 3 or 5 most important requirements.

Table 2. Strength of quotations per participants per requirement for the design of the feedback. The scores range from -2 (very negative) to 2 (very positive). When a participant did not say anything at all a score of 0 was assigned. A \* stands for a requirement mentioned in the top 3 or 5 most important requirements.

Requirement	Strength of quotations
-------------	------------------------

	1	2	7	9	11	13	14	Average	MoSCoW
<i>Medium</i>									
Computer	0	0	0	0	0	1	0	0.14	1
Mobile phone	-1	-1	0	0	0	0	0	-0.29	1
Program	-2	0	0	0	-1	2	0	-0.14	1
E-mail	2	2	2	1	-1	1	0	1.00	2
Monitor	0	0	0	0	0	0	2	0.29	1
Application	-2	0	0	2	0	0	2	0.29	1
Written	2	0	0	0	0	0	0	0.29	1
Online	0	0	0	0	1	2	0	0.43	1
Website	0	0	0	0	0	2	0	0.29	1
Free to choose	0	0	0	0	0	0	0	-	-
Central	0	0	0	0	0	0	0	-	-
Universal	0	0	0	0	0	0	0	-	-
Push feedback	0	2	0	2	0	0	0	0.57	2
User depending	0	0	0	0	0	0	0	-	-
<i>Influence the medium</i>	1	2	-1	1	1	-2	1	0.43	1
Standard format	2	1	1	0	0	2	1	1.00	2
<i>Influence of display</i>	-1	2	-1	0	1	0	1	0.25	1
Moving elements	0	2	0	0	1	0	0	0.43	1
Colour	0	0	0	0	1	0	1	0.29	1
Clicking through	2	-1	0	0	-1	0	0	0.00	1
Font	0	0	0	0	2	0	0	0.29	1
<i>Simulate</i>	2	2	2	2	2	2	2	2.00	4
Before	0	2	1	0	2	2	2	1.29	3
Afterwards	0	-2	2	0	-1	0	1	0.00	1
Positive	0	0	0	0	0	0	2	0.29	1
Negative	0	0	0	0	0	0	-2	-0.29	1
Advice/tip	0	1	2	0*	2	2*	2*	1.29	3
<i>Intervene</i>	-2	2	2	2	2	1	1	1.14	3
Boundary internally set	2	2	0	2	2	1	1	1.43	3
Boundary externally set	0	0	1	0	0	0	1	0.29	1
Intervene themselves	1	0	0	0	0	0	0	0.14	1
Notification	2	2	2	2	2	2	2	2.00	4
<i>Switch devices on/off</i>	-2	2	2	2	2	1	1	1.14	3
<i>Own contributions / other</i>									
Intelligence	0	0	0	0	0	0	0	-	-

Note. A number with \* means the participant named that requirement in the top 3 or 5 most important requirements.

Table 3. Strength of quotations per participants per requirement for the display of the feedback. The scores range from -2 (very negative) to 2 (very positive). When a participant did not say anything at all a score of 0 was assigned. A \* stands for a requirement mentioned in the top 3 or 5 most important requirements.

Requirement	Strength of quotations								
	1	2	7	9	11	13	14	Average	MoSCoW
<i>General</i>									

Graphics	2	2	2	0	2	1*	0	1.29	3
Pie chart	2	0	0	0	0	0	0	0.29	1
Line chart	2	0	0	0	0	0	0	0.29	1
Bar graph	-1	0	0	0	0	0	0	-0.14	1
Image	0	0	0	1	0	0	0*	0.14	1
Table	2	2	2	2	2	0*	0	1.43	3
Colour	0	0	1	0	0	0	0	0.14	1
Text	0	-1	-1	0	0	2	0*	0.00	1
Numbers	0	0	0	0	0	0	0	-	-
Dashboard	0	0	0	0	2	0	0	0.29	1
Zoom in/out	0	0	0	0	0	0	0	-	-
Clicking through	0	0	0	2	0	0	1	0.43	1
<i>Usage</i>									
Bar graph	0	0	2	2	0	0	1	0.71	2
Line chart	2	0	0	0	2	2	1	1.00	2
<i>Savings</i>									
Bar graph	0	0	0	0	2	0	2	0.57	2
Line chart	2	0	2	0	0	0	0	0.57	2
Dashboard	0	0	0	0	0	0	0	-	-
Text	0	0	0	0	0	2	0	0.29	1
<i>Breaking down</i>									
Dropdown menu	0	0	0	2	0	0	0	0.29	1
Bar graph	2	0	0	0	2	0	0	0.57	2
Pie chart	1	1	0	2	2	2	2	1.43	3
Table	2	0	0	0	0	0	0	0.29	1
Text	0	0	0	0	0	2	0	0.29	1
Line chart	0	0	0	2	0	2	0	0.57	2
<i>Comparison</i>									
Line chart	2	0	0	0	2	0	0	0.57	2
Bar graph	0	2	2	2	0	0	2	1.14	3
Footprint	0	0	0	2*	0	0	0	0.29	1
Pie chart	0	2	0	0	0	0	0	0.29	1
<i>Looking back</i>									
Bar graph	0	0	2	0	2	0	2	0.86	2
Line chart	0	0	0	2	0	2	0	0.57	2
Text with chart	0	0	0	0	0	2	0	0.29	1
Graph	1	0	0	0	0	0	0	0.14	1

Note. A number with \* means the participant named that requirement in the top 3 or 5 most important requirements.

Table 4. Number of participants that spoke about a requirement for the content of the feedback. The scores range from -1 (said something negative) to 1 (said something positive). When a participant did not say anything at all, a score of 0 was assigned. Negative quotations were not included in the calculation of the MoSCoW score.

Requirement	Participant per requirement							Number	MoSCoW
	1	2	7	9	11	13	14		
<i>Usage</i>	1	1	1	1	1	1	1	7	4
Only in comparison	0	1	0	1	0	0	0	2	2

Euro's	1	1	0	1	1	1	1	6	4
kWh	1	-1	1	0	1	1	0	4	3
CO2	0	-1	0	1	1	1	1	4	3
Metaphor	0	0	0	1	0	0	1	2	2
<i>Savings</i>	<i>1</i>	<i>0</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>6</i>	<i>4</i>
Euro's	1	0	1	1	1	1	1	6	4
kWh	1	0	0	0	1	1	0	3	2
CO1	0	0	0	1	1	1	0	3	2
Metaphor	-1	0	0	1	-1	-1	1	2	2
Other	0	0	0	0	0	0	0	-	-
<i>Breaking down</i>	<i>1</i>	<i>1</i>	<i>-1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>6</i>	<i>4</i>
Whole building	0	0	1	0	0	0	0	1	1
Location	0	1	0	0	1	0	0	2	2
Wing	0	0	0	0	0	0	0	-	-
Floor	1	0	0	0	1	0	0	2	2
Department	0	0	0	0	1	0	0	1	1
Space	-1	0	0	1	0	1	-1	2	2
Office	0	0	-1	0	0	0	1	1	1
Group	0	0	0	0	1	0	1	2	2
Person	0	0	0	1	0	0	0	1	1
Device	1	0	0	1	1	1	-1	4	3
Square meters	0	0	1	0	0	0	0	1	1
Electrical outlet	0	0	0	0	0	0	0	-	-
<i>Comparison</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>7</i>	<i>4</i>
Own usage	1	1	1	1	1	1	1	7	4
Usage of others	0	1	1	1	1	-1	-1	4	3
Mean	-1	0	0	0	0	0	0	0	1
Standard	0	0	0	0	0	0	0	-	-
Target	0	0	0	0	0	0	0	-	-
<i>Comparison with own usage</i>									
Three years	1	0	0	0	0	0	0	1	1
Last year	0	0	0	1	1	1	1	4	3
Season	0	0	0	1	0	0	0	1	1
Quarter	1	0	1	0	0	0	0	2	1
Last month	0	0	0	0	0	0	1	1	1
Period	0	0	1	0	0	1	0	2	1
Mean	0	0	0	0	0	0	0	-	-
Group	0	0	0	0	0	0	0	-	-
Take into account variables	0	0	-1	1	0	-1	1	2	2
<i>Comparison with others</i>									
Country average	0	0	0	0	0	0	0	-	-
External	0	0	0	1	1	0	0	2	1
Internal	1	1	0	1	0	0	0	3	3
Others in the same building	0	0	0	0	0	0	0	-	-
Anonymous	0	0	0	0	0	0	0	-	-
<i>Looking back</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>1</i>	<i>3</i>	<i>3</i>
Everything	0	0	-1	0	1	0	0	1	1
Five years	0	0	0	1	1	0	1	3	3
Two to three years	0	0	1	0	0	1	0	2	1

One year	1	1	0	0	0	0	1	3	3
Per quarter	0	1	0	0	0	0	0	1	1
Direct	1	1	1	1	1	1	1	7	4
Indirect	1	1	0	-1	1	0	0	3	2
Frequency									
Free to choose	0	0	0	1	0	0	0	1	1
On request	0	0	1	0	1	0	0	2	1
Once a year	0	1	0	0	0	-1	0	1	1
Once a quarter	1	1	0	0	0	0	0	2	1
Once a month	0	0	1	0	0	1	0	2	1
Once a week	0	0	0	1	0	0	1	2	1
Once a day	0	0	0	-1	0	-1	-1	0	1
Multiple times a day	0	0	0	0	0	0	0	-	-
With every actions	0	0	0	0	0	0	0	-	-
Own contributions / other									
Edit information	0	-1	0	1	0	1	0	2	2
Stimulate	0	0	0	0	0	0	0	-	-
Take into account company. function and user	0	0	0	0	0	0	0	-	-
Database	0	0	0	0	1	0	0	1	1
Calculation examples	0	1	0	0	0	0	0	1	1
Concrete feedback	1	0	1	1	0	0	0	3	3

Table 5. Number of participants that spoke about a requirement for the design of the feedback. The scores range from -1 (said something negative) to 1 (said something positive). When a participant did not say anything at all, a score of 0 was assigned. Negative quotations were not included in the calculation of the MoSCoW score.

Requirement	Participant per requirement							Number	MoSCoW
	1	2	7	9	11	13	14		
<i>Medium</i>									
Computer	0	0	0	0	0	1	0	1	1
Mobile phone	-1	-1	0	0	0	0	0	0	1
Program	-1	0	0	0	-1	1	0	1	1
E-mail	1	1	1	1	-1	1	0	5	3
Monitor	0	0	0	0	0	0	1	1	1
Application	-1	0	0	1	0	0	1	2	2
Written	1	0	0	0	0	0	0	1	1
Online	0	0	0	0	1	1	0	2	1
Website	0	0	0	0	0	1	0	1	1
Free to choose	0	0	0	0	0	0	0	-	-
Central	0	0	0	0	0	0	0	-	-
Universal	0	0	0	0	0	0	0	-	-
Push feedback	0	1	0	1	0	0	0	2	1
User depending	0	0	0	0	0	0	0	-	-
<i>Influence the medium</i>	1	1	-1	1	1	-1	1	5	3
Standard format	1	1	1	0	0	1	1	5	3
<i>Influence of display</i>	-1	1	-1	0	1	0	1	3	2
Moving elements	0	1	0	0	1	0	0	2	1

Colour	0	0	0	0	1	0	1	2	1
Clicking through	1	-1	0	0	-1	0	0	1	1
Font	0	0	0	0	1	0	0	1	1
<i>Simulate</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>7</i>	<i>4</i>
Before	0	1	1	0	1	1	1	5	3
Afterwards	0	-1	1	0	-1	0	1	2	2
Positive	0	0	0	0	0	0	1	1	1
Negative	0	0	0	0	0	0	-1	0	1
Advice/tip	0	1	1	0	1	1	1	5	3
<i>Intervene</i>	<i>-1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>6</i>	<i>4</i>
Boundary internally set	1	1	0	1	1	1	1	6	4
Boundary externally set	0	0	1	0	0	0	1	2	1
Intervene themselves	1	0	0	0	0	0	0	1	1
Notification	1	1	1	1	1	1	1	7	4
<i>Switch devices on/off</i>	<i>0</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>-1</i>	<i>-1</i>	<i>-1</i>	<i>3</i>	<i>2</i>
Own contributions / other									
Intelligence	0	0	0	0	0	0	0	-	-

Table 6. Number of participants that spoke about a requirement for the display of the feedback. The scores range from -1 (said something negative) to 1 (said something positive). When a participant did not say anything at all, a score of 0 was assigned. Negative quotations were not included in the calculation of the MoSCoW score.

Requirement	Participant per requirement							Number	MoSCoW
	1	2	7	9	11	13	14		
<i>General</i>									
Graphics	1	1	1	0	1	1	0	5	3
Pie chart	1	0	0	0	0	0	0	1	1
Line chart	1	0	0	0	0	0	0	1	1
Bar graph	-1	0	0	0	0	0	0	0	1
Image	0	0	0	1	0	0	0	1	1
Table	1	1	1	1	1	0	0	5	3
Colour	0	0	1	0	0	0	0	1	1
Text	0	-1	-1	0	0	1	0	1	1
Numbers	0	0	0	0	0	0	0	-	-
Dashboard	0	0	0	0	1	0	0	1	1
Zoom in/out	0	0	0	0	0	0	0	-	-
Clicking through	0	0	0	1	0	0	1	2	2
<i>Usage</i>									
Bar graph	0	0	1	1	0	0	1	3	2
Line chart	1	0	0	0	1	1	1	4	3
<i>Savings</i>									
Bar graph	0	0	0	0	1	0	1	2	2
Line chart	1	0	1	0	0	0	0	2	2
Dashboard	0	0	0	0	0	0	0	-	-
Text	0	0	0	0	0	1	0	1	1
<i>Breaking down</i>									
Dropdown menu	0	0	0	1	0	0	0	1	1
Bar graph	1	0	0	0	1	0	0	2	1

Pie chart	1	1	0	1	1	1	1	6	4
Table	1	0	0	0	0	0	0	1	1
Text	0	0	0	0	0	1	0	1	1
Line chart	0	0	0	1	0	1	0	2	1
<i>Comparison</i>									
Line chart	1	0	0	0	1	0	0	2	1
Bar graph	0	1	1	1	0	0	1	4	3
Footprint	0	0	0	1	0	0	0	1	1
Pie chart	0	1	0	0	0	0	0	1	1
<i>Looking back</i>									
Bar graph	0	0	1	0	1	0	1	3	2
Line chart	0	0	0	1	0	1	0	2	1
Text with chart	0	0	0	0	0	1	0	1	1
Graph	1	0	0	0	0	0	0	1	1

Table 7. MoSCoW scores for both the strength of quotations and participants per requirement for the content of feedback combined into a final MoSCoW score.

Requirement	Strength of quotation	Participant per requirement	Average	Combined MoSCoW
<i>Usage</i>	4.00	4.00	4.00	4.00
Only in comparison	1.00	2.00	1.50	2.00
Euro's	4.00	4.00	4.00	4.00
kWh	2.00	3.00	2.50	3.00
CO2	2.00	3.00	2.50	3.00
Metaphor	2.00	2.00	2.00	2.00
<i>Savings</i>	3.00	4.00	3.50	4.00
Euro's	4.00	4.00	4.00	4.00
kWh	2.00	2.00	2.00	2.00
CO1	2.00	2.00	2.00	2.00
Metaphor	1.00	2.00	1.50	2.00
Other	-	-	-	-
<i>Breaking down</i>	4.00	4.00	4.00	4.00
Whole building	1.00	1.00	1.00	1.00
Location	1.00	2.00	1.50	2.00
Wing	-	-	-	-
Floor	2.00	2.00	2.00	2.00
Department	1.00	1.00	1.00	1.00
Space	1.00	2.00	1.50	2.00
Office	1.00	1.00	1.00	1.00
Group	2.00	2.00	2.00	2.00
Person	1.00	1.00	1.00	1.00
Device	2.00	3.00	2.50	3.00
Square meters	1.00	1.00	1.00	1.00
Electrical outlet	-	-	-	-
<i>Comparison</i>	4.00	4.00	4.00	4.00
Own usage	4.00	4.00	4.00	4.00
Usage of others	2.00	3.00	2.50	3.00
Mean	1.00	1.00	1.00	1.00

Standard	-	-	-	-
Target	-	-	-	-
<i>Comparison with own usage</i>				
Three years	1.00	1.00	1.00	1.00
Last year	3.00	3.00	3.00	3.00
Season	1.00	1.00	1.00	1.00
Quarter	2.00	1.00	1.50	2.00
Last month	1.00	1.00	1.00	1.00
Period	2.00	1.00	1.50	2.00
Mean	-	-	-	-
Group	-	-	-	-
Take into account variables	1.00	2.00	1.50	2.00
<i>Comparison with others</i>				
Country average	-	-	-	-
External	1.00	1.00	1.00	1.00
Internal	2.00	3.00	2.50	3.00
Others in the same building	-	-	-	-
Anonymous	-	-	-	-
<i>Looking back</i>	<i>2.00</i>	<i>3.00</i>	<i>2.50</i>	<i>3.00</i>
Everything	1.00	1.00	1.00	1.00
Five years	2.00	3.00	2.50	3.00
Two to three years	2.00	1.00	1.50	2.00
One year	2.00	3.00	2.50	3.00
Per quarter	1.00	1.00	1.00	1.00
<i>Direct</i>	<i>4.00</i>	<i>4.00</i>	<i>4.00</i>	<i>4.00</i>
<i>Indirect</i>	<i>1.00</i>	<i>2.00</i>	<i>1.50</i>	<i>2.00</i>
<i>Frequency</i>				
Free to choose	1.00	1.00	1.00	1.00
On request	1.00	1.00	1.00	1.00
Once a year	1.00	1.00	1.00	1.00
Once a quarter	2.00	1.00	1.50	2.00
Once a month	2.00	1.00	1.50	2.00
Once a week	2.00	1.00	1.50	2.00
Once a day	1.00	1.00	1.00	1.00
Multiple times a day	-	-	-	-
With every actions	-	-	-	-
<i>Own contributions / other</i>				
Edit information	1.00	2.00	1.50	2.00
Stimulate	-	-	-	-
Take into account company. function and user	-	-	-	-
Database	1.00	1.00	1.00	1.00
Calculation examples	1.00	1.00	1.00	1.00
Concrete feedback	2.00	3.00	2.50	3.00

Table 8. MoSCoW scores for both the strength of quotations and participants per requirement for design of the feedback combined into a final MoSCoW score.

Requirement	Strength of quotation	Participant per requirement	Average	Combined MoSCoW
<i>Medium</i>				
Computer	1.00	1.00	1.00	1.00
Mobile phone	1.00	1.00	1.00	1.00
Program	1.00	1.00	1.00	1.00
E-mail	2.00	3.00	2.50	3.00
Monitor	1.00	1.00	1.00	1.00
Application	1.00	2.00	1.50	2.00
Written	1.00	1.00	1.00	1.00
Online	1.00	1.00	1.00	1.00
Website	1.00	1.00	1.00	1.00
Free to choose	-	-	-	-
Central	-	-	-	-
Universal	-	-	-	-
Push feedback	2.00	1.00	1.50	2.00
User depending	-	-	-	-
<i>Influence the medium</i>	<i>1.00</i>	<i>3.00</i>	<i>2.00</i>	<i>2.00</i>
Standard format	2.00	3.00	2.50	3.00
<i>Influence of display</i>	<i>1.00</i>	<i>2.00</i>	<i>1.50</i>	<i>2.00</i>
Moving elements	1.00	1.00	1.00	1.00
Colour	1.00	1.00	1.00	1.00
Clicking through	1.00	1.00	1.00	1.00
Font	1.00	1.00	1.00	1.00
<i>Simulate</i>	<i>4.00</i>	<i>4.00</i>	<i>4.00</i>	<i>4.00</i>
Before	3.00	3.00	3.00	3.00
Afterwards	1.00	2.00	1.50	2.00
Positive	1.00	1.00	1.00	1.00
Negative	1.00	1.00	1.00	1.00
Advice/tip	3.00	3.00	3.00	3.00
<i>Intervene</i>	<i>3.00</i>	<i>4.00</i>	<i>3.50</i>	<i>4.00</i>
Boundary internally set	3.00	4.00	3.50	4.00
Boundary externally set	1.00	1.00	1.00	1.00
Intervene themselves	1.00	1.00	1.00	1.00
Notification	4.00	4.00	4.00	4.00
<i>Switch devices on/off</i>	<i>3.00</i>	<i>2.00</i>	<i>2.50</i>	<i>3.00</i>
<i>Own contributions / other</i>				
Intelligence	-	-	-	-

Table 9. MoSCoW scores for both the strength of quotations and participants per requirement for the display of feedback combined into a final MoSCoW score.

Requirement	Strength of quotation	Participant per requirement	Average	Combined MoSCoW
<i>General</i>				
Graphics	3.00	3.00	3.00	3.00
Pie chart	1.00	1.00	1.00	1.00
Line chart	1.00	1.00	1.00	1.00
Bar graph	1.00	1.00	1.00	1.00
Image	1.00	1.00	1.00	1.00
Table	3.00	3.00	3.00	3.00
Colour	1.00	1.00	1.00	1.00
Text	1.00	1.00	1.00	1.00
Numbers	-	-	-	-
Dashboard	1.00	1.00	1.00	1.00
Zoom in/out	-	-	-	-
Clicking through	1.00	1.00	1.00	1.00
<i>Usage</i>				
Bar graph	2.00	2.00	2.00	2.00
Line chart	2.00	3.00	2.50	3.00
<i>Savings</i>				
Bar graph	2.00	2.00	2.00	2.00
Line chart	2.00	2.00	2.00	2.00
Dashboard	-	-	-	-
Text	1.00	1.00	1.00	1.00
<i>Breaking down</i>				
Dropdown menu	1.00	1.00	1.00	1.00
Bar graph	2.00	1.00	1.50	2.00
Pie chart	3.00	4.00	3.50	4.00
Table	1.00	1.00	1.00	1.00
Text	1.00	1.00	1.00	1.00
Line chart	2.00	1.00	1.50	2.00
<i>Comparison</i>				
Line chart	2.00	1.00	1.50	2.00
Bar graph	3.00	3.00	3.00	3.00
Footprint	1.00	1.00	1.00	1.00
Pie chart	1.00	1.00	1.00	1.00
<i>Looking back</i>				
Bar graph	2.00	2.00	2.00	2.00
Line chart	2.00	1.00	1.50	2.00
Text with chart	1.00	1.00	1.00	1.00
Graph	1.00	1.00	1.00	1.00

## Appendix I: Tables for persona ‘environmentalist’

Table 1. Strength of quotations per participants per requirement for the content of the feedback. The scores range from -2 (very negative) to 2 (very positive). When a participant did not say anything at all a score of 0 was assigned. A \* stands for a requirement mentioned in the top 3 or 5 most important requirements.

Requirement	Strength of quotations									
	3	4	5	6	8	10	12	15	Average	MoSCoW
<i>Usage</i>	2	2	2	2	1*	2	2*	1*	1.75	4
Only in comparison	0	0	0	2	0	0	0	2	0.50	1
Euro’s kWh	2	1	2	2	2	2	2	-1	1.50	3
CO2	0	2	2	0	2	0	2	1	1.13	3
Metaphor	0	0	0	0	0	0	0	2	0.25	1
<i>Savings</i>	2	2	2	2	2	2*	2*	2	2.00	4
Euro’s kWh	2	0	2	2	2	2	2	0	1.50	3
CO1	0	2	2	0	2	0	0	2	1.00	2
Metaphor	0	2	0	2	2	0	0	0	0.75	2
Other	2	0	-1	0	-1	-1	-1	1	-0.13	1
<i>Breaking down</i>	0	0	0	2	2	0	0	0	0.50	1
Whole building	2	2	2	2	2*	2	2	2*	2.00	4
Location	0	0	0	0	0	0	0	0	-	-
Wing	0	2	0	0	0	0	0	0	0.25	1
Floor	0	0	0	0	0	0	0	2	0.25	1
Department	0	0	0	0	2	0	-2	2	0.50	1
Space	0	0	2	2	0	0	0	0	0.50	1
Office	0	2	0	1	0	2	2	-2	0.63	2
Group	0	0	0	2	0	0	0	0	0.25	1
Person	0	0	2	2	0	0	0	2	0.75	2
Device	0	0	0	0	2	0	0	0	0.25	1
Square meters	2	0	1	0	2	0	2	0	0.88	2
Electrical outlet	0	0	0	0	0	0	0	0	-	-
<i>Comparison</i>	0	0	0	0	0	0	0	2	0.25	1
Own usage	2*	2	2	2	1*	2	2	2*	1.88	4
Usage of others	2	1	2	2	2	2	1	1	1.63	4
Mean	2	1	2	2	2	2	2	-1	1.50	3
Standard	0	1	0	0	0	0	0	0	0.13	1
Target	0	0	0	2	0	0	0	0	0.25	1
<i>Comparison with own usage</i>	0	0	0	0	0	0	0	0	-	-
Three years	0	0	0	0	0	0	0	0	-	-
Last year	2	1	0	0	2	2	0	2	1.13	3
Season	0	0	0	0	0	0	0	0	-	-
Quarter	0	0	0	0	0	0	0	0	-	-
Last month	0	0	0	0	2	0	2	0	0.50	1
Period	0	1	0	0	0	0	2	0	0.38	1
Mean	2	0	2	0	0	0	0	2	0.75	2

Group	0	2	0	0	0	0	0	0	0.25	1
Take into account variables	2	-1	2	1	-1	0	2	0	0.71	2
<i>Comparison with others</i>										
Country average	0	0	0	2	0	0	0	0	0.25	1
External	0	1	1	0	1	-2	2	0	0.36	1
Internal	0	0	0	0	0	2	0	0	0.25	1
Others in the same building	0	1	2	0	2	2	0	0	0.88	2
Anonymous	0	0	2	0	-2	1	0	0	0.00	1
<i>Looking back</i>	<i>0</i>	<i>2</i>	<i>1</i>	<i>2</i>	<i>2</i>	<i>2</i>	<i>0</i>	<i>0</i>	<i>1.13</i>	<i>3</i>
Everything	2	0	2	2	2	0	2	0	1.25	3
Five years	0	0	0	0	0	0	0	0	-	-
Two to three years	0	2	0	0	0	0	0	0	0.25	1
One year	0	0	0	0	2	2	2	2	1.00	2
Quarter	0	0	0	0	0	0	0	0	-	-
<i>Direct</i>	<i>2</i>	<i>1</i>	<i>1</i>	<i>2</i>	<i>2</i>	<i>1</i>	<i>2</i>	<i>0</i>	<i>1.86</i>	<i>4</i>
<i>Indirect</i>	<i>0</i>	<i>1</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>2</i>	<i>0.50</i>	<i>1</i>
<i>Frequency</i>										
Free to choose	0	0	0	0	1	0	0	0	0.13	1
On request	2	0	0	0	1	0	0	0	0.38	1
Once a year	0	0	0	0	0	0	0	0	-	-
Once a quarter	0	0	0	0	0	0	0	0	-	-
Once a month	2	0	0	2	0	0	0	0	0.50	1
Once a week	0	-1	0	2	2	0	2*	2	0.88	2
Once a day	0	2	2	-2	0	2	2*	0	0.75	2
Multiple times a day	0	-2	0	0	0	0	2	0	0.00	1
With every actions	0	-2	0	0	0	-2	0	0	-0.50	1
<i>Own contributions / other</i>										
Edit information	0	0	2	2	0	0	1	0	0.63	2
Stimulate	0	2	0	0	0	2*	2	0	0.75	2
Take into account company. function and user	0	2	2	2	2	0	0	0	1.00	2
Database	0	1	0	0	0	0	0	0	0.13	1
Calculation examples	0	0	0	0	0	0	0	0	-	-
Concrete feedback	0	2	0	2*	0	2*	0	2	1.00	2

Table 2. Strength of quotations per participants per requirement for the design of the feedback. The scores range from -2 (very negative) to 2 (very positive). When a participant did not say anything at all a score of 0 was assigned. A \* stands for a requirement mentioned in the top 3 or 5 most important requirements.

Requirement	Strength of quotations									
	3	4	5	6	8	10	12	15	Average	MoSCoW
<i>Medium</i>										
Computer	0	1	0	0	0	2	0	2	0.63	2
Mobile phone	0	0	0	0	0	-1	0	2	0.13	1
Program	0	0	0	0	0	1	0	0	0.13	1
E-mail	0	0	1	0	0	-2	0	2	0.13	1
Monitor	2*	0	0	0	0	0	0	0	0.25	1

Application	0	0	2	2	2*	0	2	0	1.00	2
Written	0	0	0	0	0	0	0	0	-	-
Online	0	0	2	2	2	0	0	0	0.75	2
Website	0	0	0	2	2	0	2	0	0.75	2
Free to choose	0	0	0	0	0	1	0	0	0.13	1
Central	0	2	0	0	0	0	0	0	0.25	1
Universal	0	0	2	0	0	0	0	0	0.25	1
Push feedback	0	0	0	2	0	0	0	0	0.25	1
User depending	0	0	0	0	2	0	0	0	0.25	1
<i>Influence the medium</i>		1	1	-2	-1	1	1	-1	0.00	1
Standard format	0	0	0	2	2	0	1	2	0.88	2
<i>Influence of display</i>	1	1	1	0	0	2	-2	-1	0.25	1
Moving elements	0	0	1	0	0	2	0	0	0.38	1
Colour	0	0	0	0	-1	-2	0	0	-0.38	1
Clicking through	2	2	0	0	0	0	0	0	0.50	1
Font	0	0	0	0	0	0	0	0	-	-
<i>Simulate</i>	2	2	2	2	1	2	2	-1	1.50	3
Before	1	2	0	2	1	0	2	1	1.13	3
Afterwards	0	2	-2	2	1	2	0	1	0.75	2
Positive	0	0	2	0	0	2	0	0	0.50	1
Negative	0	0	0	0	-1	0	0	0	0.13	1
Advice/tip	2	2	1	2	0	0	2	2	1.38	3
<i>Intervene</i>	2	-2	2	1	2	2	2	1	1.25	3
Boundary internally set	1	0	1	0	2	1	0	1	0.75	2
Boundary externally set	0	0	1	0	0	0	2	1	0.50	1
Intervene themselves	2	0	0	2	0	1	2	0	0.88	2
Notification	2	0	2*	2	0	0	2	2	1.25	3
<i>Switch devices on/off</i>	0	0	2	0	2	0	2	2	1.00	2
<i>Own contributions / other</i>										
Intelligence	2	0	1	2	2	0	0	0	0.88	2

Table 3. Strength of quotations per participants per requirement for the display of the feedback. The scores range from -2 (very negative) to 2 (very positive). When a participant did not say anything at all a score of 0 was assigned. A \* stands for a requirement mentioned in the top 3 or 5 most important requirements.

Requirement	Strength of quotations									
	3	4	5	6	8	10	12	15	Average	MoSCoW
<i>General</i>										
Graphics	2	2	0	2	2	2	2*	2	1.75	4
Pie chart	0	2	0	-2	0	0	-1	0	-0.13	1
Line chart	0	0	0	-1	0	0	0	0	-0.13	1
Bar graph	0	0	0	2	0	0	0	0	0.25	1
Image	0	0	0	2	2	0	0	0	0.50	1
Table	0	0	0	0	0	0	2	0	0.25	1
Colour	0	0	0	0	2	0	0	0	0.25	1
Text	0	-1	0	0	0	0	-2	0	-0.38	1
Numbers	0	0	0	0	0	0	-2	0	-0.25	1
Dashboard	0	0	2	2	0	0	0	0	0.50	1

Zoom in/out	0	0	0	2*	0	0	0	0	0.25	1
Clicking through	0	0	0	0	0	0	2	0	0.25	1
<i>Usage</i>										
Bar graph	0	0	0	2	2	2	2	0	1.00	2
Line chart	2	0	0	0	0	0	0	1	0.38	1
<i>Savings</i>										
Bar graph	0	0	0	2	0	2	0	0	0.50	1
Line chart	0	0	0	0	0	0	2	2	0.50	1
Dashboard	0	0	0	2	0	0	0	0	0.25	1
Text	0	0	0	0	0	0	0	0	-	-
<i>Breaking down</i>										
Dropdown menu	2	0	0	1	2	2	0	0	0.88	2
Bar graph	0	0	0	0	2	-1	0	2	0.38	1
Pie chart	2	2	0	0	2	0	2	0	1.00	2
Table	2	0	0	0	-2	0	2	0	0.25	1
Text	0	0	0	0	0	0	0	0	-	-
Line chart	0	0	0	0	0	0	0	0	-	-
<i>Comparison</i>										
Line chart	0	1	0	0	0	2	2	0	0.63	2
Bar graph	0	1	0	2	2	2	2	2	1.38	3
Footprint	0	0	0	0	0	0	0	0	-	-
Pie chart	0	0	0	0	0	0	0	0	-	-
<i>Looking back</i>										
Bar graph	0	0	0	0	0	2	0	0	0.25	1
Line chart	0	0	0	0	0	0	2	2	0.50	1
Text with chart	0	0	0	0	0	0	0	0	-	-
Graph	0	0	0	0	0	0	0	0	-	-

Table 4. Number of participants that spoke about a requirement for the content of the feedback. The scores range from -1 (said something negative) to 1 (said something positive). When a participant did not say anything at all, a score of 0 was assigned. Negative quotations were not included in the calculation of the MoSCoW score.

Requirement	Participant per requirement								Number	MoSCoW
	3	4	5	6	8	10	12	15		
<i>Usage</i>	1	1	1	1	1	1	1	1	8	4
Only in comparison	0	0	0	1	0	0	0	1	2	1
Euro's kWh	1	1	1	1	1	1	1	-1	7	4
CO2	0	1	1	0	1	0	1	1	4	2
Metaphor	0	1	0	1	1	-1	1	0	3	2
Metaphor	0	0	0	0	0	0	0	1	1	1
<i>Savings</i>										
Euro's kWh	1	0	1	1	1	1	1	0	6	3
CO1	0	1	1	0	1	0	0	1	4	2
Metaphor	0	1	0	1	1	0	0	0	3	2
Other	1	0	-1	0	-1	-1	-1	1	2	1
Other	0	0	0	1	1	0	0	0	2	1
<i>Breaking down</i>										
Whole building	1	1	1	1	1	1	1	1	8	4
Whole building	0	0	0	0	0	0	0	0	-	-

Location	0	1	0	0	0	0	0	0	1	1
Wing	0	0	0	0	0	0	0	1	1	1
Floor	0	0	0	0	1	0	1	1	3	2
Department	0	0	1	1	0	0	0	0	2	1
Space	0	1	0	1	0	1	1	1	5	3
Office	0	0	0	1	0	0	0	0	1	1
Group	0	0	1	1	0	0	0	1	3	2
Person	0	0	0	0	1	0	0	0	1	1
Device	1	0	1	0	1	0	1	0	4	2
Square meters	0	0	0	0	0	0	0	0	-	-
Electrical outlet	0	0	0	0	0	0	0	1	1	1
<i>Comparison</i>	<i>1</i>	<i>8</i>	<i>4</i>							
Own usage	1	1	1	1	1	1	1	1	8	4
Usage of others	1	1	1	1	1	1	1	-1	7	4
Mean	0	1	0	0	0	0	0	0	1	1
Standard	0	0	0	1	0	0	0	0	1	1
Target	0	0	0	0	0	0	0	1	1	1
<i>Comparison with own usage</i>										
Three years	0	0	0	0	0	0	0	0	-	-
Last year	1	1	0	0	1	1	0	1	5	3
Season	0	0	0	0	0	0	0	0	-	-
Quarter	0	0	0	0	0	0	0	0	-	-
Last month	0	0	0	0	1	0	1	0	2	1
Period	0	1	0	0	0	0	1	0	2	1
Mean	1	0	1	0	0	0	0	1	3	2
Group	0	1	0	0	0	0	0	0	1	1
Take into account variables	1	-1	1	1	-1	0	1	0	4	2
<i>Comparison with others</i>										
Country average	0	0	0	1	0	0	0	0	1	1
External	0	1	1	0	1	1	1	0	5	3
Internal	0	1	1	0	1	1	0	0	4	2
Others in the same building	0	0	0	0	0	1	0	0	1	1
Anonymous	0	0	1	0	-1	0	0	0	1	1
<i>Looking back</i>	<i>1</i>	<i>8</i>	<i>4</i>							
Everything	1	0	1	1	1	0	1	0	5	3
Five years	0	0	0	0	0	0	0	0	-	-
Two to three years	0	1	0	0	0	0	0	0	1	1
One year	0	0	0	0	1	1	1	1	4	2
Quarter	0	0	0	0	0	0	0	0	-	-
<i>Direct</i>	<i>1</i>		<i>7</i>	<i>4</i>						
<i>Indirect</i>	<i>0</i>	<i>1</i>	<i>1</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>1</i>	<i>3</i>	<i>2</i>
<i>Frequency</i>										
Free to choose	0	0	0	0	1	0	0	0	1	1
On request	1	0	0	0	1	0	0	0	2	1
Once a year	0	0	0	0	0	0	0	0	-	-
Once a quarter	0	0	0	0	0	0	0	0	-	-
Once a month	1	0	0	1	0	0	0	0	2	1
Once a week	0	-1	0	1	1	0	1	1	4	2
Once a day	0	1	1	1	0	1	1	0	5	3

Multiple times a day	0	1	0	0	0	0	1	0	2	1
With every actions	0	1	0	0	0	1	0	0	2	1
<i>Own contributions / other</i>										
Edit information	0	0	1	1	0	0	1	0	3	2
Stimulate	0	1	0	0	0	1	1	0	3	2
Take into account company. function and user	0	1	1	1	1	0	0	0	4	2
Database	0	1	0	0	0	0	0	0	1	1
Calculation examples	0	0	0	0	0	0	0	0	-	-
Concrete feedback	0	1	0	1	0	1	0	1	4	2

Table 5. Number of participants that spoke about a requirement for the design of the feedback. The scores range from -1 (said something negative) to 1 (said something positive). When a participant did not say anything at all, a score of 0 was assigned. Negative quotations were not included in the calculation of the MoSCoW score.

Requirement	Participant per requirement								Number	MoSCoW
	3	4	5	6	8	10	12	15		
<i>Medium</i>										
Computer	0	1	0	0	0	1	0	1	3	2
Mobile phone	0	0	0	0	0	-1	0	1	1	1
Program	0	0	0	0	0	1	0	0	1	1
E-mail	0	0	1	0	0	1	0	1	3	2
Monitor	1	0	0	0	0	0	0	0	1	1
Application	0	0	1	1	1	0	1	0	4	2
Written	0	0	0	0	0	0	0	0	-	-
Online	0	0	1	1	1	0	0	0	3	2
Website	0	0	0	1	1	0	1	0	3	2
Free to choose	0	0	0	0	0	1	0	0	1	1
Central	0	1	0	0	0	0	0	0	1	1
Universal	0	0	1	0	0	0	0	0	1	1
Push feedback	0	0	0	1	0	0	0	0	1	1
User depending	0	0	0	0	1	0	0	0	1	1
<i>Influence the medium</i>	0	1	1	1	-1	1	1	-1	5	3
Standard format	0	0	0	1	1	0	1	1	4	2
<i>Influence of display</i>	1	1	1	0	0	1	1	-1	5	3
Moving elements	0	0	1	0	0	1	0	0	2	1
Colour	0	0	0	0	-1	1	0	0	1	1
Clicking through	1	1	0	0	0	0	0	0	2	1
Font	0	0	0	0	0	0	0	0	-	-
<i>Simulate</i>	1	1	1	1	1	1	1	-1	7	4
Before	1	1	0	1	1	0	1	1	6	3
Afterwards	0	1	1	1	1	1	0	1	6	3
Positive	0	0	1	0	0	1	0	0	2	1
Negative	0	0	0	0	-1	0	0	0	0	1
Advice/tip	1	1	1	1	0	0	1	1	6	3
<i>Intervene</i>	1	1	1	1	1	1	1	1	8	4

Boundary internally set	1	0	1	0	1	1	0	1	5	3
Boundary externally set	0	0	1	0	0	0	1	1	3	2
Intervene themselves	1	0	0	1	0	1	1	0	4	2
Notification	1	0	1	1	0	0	1	1	5	3
Switch devices on/off	0	0	1	0	1	0	1	1	4	2
Own contributions / other										
Intelligence	1	0	1	1	1	0	0	0	4	2

Table 6. Number of participants that spoke about a requirement for the display of the feedback. The scores range from -1 (said something negative) to 1 (said something positive). When a participant did not say anything at all, a score of 0 was assigned. Negative quotations were not included in the calculation of the MoSCoW score.

Requirement	Strength of quotations								Number	MoSCoW
	3	4	5	6	8	10	12	15		
<i>General</i>										
Graphics	1	1	0	1	1	1	1	1	7	4
Pie chart	0	1	0	1	0	0	-1	0	2	1
Line chart	0	0	0	-1	0	0	0	0	0	1
Bar graph	0	0	0	1	0	0	0	0	1	1
Image	0	0	0	1	1	0	0	0	2	1
Table	0	0	0	0	0	0	1	0	1	1
Colour	0	0	0	0	1	0	0	0	1	1
Text	0	-1	0	0	0	0	1	0	1	1
Numbers	0	0	0	0	0	0	1	0	1	1
Dashboard	0	0	1	1	0	0	0	0	2	1
Zoom in/out	0	0	0	1	0	0	0	0	1	1
Clicking through	0	0	0	0	0	0	1	0	1	1
<i>Usage</i>										
Bar graph	0	0	0	1	1	1	1	0	4	2
Line chart	1	0	0	0	0	0	0	1	2	1
<i>Savings</i>										
Bar graph	0	0	0	1	0	1	0	0	2	1
Line chart	0	0	0	0	0	0	1	1	2	1
Dashboard	0	0	0	1	0	0	0	0	1	1
Text	0	0	0	0	0	0	0	0	-	-
<i>Breaking down</i>										
Dropdown menu	1	0	0	1	1	1	0	0	4	2
Bar graph	0	0	0	0	1	-1	0	1	2	1
Pie chart	1	1	0	0	1	0	1	0	4	2
Table	1	0	0	0	1	0	1	0	3	2
Text	0	0	0	0	0	0	0	0	-	-
Line chart	0	0	0	0	0	0	0	0	-	-
<i>Comparison</i>										
Line chart	0	1	0	0	0	1	1	0	3	2
Bar graph	0	1	0	1	1	1	1	1	6	3
Footprint	0	0	0	0	0	0	0	0	-	-
Pie chart	0	0	0	0	0	0	0	0	-	-
<i>Looking back</i>										

Bar graph	0	0	0	0	0	1	0	0	1	1
Line chart	0	0	0	0	0	0	1	1	2	1
Text with chart	0	0	0	0	0	0	0	0	-	-
Graph	0	0	0	0	0	0	0	0	-	-

Table 7. MoSCoW scores for both the strength of quotations and participants per requirement for the content of feedback combined into a final MoSCoW score.

Requirement	Strength of quotation	Participant per requirement	Average	Combined MoSCoW
<i>Usage</i>	4.00	4.00	4.00	4.00
Only in comparison	1.00	1.00	1.00	1.00
Euro's	3.00	4.00	3.50	4.00
kWh	3.00	2.00	2.50	3.00
CO2	2.00	2.00	2.00	2.00
Metaphor	1.00	1.00	1.00	1.00
<i>Savings</i>	4.00	4.00	4.00	4.00
Euro's	3.00	3.00	3.00	3.00
kWh	2.00	2.00	2.00	2.00
CO2	2.00	2.00	2.00	2.00
Metaphor	1.00	1.00	1.00	1.00
Other	1.00	1.00	1.00	1.00
<i>Breaking down</i>	4.00	4.00	4.00	4.00
Whole building	-	-	-	-
Location	1.00	1.00	1.00	1.00
Wing	1.00	1.00	1.00	1.00
Floor	1.00	2.00	1.50	2.00
Department	1.00	1.00	1.00	1.00
Space	2.00	3.00	2.50	3.00
Office	1.00	1.00	1.00	1.00
Group	2.00	2.00	2.00	2.00
Person	1.00	1.00	1.00	1.00
Device	2.00	2.00	2.00	2.00
Square meters	-	-	-	-
Electrical outlet	1.00	1.00	1.00	1.00
<i>Comparison</i>	4.00	4.00	4.00	4.00
Own usage	4.00	4.00	4.00	4
Usage of others	3.00	4.00	3.50	4
Mean	1.00	1.00	1.00	1
Standard	1.00	1.00	1.00	1
Target	1.00	1.00	1.00	1
<i>Comparison with own usage</i>				
Three years	-	-	-	-
Last year	3.00	3.00	3.00	3.00
Season	-	-	-	-
Quarter	-	-	-	-
Last month	1.00	1.00	1.00	1.00
Period	1.00	1.00	1.00	1.00

Mean	2.00	2.00	2.00	2.00
Group	1.00	1.00	1.00	1.00
Take into account variables	2.00	2.00	2.00	2.00
<i>Comparison with others</i>				
Country average	1.00	1.00	1.00	1.00
External	1.00	3.00	2.00	2.00
Internal	1.00	2.00	1.50	2.00
Others in the same building	2.00	1.00	1.50	2.00
Anonymous	1.00	1.00	1.00	1.00
<i>Looking back</i>				
Everything	3.00	3.00	3.00	3.00
Five years	-	-	-	-
Two to three years	1.00	1.00	1.00	1.00
One year	2.00	2.00	2.00	2.00
Quarter	-	-	-	-
<i>Direct</i>				
Indirect	1.00	2.00	1.50	2.00
<i>Frequency</i>				
Free to choose	1.00	1.00	1.00	1.00
On request	1.00	1.00	1.00	1.00
Once a year	-	-	-	-
Once a quarter	-	-	-	-
Once a month	1.00	1.00	1.00	1.00
Once a week	2.00	2.00	2.00	2.00
Once a day	2.00	3.00	2.50	3.00
Multiple times a day	1.00	1.00	1.00	1.00
With every action	1.00	1.00	1.00	1.00
<i>Own contributions / other</i>				
Edit information	2.00	2.00	2.00	2.00
Stimulate	2.00	2.00	2.00	2.00
Take into account company. function and user	2.00	2.00	2.00	2.00
Database	1.00	1.00	1.00	1.00
Calculation examples	-	-	-	-
Concrete feedback	2.00	2.00	2.00	2.00

Table 8. MoSCoW scores for both the strength of quotations and participants per requirement for design of the feedback combined into a final MoSCoW score.

Requirement	Strength of quotation	Participant per requirement	Average	Combined MoSCoW
<i>Medium</i>				
Computer	2.00	2.00	2.00	2.00
Mobile phone	1.00	1.00	1.00	1.00
Program	1.00	1.00	1.00	1.00

E-mail	1.00	2.00	1.50	2.00
Monitor	1.00	1.00	1.00	1.00
Application	2.00	2.00	2.00	2.00
Written	-	-	-	-
Online	2.00	2.00	2.00	2.00
Website	2.00	2.00	2.00	2.00
Free to choose	1.00	1.00	1.00	1.00
Central	1.00	1.00	1.00	1.00
Universal	1.00	1.00	1.00	1.00
Push feedback	1.00	1.00	1.00	1.00
User depending	1.00	1.00	1.00	1.00
<i>Influence the medium</i>	<i>1.00</i>	<i>3.00</i>	<i>2.00</i>	<i>2.00</i>
Standard format	2.00	2.00	2.00	2.00
<i>Influence of display</i>	<i>1.00</i>	<i>3.00</i>	<i>2.00</i>	<i>2.00</i>
Moving elements	1.00	1.00	1.00	1.00
Colour	1.00	1.00	1.00	1.00
Clicking through	1.00	1.00	1.00	1.00
Font	-	-	-	-
<i>Simulate</i>	<i>3.00</i>	<i>4.00</i>	<i>3.50</i>	<i>4.00</i>
Before	3.00	3.00	3.00	3.00
Afterwards	2.00	3.00	2.50	3.00
Positive	1.00	1.00	1.00	1.00
Negative	1.00	1.00	1.00	1.00
Advice/tip	3.00	3.00	3.00	3.00
<i>Intervene</i>	<i>3.00</i>	<i>4.00</i>	<i>3.50</i>	<i>4.00</i>
Boundary internally set	2.00	3.00	2.50	3.00
Boundary externally set	1.00	2.00	1.50	2.00
Intervene themselves	2.00	2.00	2.00	2.00
Notification	3.00	3.00	3.00	3.00
<i>Switch devices on/off</i>	<i>2.00</i>	<i>2.00</i>	<i>2.00</i>	<i>2.00</i>
<i>Own contributions / other</i>				
<i>Intelligence</i>	<i>2.00</i>	<i>2.00</i>	<i>2.00</i>	<i>2.00</i>

Table 9. MoSCoW scores for both the strength of quotations and participants per requirement for the display of feedback combined into a final MoSCoW score.

	Quote	Requirements	Total	Combined MoSCoW
<i>General</i>				
Graphics	4.00	4.00	4.00	4.00
Pie chart	1.00	1.00	1.00	1.00
Line chart	1.00	1.00	1.00	1.00
Bar graph	1.00	1.00	1.00	1.00
Image	1.00	1.00	1.00	1.00
Table	1.00	1.00	1.00	1.00
Colour	1.00	1.00	1.00	1.00

Text	1.00	1.00	1.00	1.00
Numbers	1.00	1.00	1.00	1.00
Dashboard	1.00	1.00	1.00	1.00
Zoom in/out	1.00	1.00	1.00	1.00
Clicking through	1.00	1.00	1.00	1.00
<i>Usage</i>				
Bar graph	2.00	2.00	2.00	2.00
Line chart	1.00	1.00	1.00	1.00
<i>Savings</i>				
Bar graph	1.00	1.00	1.00	1.00
Line chart	1.00	1.00	1.00	1.00
Dashboard	1.00	1.00	1.00	1.00
Text	-	-	-	-
<i>Breaking down</i>				
Dropdown menu	2.00	2.00	2.00	2.00
Bar graph	1.00	1.00	1.00	1.00
Pie chart	2.00	2.00	2.00	2.00
Table	1.00	2.00	1.50	2.00
Text	-	-	-	-
Line chart	-	-	-	-
<i>Comparison</i>				
Line chart	2.00	2.00	2.00	2.00
Bar graph	3.00	3.00	3.00	3.00
Footprint	-	-	-	-
Pie chart	-	-	-	-
<i>Looking back</i>				
Bar graph	1.00	1.00	1.00	1.00
Line chart	1.00	1.00	1.00	1.00
Text with chart	-	-	-	-
Graph	-	-	-	-

## Appendix J: MoSCoW tables with requirements for persona ‘money saver’

Table 1. Overview of all the requirements for the content of the feedback ordered from must have to won't have for persona ‘money saver’.

User requirement	Motivation	Implications
<p>Display energy usage</p> <hr/> <p>Display in euro's</p> <p>Display in kWh</p> <p>Display in CO2</p> <p>Display as a metaphor</p> <p>Only in comparison</p>	<p>People are not aware of their current usage and wish to become familiar and aware of it.</p> <p>If usage is shown in the feedback they can retrace the effects behaviour has on it.</p> <p>Usage must be displayed even if it is not compared with other data. Almost all the subjects find displaying usage one of the most important parts of the feedback.</p>	<p>Usage must be displayed in euro's, and should be displayed kWh and CO2. Displaying usage in a metaphor could also be an option.</p>
<p>Display savings made in the past</p> <hr/> <p>Display in euro's</p> <p>Display in kWh</p> <p>Display in CO2</p> <p>Display as a metaphor</p>	<p>People wish to see their savings as it serves as a way to become aware how to save energy, and it stimulates as one can see the results of one's actions. Three of the subjects indicate savings to be in the top three of most important parts of feedback.</p>	<p>Savings must be displayed in euro's, while displaying it in kWh, CO2 and a metaphor could be an option.</p>
<p>Break down the feedback</p> <hr/> <p>Device</p> <p>Location</p> <p>Floor</p> <p>Space</p> <p>Group</p> <p>Whole building</p>	<p>Subjects differ a lot in the way they want the feedback to be broken down as they all work in different buildings with different characteristics.</p> <p>Therefore they all have different wishes about what is a desirable way to break feedback down</p>	<p>Present the feedback anyhow per device. Also, by breaking down the feedback, take into account the different characteristics of the buildings and the companies.</p>

Department Office Person Square meters	and how specific this should be.	
Make comparisons with own usage Last year Quarter Period Take into account variables Last month Season Three years	Subjects find it useful to see their own previous usage and find that this information can be used to save more energy.	A comparison of own current usage with the usage in the last year should be included. Comparisons with a previous quarter or period could be included. All the other options don't have to be included.
Direct feedback	Feedback should be given in a direct manner as this results in seeing effects more directly so that one can respond and steer directly to save energy. One person indicates this is one of the most important parts of the feedback.	Make it possible to see every action directly in the feedback without giving a notification
Give feedback frequent Once per quarter Once per month Once per week Once per day Once per year On request Free to choose	Subjects have diverse needs when it comes to frequency. They have different boundaries for what they experience as annoying. For some subjects once a quarter is enough, while others want more frequent feedback, such as once a week.	As the subjects differ much in their wishes for frequency, it should be made possible for users to choose their own frequency.
Make comparisons with others Internal External	A comparison with others should be made so one can see how one's energy usage is compared to others.	Internal comparisons, within a company (between employees) should be an option, while external comparisons, between

		companies, could be an option.
Looking back	Some subjects want to look back five years as this is long enough to see some history and at the same time the information stays meaningful. Other subjects want to look back for one year as they find feedback from further back is not meaningful anymore. One person even finds this one of the most important parts of the feedback.	Make sure that subjects can look back at least five years on their feedback.
Five years		
One year		
Two to three years		
Everything		
Per quarter		
Concrete feedback	Subjects wish the feedback to be concrete in that one receives easy and simple feedback that is applicable on their own situation. They want their feedback to be short and sweet.	Give subjects information about their behaviour and feedback that is useful and applicable for them and their situation.
Edit information	Subjects want to change the information that is given to them in the feedback, for example make a selection in the feedback.	Give subjects the possibility to change the information such as a configuration option.
Indirect feedback	Some subjects wish to see their feedback in an indirect way as they think they do not will look continuously at the feedback to see the effects of their actions.	Make sure that the feedback can also be given indirect for the persons that don't want their feedback directly.
Create database	One subject wishes to see a coupling between a database and the feedback so that one can see important moments in the feedback.	Use a database in which notations can be made and linked to the feedback. Show a little mark in the feedback for a notation that is made in the

		database.
Calculation examples	One subject indicated that he wishes to see calculation examples as it helps to save energy.	Provide calculation examples to show users what they could do to save energy and what it produces for the user.
Compare own usage to mean	One subject indicated that a comparison with a mean is not useful as one does not know what the mean consists of.	When comparing own usage or savings with oneself or others, do not make a comparison with a mean.

Note: As there must be a frequency to give the feedback, this is considered as a must have although this is not per se said by the subjects.

Table 2. Overview of all the requirements for the design of the feedback ordered from must have to won't have for persona 'money saver'.

User requirement	Motivation	Implications
Medium	Subjects wish to receive their feedback by e-mail as it gives them the possibility to determine themselves when they want to look into the feedback. Further, subjects would like to see an application as by using it, feedback is always available. Also, some of the subjects want the medium to push the feedback.	Give feedback at a certain frequency by e-mail, as it is the preferred medium and it pushes the feedback to the user. Giving the feedback through an application could also be an option. All the other options are no good options for a medium.
E-mail		
Application		
Push feedback		
Computer		
Mobile phone		
Program		
Monitor		
Written		
Online	Subjects want the feedback to simulate certain actions in the present as they find it useful and it will help them to save more energy. Three persons find being handed an advice or tip one of the most important parts	Simulate a certain action in the present and bring this in the form of an advice/tip. Also include what the result of this action will be in terms of saving energy. After the action is done, give feedback to the user about how much is saved. Bring the
Website		
Simulate		
Before		
Advice/tip		
Afterwards		
Positive		
Negative		

	of the feedback.	information in a neutral way, not rather positive or negative.
Intervene	Subjects wish that it is possible to intervene in the use of devices as it will help the subjects become more aware.	Give the user the option to set a boundary themselves at which they wish to receive a notification when the boundary is crossed. When a boundary is crossed, give a notification to the user.
Notification		
Boundary internally set	One should only intervene when a boundary that is internally set, by someone himself or someone in the company, is crossed.	
Boundary externally set		
Intervene themselves		
Switch devices on/off	Some of the subjects wish that it should be made possible to switch devices on or off as it, especially switching devices off, will result in saving more energy.	Build in an option that it is possible to switch devices on or off automatically. Make it possible that this switching can be adjusted for each device separately.
Standard format	Most of the subjects do not see value of changing the display on their own as they attach more importance to the content. Therefore, they wish to receive their feedback in a standard format.	Design a standard format that is simple and concise, and use this to provide the user with feedback.
Influence the medium	Some of the subjects wish to influence the medium as they want it to match their wishes and expectations of a medium.	Make it possible to influence the medium in that one can move through the feedback by clicking in it.
Influence of display	A few subjects wants to influence the way the feedback is displayed as it will result in a display according to their wishes.	Give users the option to change the display according to their wishes by let them for example change the colour or font.
Moving elements		
Colour		
Clicking through		
Font		

Note: As there must be a medium to give the feedback, this is considered as a must have although this is not per se said by the subjects.

Table 3. Overview of all the requirements for the display of the feedback ordered from must have to won't have for persona 'money saver'.

User requirement	Motivation	Implications
General		
<ul style="list-style-type: none"> <li>Graphics</li> <li>Table</li> <li>Pie chart</li> <li>Bar graph</li> <li>Image</li> <li>Colour</li> <li>Text</li> <li>Dashboard</li> <li>Clicking through</li> </ul>	<p>Subjects wish to see their feedback in graphics and tables as they find them useful and give a direct good overview. Four subjects find the display one of the most important parts of the feedback.</p>	<p>Display all the feedback in graphics, tables or both.</p>
<p>Display energy usage</p> <ul style="list-style-type: none"> <li>Line chart</li> <li>Bar graph</li> </ul>	<p>Overall, subjects prefer charts over graphs, and also prefer diagrams with two lines or bars for the display of their usage.</p>	<p>Usage should be displayed in a line chart, preferably with two lines.</p>
<p>Display savings made in the past</p> <ul style="list-style-type: none"> <li>Line chart</li> <li>Bar graph</li> <li>Text</li> </ul>	<p>Subjects have different wishes regarding how they want to see their savings, however, a graph with double lines or bars seems to fit the best.</p>	<p>Display savings in a graph with double lines or bars.</p>
<p>Display broken down feedback</p> <ul style="list-style-type: none"> <li>Pie chart</li> <li>Bar graph</li> <li>Line chart</li> <li>Dropdown menu</li> <li>Table</li> <li>Text</li> </ul>	<p>Subjects wish to see their feedback broken down by using a pie chart as it gives a clear image on, for example, different devices.</p>	<p>Display broken down feedback in a pie chart.</p>
<p>Display comparisons</p> <ul style="list-style-type: none"> <li>Bar graph</li> </ul>	<p>In comparing feedback, subjects have a preference for bar</p>	<p>Display feedback that is using comparisons in a bar graph.</p>

Line chart	graphs, preferably with two bars.	
Pie chart		
Display feedback history	The subjects do not have clear wishes on which kind of graph they want to display earlier feedback in.	No clear wishes for looking feedback back are present. However, it should be displayed in a graph, rather than for example a table.
Bar graph		
Line chart		
Text with chart		
Graph		

## Appendix K: MoSCoW tables with requirements for persona 'environmentalist'

Table 1. Overview of all the requirements for the content of the feedback ordered from must have to won't have for persona 'the environmentalist'.

User requirement	Motivation	Implications
Display energy usage Euro's kWh CO2 Metaphor Only in comparison	<p>By showing current usage, people become more aware of their usage as they don't know what they currently are using. However, people indicate displaying usage is depending on one's function and personality and wishes may therefore differ. Usage must be displayed, even if it is not compared with other data. For some of the people covered by this persona, displaying usage is considered to be one of the three most important points the feedback should meet.</p>	<p>Usage must be displayed in euro's and it should also be displayed in kWh. A display in CO2 could be an option, however, usage should not be displayed in a metaphor</p>
Display savings made in the past Euro's kWh CO2 Metaphor Other	<p>Already made savings should be displayed as one can see the results of one's actions which in the end can serve as encouragement to change behaviour. For two persons in this persona, displaying savings is one of the most important parts of the feedback.</p>	<p>Savings should be displayed in euro's, and could also be displayed in kWh and CO2. Displaying it in a metaphor is discouraged as people indicate this is depending on different types of people. Savings should also not be displayed in, for example, cubic meters.</p>
Break down the feedback Space Group	<p>Subjects wish to see the feedback broken down into spaces as it is specific, but not too much. One subject mentions that it has to be a</p>	<p>The feedback should be broken down per space and could be broken down per group, device or floor. However, when breaking down the</p>

Device	space in which energy usage can be influenced by users. Breaking the feedback down into groups is also found to be interesting as it will show large consumers. For two persons in this persona, breaking feedback down is one of the most important parts of the feedback.	feedback, taken into account that users work in different companies that all are housed differently, some have multiple locations while others only have one floor in a general building.
Floor		
Location		
Wing		
Department		
Office		
Person		
Electrical outlet		
Make comparisons with own usage	The feedback should be able to make comparisons with own usage as it serves as a way to see effects and the difference between two moments. The feedback could take variables in account while comparing, such as season or occupation, to make the comparison relevant.	The feedback should compare own usage with the previous year. Comparison with the mean of one's usage and taking into account variables while comparing could both be an option.
Last year		
Mean		
Take into account variables		
Last month		
Period		
Group	Comparisons with others should be made as it serves as a way to gain insight and makes it possible to see how one is doing compared with others.	Compare own usage and savings with colleagues and other companies. When one is settled in a general building, make comparisons with the other companies in that building. Comparisons don't have to be anonymous.
Make comparison with others		
External		
Internal		
Others in the same building		
Country average	Subjects want to look back everything as they find it a pity to throw away old data, especially as it costs little space to save the data nowadays. When looking all the feedback that is ever giving back, it serves as a way to compare previous years.	Make it possible to look all the feedback that is ever given back. When one does not want to see everything but just one year, make it possible to only look at one year instead of all the years
Looking back		
Everything		
One year		
Two to three years		

Direct feedback	<p>People want to look continuously into their feedback as it helps them to get stimulated to watch their energy usage</p>	<p>Make it possible for people to continuously see their usage and savings without giving a notification every time an action leads to in- or decrease in energy.</p>
<p>Give feedback frequent</p> <ul style="list-style-type: none"> <li>Once a day</li> <li>Once a week</li> <li>Free to choose</li> <li>On request</li> <li>Once a month</li> <li>Multiple times a day</li> <li>With every action</li> </ul>	<p>Most people want the feedback to come once a day as they think they will experience this as the least burdensome. However, feedback once a week could also be an option as it helps the person to see how the week went. This also fits in the working scheme of the users as they are mostly very busy and do not always have lots of time to look at the feedback. According to two subjects, frequency is one of the most important parts of the feedback.</p>	<p>Feedback should be given once a day when for example shutting down the computer/laptop at the end of the day. Giving feedback once a week could also be an option.</p>
Indirect feedback	<p>Having feedback indirect makes it possible to get a clear look on savings according to one of the subjects.</p>	<p>Give subjects the option to also receive their feedback indirect next to receiving their feedback directly.</p>
Edit information	<p>Some people want to edit the information that is given to them in the feedback rather than this is fixed as they may not be interested in some of the feedback that is given to them.</p>	<p>Make an option for users of the feedback system to edit the information that is given to them. For example, let the user make a selection in periods and let him look into information more deeply when he wishes to.</p>
Stimulate	<p>People want to get positive feedback and be rewarded as it stimulates them in saving energy.</p>	<p>Bring the feedback in a positive way and offer rewards to persons that are performing good. Don't use</p>

	Stimulating the people may result in them being persuaded, which is currently not always the case. One person indicates this as one of the most important parts of the feedback.	punishments or negative feedback.
Take into account company, functions and user	Subjects indicate that their company is different than others, and that people with different functions most likely also have different wishes as they are different users.	When designing the feedback system, give the user options to configure the feedback to their wishes.
Concrete feedback	People want the feedback to be simple, concrete and to the point. If this is not the case, some of the subjects will drop out of using the feedback system. Two people indicate this as being one of the most important parts of the feedback.	Make sure that the feedback is not too technical or uses jargon. Give feedback that is useful and applicable in their situation.
Create database	One subject indicated that a database coupled with the feedback will help him in discovering more detailed feedback.	Use a database in which notations can be made and linked to the feedback. Show a little mark in the feedback for a notation that is made in the database.

Note: As there must be a frequency to give the feedback, this is considered as a must have although this is not per se said by the subjects.

Table 2. Overview of all the requirements for the design of the feedback ordered from must haves to won't haves for persona 'the environmentalist'.

User requirement	Motivation	Implications
Medium Computer Application	People have very different wishes for mediums. People want to receive their feedback	Make the feedback system an online system so it can be used on a computer, mobile or even a

<p>Online Website E-mail Mobile phone Program Monitor Free to choose Central Universal Push feedback User depending</p>	<p>on their computer or by e-mail as they use them for work. They wish to use an application as you have direct access. Online feedback or feedback by a website is desirable as it is accessible for everyone. One subject wants the medium to bring him the feedback, and thus let the medium push the information. Another subject wants the medium to be universal so everyone can access feedback at a medium of his choice. Two people indicate the medium as being one of the most important parts of the feedback.</p>	<p>tablet. It can be in the form of an website, e-mail or application, as they all make use of the Internet. Give subjects the option to choose the online medium they prefer the most.</p>
<p>Simulate Before Advice/tip Afterwards Positive Negative</p>	<p>People think that simulating savings that can be done will help create insight among employees. One subject says it is important that only relevant actions should be simulated in that an advice should be given to, for example, turn a device off when one has the possibility to this.</p>	<p>Simulate savings that can be done and give them in the form of a tip or advice and give this both before an action can be done and afterwards the action is done. Bring the information in a neutral way, not rather positive or negative.</p>
<p>Intervene Notification Boundary internally set Intervene themselves Boundary externally set</p>	<p>People find it useful to intervene when a certain boundary, set by themselves or someone else in the company, is crossed. They want a notification when this is</p>	<p>Make it possible to intervene when a certain boundary is crossed and send a message to the user to notificate them.</p>

	the case to keep the intervening in own hands.	
Switch devices on/off	Some subjects find it useful to switch devices on or off as it helps them save energy. They want different boundaries for different devices.	Make it possible to let IPSUM switch devices on or off in an intelligent way while taking into account the users wishes about which devices can be switched on or off and at which point this can be done.
Influence the medium	Some people want to influence the medium in that it will correspond with their expectations of a medium and therefore will keep the user motivated.	Make it possible to influence the medium in that one can move through the feedback by clicking in it.
Standard format	Some subjects do not need to influence the display or find it not important, and rather want a standard format.	Offer a standard format for the feedback system, designed by IPSUM.
Influence of display Moving elements Colour Clicking through	Some subjects want to change the display of the feedback according to their wishes as they expect that to keep them motivated.	Offer users the possibility to change the display of the feedback, for example changing the colour.
Intelligent feedback system	People wish that the feedback system will think for and with them and does most of the work.	Build intelligence in the feedback system so it becomes an intelligent system.

Note: As there must be a medium to give the feedback, this is considered as a must have although this is not per se said by the subjects.

Table 3. Overview of all the requirements for the display of the feedback ordered from must haves to won't haves for persona 'the environmentalist'.

User requirement	Motivation	Implications		
General				
Graphics				
Pie chart				
Line chart				
Bar graph	People like to see the feedback in graphs, rather than in tables, text or numbers, as four subjects indicated they are visually oriented.	Display the feedback, regardless which information, in a graph.		
Image				
Table				
Colour				
Text				
Numbers				
Dashboard				
Zoom in/out				
Clicking through				
Display energy usage			To see their usage, people have more affinity with bar graphs then line charts.	Display usage in a bar graph.
Bar graph				
Line chart				
Display savings made in the past	People have no clear preference for how their savings should be displayed.	As people wish to see their savings in the same way as their usage, use a bar graph to display the savings.		
Bar graph				
Line chart				
Dashboard				
Display broken down feedback	For the feedback broken down according to ones wishes, the dropdown menu, pie chart and table could be options.	Display broken down feedback in either a dropdown menu, pie chart or table.		
Dropdown menu				
Pie chart				
Table				
Bar graph				
Display comparisons	The subjects tend to prefer bar graphs over line charts when they want to compare with themselves or others.	Display comparisons in bar graphs, especially double bar graphs.		
Bar graph				
Line chart				

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Display feedback history

Bar graph

Line chart

People do not have a clear image about how they want to see feedback from the past in a graph.

No clear wishes for looking feedback back are present. However, it should be displayed in a graph, rather than for example a table.

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## Appendix L: Dutch and English quotes per subject

Dutch	English
Subject 2	
Dat heeft alleen maar te maken met gewoon het bedrijfsrendement (p. 3)	That only has to do with operating efficiency
Subject 5	
Nou de belangrijkste reden, kijk uiteindelijk kun je alles plat slaan naar geld, maar het gaat er over bewust energie gebruik. He bedoel het maatschappelijk verantwoord bezig zijn, nogmaals dat stoken met ramen open dat is onzin. Als je daar nou, maar als je denkt dat doen ze nu eenmaal zo, nou dat betekent dus dat je opgeeft dat je goed bezig bent. En op het moment dat je die, hé dus het geld is uiteindelijk drijfveer, maar ook hoe duurzaam ben je voor je kinderen en je kleinkinderen, als je die gaat krijgen. He dus het moet niet zijn na mij de zonvloed, he het moet die voetstappen die je achterlaat moeten zo groen mogelijk zijn (p. 2)	The most important reason, look in the end everything relates to money, but it is about aware energy consumption. Being socially responsible, again, heating with the windows open is nonsense. But if you think: ‘that is the way it goes’, it means that you are giving up on doing well. And at the moment that you, look, money is a drive in the end, but also how durable you are for your children and grandchildren, if you are getting any. It should not be after me the deluge, the footprints you leave must be as green as possible.
Subject 6	
Dagelijks hoef ik het niet, daar word ik helemaal gek van. (p. 3)	I don’t want daily, that will drive me crazy
Subject 10	
Ja ja ja dat lijkt me de basis van het verhaal (p. 3)	Yes yes yes, that seems to be the base of the story to me
Subject 11	
Ja de belangrijkste reden voor een bedrijf is natuurlijk economisch altijd belangrijk (p. 1)	The most important reason for a company is of course always economical always

Subject 12

Omdat ik het zonde vind. Dat zijn niet de kosten omdat ik niet weet of dat uitmaakt. Want als ik dan moet afslaan met mijn auto om hier naar toe te gaan en dan het licht uit te doen, dat kost me waarschijnlijk meer dan het licht laten branden maar dat weet ik niet dus. Maar ik vind het nergens op slaan, ik vind het zonde. Mensen moeten gewoon die lichten uit doen als ze als laatste weg gaan. En het kan, het komt wel voor dat mensen hier tot diep in de nacht werken, dus voordat ik begin te vloeken kijk ik eerst of er echt niemand zit, en dan vind ik het echt. Ik vind het zonde, het is echt verspilling (p. 1)

Because I think it is a shame. It are not the costs because I do not know if they matter, because if I have to take a turn with my car to drive up here and put the lights off, it will probably cost me more than leaving the lights on. But that I don't know. But I think that is rubbish, I think it is a shame. People must put the lights off when they leave as last. It does occur that people work here till deep in the night, so before I start cursing I look if there is really nobody here, and then I find it. I find it a shame, it is really a waste.