MASTER THESIS

Pure Gamification: stimulating energy saving behaviour through personalized gamification

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Abstract

Despite the increased attention for the environment, sustainability and reducing energy consumption have not yet become common behaviour. Dutch energy suppliers are obliged to cooperate in reducing consumption by stimulating energy saving behaviours among their customers. A strategy that has already proven itself to be effective for stimulating energy saving behaviours is personalized gamification. This thesis aims to investigate how a personalized gamified energy saving application can be designed based on individual preferences within the context of an energy supplier. To design a personalized gamification application the proposed method of Knutas et al. was adapted by leaving out the parts about machine learning and adding an evaluation phase. This adapted method has proven to be effective for designing persuasive personalized gamification as it shows that customization by users is a valuable alternative for using machine learning personalization strategies. To indicate the present user types within the customer base of Pure Energie the Hexad survey (n = 274) was used and results revealed that the user types philanthropists, free spirits, and achievers were most present. An iterative design process focussing on personalizing for these three user types followed in which the design of the gamified application was adapted using feedback of both stakeholders and customers using interviews (n = 9) and focus groups (n= 4 & n=6). Resulting in two final designs stimulating energy saving behaviour, a dashboard which allowed for personalization within gamified elements and the energy editor in which users can change characteristics in their households to learn about the effects of actions on their energy consumption. These two final designs were validated using a clickable along with interviews (n = 13).

The added value of this study is that it shows that the Hexad scale is a suitable method to understand the main motivations of a target group. Results suggest that designing within gamified mechanics based on a user type's main motivation is an effective strategy for personalization. Although autonomy is mostly important for free spirits, it is to some extent important for every user type within an energy saving application as each participant liked the customization approach applied in the dashboard. The main motivations of each user type showed similarities with the predetermined user groups of Pure Energie. Philanthropists motivations have overlap with green driven customers, achievers with price driven customers, and free spirits with demanding customers. Based on these findings we propose an inside out framework explaining the three main user groups within a gamified energy saving application and how to design for them. Next to this, we also propose a generalised framework visualisation of this inside out model involving every user type of the Hexad scale. Motivation-based design is not the only successful personalization design strategy for an energy saving application, adapting designs to personal situation and already existing energy saving behaviour also suggest to motivate users. Furthermore, the results indicated that essential elements to create a basic understanding and get users involved within an energy saving application are information provision, progress, interactive user interface, and feedback. Lastly, we advise future researchers and gamification practitioners to use a step by step approach when implementing gamification for the first time within organisations to prevent losing the stakeholder within the process. Future long-term research is needed to research the effect of these personalization strategies and designs on actual energy saving behaviours. In sum, our study can support researchers and practitioners in designing personalized gamification applications, especially for the goal of stimulating energy saving behaviour within the context of a green energy supplier.

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1 Introduction[1]

Climate change is a hot topic and one of the biggest challenges mankind is facing nowadays [1]. To address the problem of climate change, the EU has introduced legislation to reduce emissions by at least 40% by 2030[2]. In order to reduce emissions, measures have to be taken at various levels, including the energy sector. Looking at the Netherlands, the total energy consumption can be split up in several sectors, of which households form a large share of 13 percent [2]. At the moment many house owners already want to contribute to a better climate. For example, four out of ten Dutch people indicate that they would like to reduce their energy consumption [3]. Although millions of Dutch people are willing to live more sustainably, many of them fail [4]. This raises the question why, despite the increased attention for the environment, sustainability and reducing energy consumption have not yet become a common behaviour.

An explanation might lie within a headline from October 2018 published by the NOS: *"We save energy mainly for the wallet, not for the environment"* [3]. However, to really motivate consumers to reduce their energy consumption motivations should be triggered which go beyond a mere motivation to just save energy or money [5]. A suitable channel through which people can be triggered to reduce their energy consumption is via their energy supplier, which is investigated in this thesis. These companies stand in direct contact with their customers, the households of the Netherlands. Due to the direct connection between energy suppliers and households, energy suppliers have been made jointly responsible for reducing the energy consumption of their customers. Since 2017, energy suppliers are obliged to encourage energy savings among their customers [6]. In the advice given along with this new legislation, gamification was cautiously mentioned as a tool for stimulating energy saving behaviour among customers.

Gamification is a field of research that has become increasingly popular for its ability to lead to behaviour change through a fun environment. A well-known definition of gamification is as *"the use of game design elements in non-game contexts"* [7, p. 10]. Another definition of gamification is *"a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation"* [8, p. 19]. The potential of gamification lies in restructuring of tasks by adding game elements and affordances [9]. It is used as mean of supporting user engagement and enhancing positive patterns in service use, such as increasing user activity, social interaction, or quality and productivity of actions [10]. While gamification sounds similar to the concept of serious gaming their core ideas differ. Ritterfeld et al. [11] defined serious gaming as *"any form of interactive computer-based game software for one or multiple players to be used on any platform and that has been developed with the intention to be more than entertainment"*. The main difference is that a serious game is a real digital game, while gamification is the adaptation of game design elements in a non-game context without the need of designing a real digital game.

The concept of gamification consists of three main elements, affordances implemented in a gamified system that lead to physiological outcomes which lead to further behavioural outcomes [12]. Affordances within gamification consists of various elements that structure games and induce gameful experiences. Psychological outcomes can be explained by the self-determination theory (SDT) [13, 14]. SDT states that intrinsic motivations can be increased if feelings such as competence, autonomy and relatedness are induced by gameful experiences [9]. If gamification is applied well these psychosocial outcomes can lead to behaviour change. However, its effects are highly dependent on the context it is being implemented and the user using it [12]. Because the effects of gamification are highly user dependent, tailored gamified solutions are proven to be more successful than one-size fits all approaches [15–18]. But creating different tailored gamified solutions that can stimulate each user groups motivation can cause behavioural change within every group. It is precisely the ability of personalized gamification to achieve behavioural change that makes it able to incentivize energy saving behaviour among a group of different individuals.

During the past years, the potential and interest for gamification within the environmental contexts has increased [6]. Which has led to more insights into the possibilities and effectiveness of gamified applications within this area. A literature review on gamified applications designed to incentivize energy savings showed average results from 4 up to 24% in energy savings within households [19]. Personalized gamification within this context is also explored and found to be more effective than one size fits all solution [20–22]. Gamified applications that incentivize energy savings have also been applied in the commercial sector. Consumers can be engaged towards a more sustainable lifestyle by gamification applied to incentivize energy savings

[1] Part of this thesis is adapted from the Research Topics with the title "Applying personalized gamification online channels of energy companies in order to incentivize energy saving behaviour and increase customer retention" by Laura van der Neut an internal report handed in as preparation for this thesis.

[2] European Commission "Progress made in cutting emissions", https://ec.europa.eu/clima/policies/strategies/progress_en (accessed August 14, 2020)

[3] NOS "Energie besparen doen we vooral voor de portemonnee, niet voor het milieu", https://nos.nl/artikel/2256277-energie-besparen-doen-we-vooral-voor-de-portemonnee-niet-voor-het-milieu.html (Accessed October 20, 2020)

[20, 23, 24]. According to Ponce et al. [25] residential customers should be motivated to take an active role in energy applications. As a consequence, their willingness to control their energy behaviour towards energy saving increases. Gamification could play an important role in the energy applications of energy suppliers to offer the psychological element to consumers which is needed to let them start reducing their energy consumption. Although gamification is yielding promising results for stimulating energy saving behaviours, the concept has not been widely applied by energy suppliers in the Netherlands.

Back in 2017, Dutch energy suppliers were first advised to apply gamification to stimulate energy savings among customers as it had not been applied until then [6]. A few years later, at the time of writing, energy suppliers are not making use of gamification to its full potential. They sparsely apply it in for example their monthly overview and sometimes in their online applications. However, there are many more opportunities for these companies to apply gamification properly. A great opportunity in this specific context lies in combining gamification with smart meter technology. Nowadays, this smart meter data is often presented via plain numbers and graphs. The combination of these two techniques offers a way to encourage energy saving behaviour among customers and increases customer experience and online user engagement [26, 27]. Gamification is therefore not only useful for energy suppliers to make their customers more sustainable but can also be of value for other challenges they experience.

Gamification can help energy suppliers within the competitive market as it can lead to a more interesting and usable product that comes nearer to the final customer and, in general, is an important advantage from competitors [28]. From a marketing and business perspective, the increase of customer experience and engagement which gamification can bring about can enhance brand loyalty, awareness , innovation, and monetization [10, 27–29]. If applied well, gamification can positively effect brand engagement and is an effective technique for brand management [30, 31]. These are all important factors for energy suppliers when it comes to how they want to present their brand and can help them retain and win customers. In addition, gamification can respond to the increase of online user engagement in the energy world, as customers expect to have more insights in their energy consumption due to the rise of the smart meter [26]. However, each company customers base consists of individuals forming different user groups which makes the factor of personalization for gamification important to make it effective. Concluding, gamification has energy companies way more to offer than just stimulating energy saving behaviour among their customers. If applied well, in a personalized format, it can also improve both customer sustainability and retention.

Therefore, the potential of personalized gamification and its effectiveness to motivate energy saving behaviours within a commercial environment of an energy supplier are worth exploring. In recent years there has been a lot of research conducted into gamification in the environmental sector, but there is a research opportunity to specifically research the possibilities of gamification to stimulate energy savings within the context of energy suppliers. Thus, this study was aimed to develop a way in which energy suppliers could use personalized gamification that stimulates customers to decrease their energy consumption.

This master thesis project is conducted on behalf of the company Pure Energie, an energy supplier, located in Enschede in the Netherlands. As a company they strive towards a more durable world, starting by making The Netherlands more sustainable[4]. Pure Energie makes the promise that they provide their customers only with green electricity produced by their own wind turbines and solar parks, all located in the Netherlands. To be able to fulfil this promise they own 74 wind turbines and one solar park which is good for the energy supply of more than 100.000 households. This makes them one of the few companies who both generate and supply green energy to their customers. As the market share of Pure Energie is growing, they are looking for new opportunities to differentiate themselves in the fast-changing energy market. At the same time, they want to help their customers living more sustainable. Earlier performed research into customer satisfaction at Pure Energie revealed that many customers are asking for improvements within their online channels. A possible solution further explored in this master thesis is to apply gamification in their online channels to increase customer satisfaction and sustainable behaviour of customers. Due to the promising fact that gamification in combination with the smart meter technology offers a way to increase consumer experience and encourage conservation behaviour [26], Pure Energie is interested into what kind of possibilities this technique can offer for their online channels.

1.1 Research questions

The goal of this master thesis is to look into *how personalized gamification can be applied within a consumer environment focussed on green energy to persuade a customer to become more sustainable and to increase customer satisfaction and retention.* This study is conducted as a first step to work towards this overarching goal. As a study researching customer retention is outside the scope of this master study, the

[4] Pure Energie, “Over ons”, https://pure-energie.nl/over-ons/ (accessed August 14, 2020)

focus in this study is on obtaining first insights into the possibilities of personalized gamification for green energy suppliers. To research this the following main research question was developed.

How can we design a personalized gamified energy saving application based on individual preferences of users within the context of a green energy supplier?

To be able to answer this research question a set of guiding questions (GQs) were set up. Each guiding question involved sub questions which were necessary to find the answer to the specific guiding question. The guiding questions together helped to answer the main research question of this master thesis. The following guiding questions and sub questions were set up:

(GQ1) What is personalized gamification?

- What is gamification?
- How can gamification be personalized?
- How can personalized gamification be applied?
- How can personalized gamification be designed?

(GQ2) How can we apply personalized gamification for green energy suppliers, in this project for the case Pure Energie?

- What is the best environment to apply personalized gamification techniques within energy companies?
- What is the state of the art on gamification designed for incentivizing customer experience and conservation behaviour?
- How can personalized gamification be done for customer groups?
- How can gamification be applied to stimulate energy saving behaviour?
- What are important factors when designing personalized gamification for stimulating energy saving behaviour?

(GQ3) How can we design for a user's needs within a gamified energy saving application, in this project for the case study Pure Energie?

- What type of personalized gamified elements can motivate the customer groups?
- How do customers experience proposed personalized gamification solutions?

1.2 Thesis outline

This report describes the work conducted for this master theses in order to answer the main research question posed in this chapter. First, a review of the literature will be given in Chapter 2. This review consists of definitions of personalized gamification, gamification for energy saving, a state of the art on gamification for energy saving, background theory on Pure Energie, and an expectation of user types in the cohort of Pure Energie. Chapter 3 describes the method applied to answer the main research question of this study. Chapter 4 shows the more in-depth method and results of the Hexad survey applied within the customer base of Pure Energie. Then, Chapter 5 describes the ideation phase of this study explaining the method and results. This is followed by Chapter 6 explaining the process in which the gamified design was iteratively updated from low-fidelity to high-fidelity prototype. After that, Chapter 7 explains the tests together with the results of the final validation performed with the final prototype. Thereafter, a discussion of the results is given in Chapter 8. Finally, Chapter 9 presents the conclusion of this research in which the research questions are answered.

2 Background theory

This chapter introduces the background theory as a literature review and serves as a starting point for this research. First, an introduction into the theoretical background of gamification is given. Then, the literature on gamification applied for energy saving is given. This part is followed by a section going deeper into the opportunities and possibilities of personalized gamification. Additionally, the user typologies described in section 2.3 are described through the lens of a green energy supplier. The final section explains the expectations of user typologies occurring in the customer base of Pure Energie by coupling knowledge on the customer base of Pure Energie with the found literature in this chapter.

The method used for this literature analysis is described in Appendix A. Next to a literature analysis, a state of the art and stakeholder analysis have been performed. During the state-of-the-art research several gamified applications with a focus on energy saving are analysed. This research is described in Appendix B and helped to get an overview of the already existing applications focussing on energy savings. Besides a stakeholder analysis was performed focussing on the opportunities of gamification within the online channels of Pure Energie. This stakeholder analysis was performed through an interview and online search on the website of Pure Energie and is described in Appendix C.

2.1 Gamification

Gamification can be seen to have three main elements, namely motivational affordances, psychological outcomes, and behavioural outcomes [9]. These three elements can be seen as a flow of elements in which gamified motivational affordances can lead to psychological outcomes which further lead to behavioural outcomes. Each element will be further explained in the next three subsections.

2.1.1 Motivational affordances in gamification

Motivational affordances within gamification are features that structure games and induce gameful experiences by players. There are a lot of different types of affordances that can be used within gamified systems. The use of these features within games is not limited to one, it is possible to use several features within a system. The most used motivational affordances within the literature are leaderboards, badges and points [9]. Others also mention goals, achievements, levels, challenges and rewards as often used game elements [28]. Although elements such as leader boards, badges and points are mostly used, they might result into the player becoming bored or frustrated [32]. However, challenges have proved to keep players interest alive and to keep their engagement over time [33, 34]. Hamari et al. [12] identified ten core components of motivational affordances in gamification, see Table 1.

Table 1: Motivational affordances that can be applied within gamified systems [12]

Motivational Affordances
Points
Leader boards
Achievements/badges
Levels
Stories/themes
Clear goals
Feedback
Rewards
Progress
Challenges

2.1.2 Psychological outcomes through gamification

The result of physiological outcomes through gamification can be explained by studies on motivational behaviour. These studies have distinguished two types of motivations, extrinsic and intrinsic [14]. A motivation is intrinsic if an individual is performing an activity, because of the pleasure and motivation that occurs by the activity itself [10]. On the other hand, extrinsic motivation appears when an activity is performed with the goal to reach an external reward. Participation in games by individuals can be based on intrinsic as well as on extrinsic motivations or a combination of both. However, the act of playing a game is generally more considered to be based on intrinsic motivations than extrinsic motivations [10].

A theory that explains motivational needs of people is the self-determination theory (SDT) [13, 14]. SDT proposes that intrinsic motivation can be increased if an individual's motivational needs for competence, autonomy and relatedness are met [13]. The three motivational needs proposed by the SDT be explained as follows. Autonomy is the feeling of freedom to choose an activity and the way of performing it. Competence refers to the feeling of being competent and successful in completing a task, where relatedness is the feeling of recognition into other's actions. These three types of motivational needs are as well linked to playing games. Accordingly, Ryan, Rigby and Przybylski [35] proposed that the appearance of these motivational needs independently predict enjoyment and future game play in a positive way. In addition to enjoyment and future gameplay competence, relatedness and autonomy evoked by gameful applications can lead to behavioural outcomes [12].

When looking at the motivational need of competence, it's importance is also supported by another theory on motivation, namely the flow theory constructed by Csikszentmihalyi [36]. This theory describes a link between the motivational need of competence and the concept of flow, which is a mental state in which an individual is fully immersed in a specific task and loses track of time and worries. An individual experience flow like an intrinsic motivation, whatever the task is it becomes worth it for its own sake. The concept of flow plays an important role in game experience [37]. A well designed flow experience in a game can lead to feeling of competence, which can bring a player in a flow, and increases the motivation to keep on playing a game [12]. Csikszentmihalyi's [36] research identified eight major characteristics which describe an individual's feelings if experiencing his concept of *flow*:

1. Confront a task with a reasonable chance of completion.
2. Must be able to fully concentrate on the task while losing track on everyday life thoughts.
3. Clear goals on the task in mind.
4. Receiving immediate feedback.
5. Fully concentrated on the task at hand.
6. Feeling of control on self-performed actions.
7. Loosing self-consciousness.
8. Loosing track of time.

Another perspective on intrinsic and extrinsic motivations is elaborated by Schell [38] as he describes the difference between "wanna" and "hafta" motivations. This difference can be explained by things individuals want to do (wanna) and things individuals are obligated to do (hafta). To express the difference between these motivations Schell points to neuroscience research telling "*pleasure seeking and pain avoiding are two different systems in the brain*" [38, p. 158]. This means that that pleasure seeking, the "wanna", and pain avoiding related to "hafta" are two separate processes of motivation. Both pleasure seeking and pain avoidance are types of motivations and they can work well in combination. While this may be true, they are often out of balance within games which leads to a motivational decrease. As a conclusion Schell has formed a lens of motivation, which consists of questions to examine the motivations of a game.

2.1.3 Behavioural outcomes through gamification

A gamified system may have different behavioural outcomes depending on the context and its goal. Although gamification is applied in different contexts, it was not always proven to be successful due to misused contexts and unattended users. A literature review on 24 papers on gamification indicated that gamification has positive effects [12]. However, the effects are greatly dependent on the context in which gamification is being implemented, as well as on the users using it. Another literature review of 15 papers on gamification in online programs showed that gamification is effectively increasing engagement in social programs [39]. A more recent literature review in which 273 papers were analysed showed that most of the results of research on gamification are towards positive findings on the effectiveness of gamification [9]. Although mostly positive results were found, they state that the research on gamification lacks coherence in research models, a consistency in the variables and theoretical foundations [9]. An important factor to keep into account when looking at the effectiveness of a gamified system is that not every system works for every individual. Within games there are different types of users, so it is hard to design an experience that results in behavioural outcomes for every user, since skill levels can vary a lot between

players [40]. Therefore several researchers conclude that personalised solutions are most of the time better than one-size fits all approaches [15–18].

2.1.4 Conclusion on gamification theory

Within gamification motivation of users is necessary to attract users to make and keep on making use of a gamified application. Individuals differ in their motivational behaviour which can be based on intrinsic and or extrinsic motivations and can be stimulated with the help of game design elements. Both motivations can be applied within gamification and lead to positive effects. However, intrinsic motivations are often named in the literature as a better motivator since they motivate more often for longer term use [41]. According to the STD theory intrinsic motivations are dependent on the degree of an individual's motivational needs for competence, autonomy and relatedness [13]. To reach psychological outcomes. People do not only differ in their motivations, but as well in their behaviour. A certain type of game design can be effective for someone and at the same time not affecting anyone else. This can be explained by the fact that the effectiveness of gamification depends greatly on the user as well as the context in which it is applied. Despite this fact gamification already shows promising results, however it is hard to design a gamified solution which causes positive behaviour changes for every user. For this reason, personalized gamified solutions are found to be more effective than one-size fits all productions.

2.2 Gamification for energy saving

Gamification to stimulate energy saving behaviours can be done through online applications. Many gamified applications that focus on stimulating energy saving behaviours have already been created and researched from different perspectives. A literature review on gamified applications designed to incentivize energy savings showed promising results by energy savings from 4 up to 24% within households [19]. Another review on 57 apps targeting energy usage and containing at least one gamification element analysed the elements of gamification and behavioural constructs for each app [42]. Results showed that the number of gamification components was the only significant predictor for positive app ratings. The use of game elements had minimal positive effect on app ratings, while behavioural constructs do not influence app rating. Based on their findings, three recommendations have been formulated for energy app designers. The first recommendation is to improve discoverability of apps within the app store. The second recommendation is to make use of more gamification components and game design elements in an app since most researches only made use of one element. Lastly, they recommend that the design should be well integrated together with the used components and elements to improve the user experience.

Another study solely explored a gamification within the domestic energy consumption [43]. This resulted in a literature review on 25 papers in which different gamification elements were applied by the papers. The most frequently used gamification element was used 17 times (feedback) and the lowest twice (user-generated content). When looking at how often the recognized gamification elements in the papers occur from high to low it is as follows: feedback, challenges, social sharing, rewards, leaderboards, points, tips, levels, rankings, avatars, badges and user-generated content. It was found that the effect of energy consumption games was largely positive when looking at reducing energy consumption in households. Nineteen studies showed exclusively positive effects and none of the studies solely showed negative effects. However, six of the studies showed mixed effects. These results apply that games appear to be effective in imparting knowledge on energy saving and consumption. Additionally, most of the games resulted in positive effects on self-reported and actual energy saving behaviour. However, it is unknown what the effect of these games is on behaviour on the long-term. To be able to solve this problem, the authors state that future research should focus more on quantitative empirical research.

2.2.1 (Gamified) elements of energy saving applications

Looking at the overall picture of energy saving applications several elements seem to be essential for such an application. Alskaif et al. [20] made a list of the most used design elements divided into five categories, including game elements, within residential energy applications. This list is depicted in Figure 1 and Alskaif et al. [20] suggest that each category should at least be incorporated within an energy saving application. Beck et al. [42] agreed upon this list of elements, however they also mention feedback as an often used gamified category. Both state that the five categories: information provision, rewarding system, social connection, user interface, and performance status should at least be partly incorporated into an energy saving application [20, 42] and Beck et al. also add feedback to that list [42]. An important category is the user interface, since the motivation of users greatly depends on it. To have a positive effect on customer engagement the interface should not only be useful, but as well attractive and enjoyable to improve user experience [20, 42].

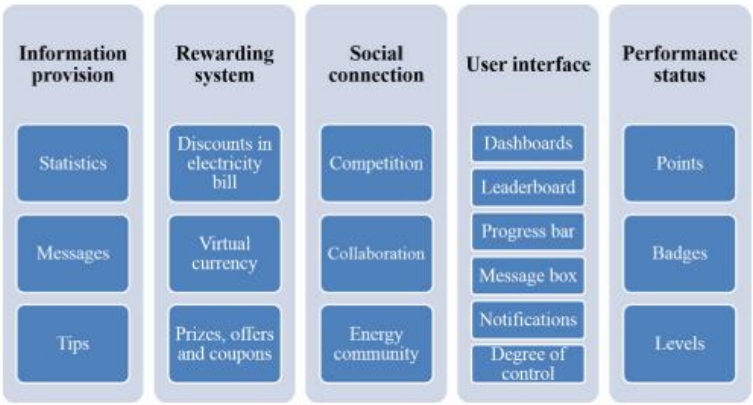

Figure 1: Most used game design elements for residential energy applications [20]

To get users involved in an energy saving application on both short and long-term various game design elements can be used. The literature suggests that some elements could stimulate short-term usage where others stimulate long-term usage and behaviour change. To stimulate users to make use of energy applications points and prices can be applied [44]. As a second step users need to get involved into an energy consumption application, which can be reached using the elements competition and social sharing [44, 45]. Looking at how to stimulate users for the longer-term usage other elements can be better applied. Feedback and rewards are one of them, as they are proven to be effective in stimulating energy saving behaviours [43, 46, 47]. When users perform a certain task well and are aware of it, they will have a stronger intention to repeat this task in the future [46]. An individual successfully reaching his goal will therefore have a stronger intention to maintain his behaviour. Another element successful in stimulating long-term usage are challenges [44, 48]. However, contradictory to this finding other research indicated that the use of challenges are effective in inciting people to change their energy consumption behaviour [43]. Therefore, challenges could also be useful in stimulating individuals to start making use of an energy saving application.

Wee and Choong [24] conducted a large-scale research in which they looked whether the effectiveness of a variety of game design elements were predicting intrinsically motivating behaviours for incentivizing energy saving. A total of nine game elements supporting the three needs of the SDT theory [13, 14] were researched by the use of a survey. The game elements personal profile and non-fixed structure were supporting the need for autonomy. Second, the need for competence was supported by challenge, feedback, short cycle time, and theme. Lastly, the need of relatedness was supported by the game elements competition, cooperation, and chat-based social network. In total, 1500 valid survey responses were gathered from university students. Results indicated that the nine game design elements were useful in satisfying users' autonomy, competence, and relatedness. Overall findings suggest that game design elements in energy-saving campaigns are able to intrinsically motivate university students and incentivize energy saving behaviours. Subsequently, a suggestion for a real-life energy-saving campaign for each of these game elements was made, see Table 2. When comparing the list of gamified elements with the most common used elements mentioned by Hamari et al. [12] from Table 1 some differences can be seen. For instance, the research of Wee and Choong [24] does not mention points, achievements and leader boards. Although this research showed a positive effect of gamification on energy saving behaviours, the participants only consisted of students and no field experiment on the effectiveness of the game elements was performed.

Table 2: Suggested game elements for a gamified energy-saving campaign [24, p. 105]

Personal profile: recognize every participant in energy-saving campaign by keeping a record on the profile of every participant with updated personal information.
Non-fixed Structure: provide all possible energy-saving tips to participants rather than fixing them into few common tips in energy-saving.
Challenge: provide the participants with energy-saving challenges such as energy-saving goals or missions for them to achieve.
Feedback: provide the participants with feedbacks on their energy-saving performance, indicate how well they have performed could give an encouragement for them to save more energy.
Theme: provide the participants with several energy-saving themes that can lead them into smaller energy-saving task to achieve broader energy-saving goal.

Short Cycle Time: provide the participants with several small energy-saving tasks or missions that with short cycle time, in other words small task with short completion time.

Competition: provide the participants with energy performance's leaderboard to enable them view their own and others performance anytime.

Cooperation: provide the participants with sharing and discussion forum, blog, website or any other similar platform to enable sharing and discussion among participants on how to save more energy and cooperation among each other to achieve the same goal of saving energy.

Chat-based Social Networking: provide the participants with social-networking chatting platform such as WhatsApp, Line and any other similar platform to get the participants get connected among each other and making friends with each other for social purpose.

2.2.2 Metaphors to visualize energy usage

Most of the gamified energy applications are energy feedback systems that show data on energy usage together with game design elements. At the moment, energy companies do often not make use of gamification in their energy feedback systems. Current applications in the energy sector often present energy usage data with the help of visualizations like graphs. However, there are many people who do not easily understand abstract numerical data about their energy usage [49]. One way to present data more clearly is with the help of metaphors, where things are explained in a term of something else. The research of Melenhorst et al. [50] and Koroleva et al. [51] applied metaphors for three main goals of energy saving, namely monetary, sustainable, and hedonic goals (pleasure energy saving). Both researches used piggy banks as a metaphor to show the impact of energy saving on costs. The sustainable goal was also visualized the same way, namely trees corresponding to saved CO_2 emissions are used. However, the research of Koroleva et al. [51] also used two visualizations for the sustainable goal. The second metaphor allowed users to monitor an energy saving goal. This was visualized using a battery, which fills up when more energy is saved, showing the progress of the user. The metaphor for the hedonic goal differed in both researches. One research focussed on gamified achievements, allowing the user to win badges by reaching energy saving goals [50]. These badges are visualized as jars filled with candies which correspond to the points received by the achievement. Regarding the hedonic goal of the other research, rather than the candies filling a jar, the system fills a jar with badges after achievements [51].

2.2.3 Users of energy saving applications

Many individuals are using energy feedback systems and with the introduction of smart meters the interest towards these applications only increased. Gölz and Hahnel [5] mapped four main goals that people hold towards the use of energy feedback systems. These goals include: having fun, controlling and reducing costs, learning to save electricity, and avoiding inconvenience. The motivation of individuals for using energy feedback systems is not based on one goal, but is shaped on a set of multiple goals. A set of goals can differ between individuals, because they can have different motivations. Based on this difference between goals Gölz and Hahnel [5] presented three different customer groups regarding energy system usage. For each customer segment the main goal, sub goal, communication orientation, additional focus and promising add-ons were defined. The segmented customer groups can be used in practice by companies to identify customer groups and be able to create tailored energy feedback systems. An overview of the three identified customer segments with their focus and goals is displayed in Table 3.

Table 3: Customer segments based on their goals regarding energy saving feedback systems [5]

	Customer segment 1	**Customer segment 2**	**Customer segment 3**
Main goal	Save costs	Having fun and learning to save electricity	Saving energy
Sub goal	Learn electricity saving	Save costs	avoiding inconvenience
Communication orientation	Saving costs	Hedonic aspects	Perceived inconvenience
Additional focus	Saving energy	Saving energy	Saving energy
Promising add-ons	Variable tariffs and dynamic pricing	Online game aspects, real-life events	Tips on how measures for energy saving can be integrated without negative impacts

2.2.4 Conclusion on gamification for energy saving

Gamification for energy saving is proven to be successful in the literature. This gamification is often applied through online applications. Such applications should at least contain the elements from the following categories: information provision, rewarding system, social connection, user interface, feedback, and performance status [20, 42]. Different game elements can be useful for short-term or long-term usage and the number of positive game elements is significant to users giving positive ratings about the application [42]. Different game elements were found to support the three intrinsic motivations from the SDT when it goes about energy saving behaviour [24]. Suggesting that these intrinsic motivations are important when you want to change individuals energy consumption behaviour. As earlier mentioned personalized gamification approaches are often more effective than one-size fits all solutions [15–18]. The finding that there are three customer segments regarding their motivations towards energy saving applications (Table 3) suggests that this personalization is also important within the energy world. As individuals could differ in their motivations one approach will probably not motivate each user. Personalization for each different user type offers the possibility to make an energy saving application attractive for every user. A common way to add personalization to gamified applications, interesting for this study, is the use of player typologies. This manner for personalized gamification is further explored in the upcoming section.

2.3 Towards personalized gamification

Several user typology models exist in the literature. One of the first models that has put this technique into practice is the Bartle's player type model [52], which identifies four player types (achiever, explorer, socialiser and killer) for Multi-User Dungeons (MUDs). A more recent user typology, also applied to personalize gameful systems, is the BrainHex model [53]. During the development of this model previously existing player typologies in the literature as well as neurobiological research were considered. This resulted in the BrainHex model considering seven different player types: achiever, conqueror, daredevil, mastermind, seeker, socialiser, and survivor. Although these models have been used to personalize gameful systems their usefulness for gameful design is limited, because they are specifically built for game design [15]. With this in mind and based on research on human motivation, player type, and practical design experiences Marczewski [54] developed the Gamification User Types Hexad Scale to be able to design for personalised gamification solutions. This framework states that there are six different user types who differ in both their intrinsic and extrinsic motivational factors. It is worth noting that an individual is often not restricted to one player type of the Hexad scale [15]. Although individuals often have the tendency towards one player type, they will also be motivated to some degree by other user types. The user types of the Hexad scale can be seen as personifications of people's intrinsic and extrinsic motivations, as defined by the earlier mentioned SDT [14]. But as an addition to the three intrinsic motivational needs out of the STD, the Hexad framework added and extra intrinsic motivational need, namely purpose as is been illustrated in Figure 2.

Figure 2: Hexad model describing user types in gamification retrieved from [54]

Below, the list of user types by the User Type Hexad Scale are described together with their motivational factors [15, p. 231,232]:

> *"**Philanthropists** are motivated by purpose. They are altruistic and willing to give without expecting a reward.*
>
> ***Socialisers** are motivated by relatedness. They want to interact with others and create social connections.*
>
> ***Achievers** are motivated by competence. They seek to progress within a system by completing tasks, or prove themselves by tackling difficult challenges.*

Free Spirits *are motivated by autonomy, meaning freedom to express themselves and act without external control. They like to create and explore within a system.*

Players *are motivated by extrinsic rewards. They will do whatever to earn a reward within a system, independently of the type of the activity.*

Disruptors *are motivated by the triggering of change. They tend to disrupt the system either directly or through others to force negative or positive changes. They like to test the system's boundaries and try to push further."*

The user types philanthropist, free spirit and achiever are on average the strongest motivations, closely followed by socialiser and player contrarily the disruptor has lower average scores [15]. This suggests that the motivations and with them these user types are most likely to be motivated in gameful systems. Results also indicated that user types and scores are significantly correlated to both gender and age [55]. Women scored slightly higher on intrinsic motivations than men, but on the other hand men scored slightly higher in disruption on average [55]. Furthermore, the influence of intrinsic motivations increases with the age and the extrinsic motivations decreases with age [55].

The Hexad framework was used by Tondello et al. [15] as a base to create a procedure to assess an individual's user type based on personal preferences. A 24-items validated survey, answered on a seven points Likert scale, was proposed to score users' preferences towards the six different user types in the Hexad model [15]. Using a survey to determine individuals preferences was proven to be more useful than asking individuals directly, because it helps to understand more about user psychology in a gamified context than just the elements that they prefer [15]. Therefore, the survey is mostly helpful in a context where it is important to determine player types of people who are not into games. These people do not have any knowledge on game elements and thus their preferences for player types. Besides the survey, the researchers also presented a list of correlations found between the Hexad user types with game elements. Both outcomes can be used in new research. First, the survey can be used to screen the target audience on their user type preferences. Secondly, adequate game design elements matching the user types can be used to design a gameful application.

Tondello et al. [15] already showed promising results on the validity of the user Hexad scale. However, the survey was validated on a small sample, namely 133 students. Not only the sample was small, but it was also limited to students who were all studying at the same university which could have caused a bias. For this reason Tondello et al. [55] conducted a follow up study using the same 24-items survey to see whether the system can be structurally validated. The follow up study consisted of three large-scale empirical validation studies and revealed that the structural validity is generally acceptable through reliability and factor analysis. These outcomes confirm that the User Type Hexad Scale survey is an appropriate method for developing personalized gameful design. The validation led to a reformulation of three questions out of the survey resulting in a new survey still used to determine an individual's user typology.

2.3.1 Diving deeper into the motivational needs and affordances of user types

The User Type Hexad scale consists of six different user types. Each user type is motivated in a different way with associated motivational affordances which can trigger intrinsic or extrinsic motivations. Some of the user types of the Hexad framework are close to each other and slightly overlap, because their motivational factors are related [15, 55]. Achievers and players are both motivated by achievement, however they differ in focus. Where players are focusing on extrinsic awards, achievers are focussing on competence. Furthermore, Tondello et al. [55] demonstrated a strong correlation between the user types philanthropist and socialiser. Both user types are motivated to play with others, but they differ because a socialiser's interest solely on interaction with others, while philanthropists interact with others to help them. Lastly, free spirits and disruptors are both motivated by autonomy and creativity. While this may be true a free spirit stays within the system without having the desire to change the system and disruptors attempt to go beyond borders trying to change the system. The overlap between motivations of user types and their difference in focus within a motivation is displayed in Figure 3.

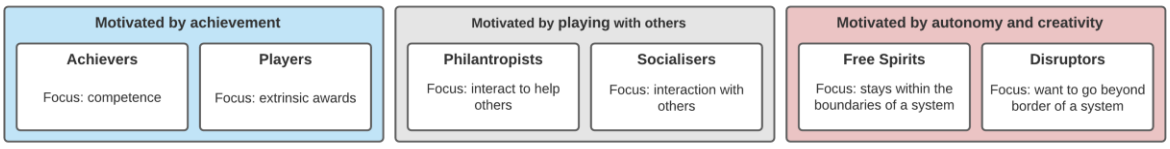

Figure 3: Overview of player types from the Hexad scale with the overlapping motivations and single focusses

Since the act of playing a game is generally more considered to be based on intrinsic motivations than extrinsic motivations [10], this section will mostly focus on the intrinsic motivations. When an individual's intrinsic motivations are satisfied psychological outcomes will occur. However, it might also be that extrinsic

motivations might be of value if the user type player is largely present. Because of this, it is also researched how extrinsic motivations can be triggered by motivational affordances. This section discusses the main motivations of each user type with coupled motivational affordances out of the literature. An overview of the motivational affordances linked to each specific user type found for each paper from the literature search is shown in Table 5. Table 5 also shows whether the specific paper had a focus on gamification applied specifically for energy saving purposes. Next to the motivational affordances, the last subsection focusses on literature were the link between the Hexad user types and persuasive technology was researched.

Free spirits

Free spirits are motivated by autonomy [15], in other words self-efficacy, which is one of the motivational needs of the self-determination theory (SDT) [13, 14]. This means that this user type likes to have a feeling of freedom and want to make their own decisions without the feel of external control. Free spirits will often try all the functionalities within a system and is most often the one finding the flaws in a system. Although they like to explore systems, they do not have the tendency to go beyond the boundaries of a system. As Tondello et al [56] describes this desire of free spirits being linked to game design elements involving immersion. These elements stimulate self-efficacy, as they allow players to fully immerse themselves in the game and feel part of it. Wee and Choong [24] identified personal profile and non-fixed structure successful in satisfying a user's need for autonomy when striving towards better energy conservation behaviour. Non-fixed structure is also proven by Osbaldiston and Sheldon [46] to be effectively, since letting users choose their own actions and goals let them better identify with their goals and enhances the feeling of autonomy. Concluding, free spirits like to turn the buttons and following a preconceived path is not their favourite activity. Instead, they are getting excited when they can choose their own journey through a system and let them determine how they progress.

The literature shows positive relations between free spirits and several motivational affordances. Table 5 displays the motivational affordances found in different papers which according to each paper stimulate the motivational need of autonomy. Looking at these different findings, some conflicting differences become visible. For example, Marczewski [57] found customization as an motivational affordance stimulating autonomy, where other research did not found this link [56]. More specifically looking at the context of energy saving, research also showed that customization did not have an effect on the motivation of players within energy saving applications [58]. These different findings do not directly mean that free spirits do not get pleasure out of customization, but maybe it is not directly increasing their motivations for specific behaviour change.

Another noticeable difference is found in the results of the research of Kotsopoulos et al [59] who researched the preference of Hexad user types towards game elements within an gamified energy saving application at the workplace. Their results showed significant relations between free spirits and several game design elements such as badges, points, and progression. However, other researches do not show these elements being linked to free spirits, but rather to the user type player. One explanation could be that this difference is caused by individuals forming a spectrum of user types, which could cause them to be interested in motivational affordances of other user types than their main type. However, there can also be another cause for this difference. Since the three elements were found in a research which focusses on stimulating energy saving behaviour, it could also be that these elements are crucial when stimulating energy saving behaviour through a gamified solution.

Philanthropists

The user type philanthropists is motivated by purpose [15]. Their behaviour is often leaded through altruism and they are willing to give without expecting a reward [15]. Philanthropist tend towards having serious fun, so having fun is important for them, but at the same time a task must be meaningful. For a philanthropist a task can be meaningful if they can help others or can help towards a higher goal. It is important for philanthropists to let them feel being of purpose within a system. As depicted in Table 5 the literature shows different motivational affordances stimulating the feeling of purpose for philanthropist. Marczewski [57] suggested different design elements such as collection and trading and knowledge sharing. Tondello et al [56] found that philanthropists are not motivated by elements involving immersion, but by elements involving progression. Progression gives philanthropists feedback on their level of purpose within a system and helps them to make clear what is still possible. Kotsopoulos et al [59] also found a correlation between an element of progression and philanthropists, namely badges, while other research often linked this element to players.

Achievers

Achievers are motivated by competence and mastery [15]. Competence is one of the three motivational needs out of the self-determination theory (SDT) [13, 14]. This means that competence is a very strong motivational need which could have a large positive effect on someone's intrinsic motivations and therefore

also on enjoyment future game play [35]. If together with the two other motivational needs of the SDT competence is evoked it can lead to behavioural change [12]. Due to this reason achievers are a strong user type within the Hexad scale. This behaviour manifests itself in trying to make progress within a system by completing tasks or tackling difficult challenges [15]. Within a system achievers are always looking to learn new things and improve themselves. They do not shy away from challenges and enjoy taking part in competitions. The willing of achievers to make improvements is mostly focussed on becoming better than others than becoming better yourself.

Marczewski [57] identified different motivational affordances which stimulate the feeling of competence and mastery such as challenges and certificates. Challenges are more often listed as an element who supports the need of competence [24, 56]. The research of Wee and Chong [24] applied the research for gamification applied for energy saving and also found other elements supporting competence. In addition to free spirits, achievers are also motivated by elements involving immersion [56]. Besides, achievers also get marginally motivated by progression just as philanthropists [56]. The same research also indicate that achievers are moderately motivated by risks and rewards, which include elements such as points, lotteries, and challenges. Looking at the spectrum of persuasive technologies, achievers were not motivated by any of the persuasion strategies, which might suggest that persuasion might not be an effective approach to motivate this user type [60].

Players

The user type player is motivated by extrinsic rewards, which causes them to do anything to earn a reward in which the type of activity does not play a role [15]. This user type is mostly motivated to do tasks within a system for a reward for themselves. It does not matter what the task is they will do whatever it takes in a system to earn a reward. This means that if they have to cooperate on a task to earn a reward, they will work on it. The same is true when they have to work on a task on their own. Concluding, this user type is focussed on external motivational needs more than internal motivational needs.

Socialisers

Socialisers are motivated by relatedness and get pleasure out of interacting with others [15]. It is an intrinsic user type and relatedness also forms one of the three motivational needs out of the self-determination theory (SDT) [13, 14]. This means that relatedness is as well a very strong motivational which could have a large positive effect on enjoyment future game play [35]. Socialisers like social competition, forming teams, and enlarging their social network. This means that a socialiser is just interested in the interaction with others itself without having another explicit goal.

One research on energy usage in a household made use of little characters to stimulate the feeling of relatedness out of the STD-theory [48]. Different characters can be chosen that are equal to the number of people in a household. These characters all came back within actions in the gamified app. For instance, while giving energy saving tips.

Disruptors

Disruptors are motivated mostly motivated by change, but also by autonomy and creativity [15]. Disruptors are seeking to go beyond the borders of systems. This is the user group that often finds mistakes within systems as they look further than the other user types. Because of this behaviour disruptor can cause both positive as negative effects in the system. Their actions can be negative, because they can act as griefers or cheaters, but on the other hand they can also work to improve the system by indicating mistakes.

Persuasive strategies and Hexad user types

The research of Orji et al. [60] looked into the relationship between individual preferences for persuasive strategies and the six user types out of the Gamification User Type Hexad scale. Although several links between the user types out of the Hexad scale and persuasive strategies were found, it is not said that these count for every research. This specific research focussed on the health domain, and the effectiveness of persuasive strategies are context and intention specific [61]. Therefore, it might be that a study performed in another context and intention will give different results. This does not only count for persuasive strategies, but also for gamification. Therefore, Table 5 shows whether the research focussed on energy saving applications making the results more reliable for this study.

Conclusions user types

Each individual does not solely belong to one specific use type, but forms a spectrum of different user types. This might be one of the reasons why there is overlap of motivational affordances within several studies. It can also be that motivational affordances are linked to user types based on the context of

gamification and cannot be generalized. It seems hard to design the solution that reaches the perfect level between wanna and hafta due to the overlap and differences within several studies. The Hexad scale might therefore work as a starting point to indicate what type of players are present in a target group, but will not solely be the solution. However, it still can give some direction in personalization strategies for specific user types. As the SDT support intrinsic motivations which are more important than extrinsic motivations in game playing, it might be important to include parts of all these motivational needs of the SDT.

2.3.2 Designing personalized gamification

Earlier research proposed a five step method to produce gameful design [62]. However, this was not focussed on personalization within gamification. Developing a personalized gamification application asks for more design steps than designing a one-size fits all approach. To overcome this problem Knutas et al. [63] suggest that gamification systems should use algorithms to automate some of the aspects of the personalization of gameful systems. They presented a design process to create supervised machine learning algorithms that enable the selection of personalized game elements based on the user type and system context, depicted in Table 4. Their proposed design process is based on the Deterding's five steps on gameful design [62], which form step 1,2,4,5, and 7 in Table 4. However, step 3 and 6 are novel steps focussing on personalization and a machine learning algorithm.

Table 4: Proposed gamification design process adapted from [63, p. 13599]

Design step	Activities
Define gamification strategy	Define the context where the gamification system operates and the desired outcomes. Formulate them as a) target outcome and metrics, b) target audience and activity, c) constraints and requirements.
Research	Translate user activities into behaviour chains. Identify user needs, motivations, and hurdles. Determine gameful design fit.
Select personalization strategies	Select personalization strategies based on gamification context, user needs, and user research.
Synthesis	Formulate activity-challenge-motivation triplets.
Ideation	Brainstorm, ideate and record challenges in addition to conditions that trigger them. Frame the challenges with the selected persuasion strategies.
Distil rules into an algorithm	Use a selected machine learning algorithm to convert human-written ruleset into an algorithmic form.
Rapid prototyping	Instantiate algorithm. Build prototype, playtest, analyse, ideate design changes. Repeat steps as long as necessary.

Table 5: Overview of found motivational affordances for each user type within the literature

	Energy focus	Achiever	Disruptor	Player	Philanthropist	Free Spirit	Socialiser
	Motivational affordances gamification						
[57]	No	challenges, certificates, learning new skills, quests, levels or progression, and epic challenges	innovation platforms, voting mechanisms, development tools, anonymity, anarchic gameplay.	points, rewards or prizes, leaderboards, badges or achievements, virtual economy, and lotteries or games of chance	collection and trading, gifting, knowledge sharing, administrative roles	exploratory tasks, nonlinear gameplay, Easter eggs, unlockable content, creativity tools, and customization	guilds or teams, social networks, social comparison, social competition, and social discovery.
[24]	Yes	challenges, feedback, theme, short cycle time and competition	-	-	-	Personal profile and non-fixed structure.	competition, cooperation, chat-based social network.
[56]	No	challenges, mystery box, easter eggs, themes, narrative or story, exploratory tasks, learning, unlockable content, levels/progression, meaning purpose, progress feedback, learning, points, lotteries	mystery box, easter eggs, themes, narrative or story, access, lotteries, boss battles, challenges	access, lotteries, boss battles, challenges, social comparison, leaderboards, competition, networks, status, teams, trading	levels/progression, meaning purpose, progress, feedback, learning	challenges, mystery box, easter eggs, themes, narrative or story, exploratory tasks, learning, and unlockable content	social comparison, leaderboards, competition, networks, status, teams, trading
[59]	Yes	-	Status	Rewards, Points, Badges, Leaderboards, Status	Badges, roles	Points, Badges, Progression, Status, Levels, Roles	Points, badges, rewards, roles

2.4 User types through the lens of a (green) energy supplier

In addition to the background research on the user types of the Hexad scale, each user type is highlighted through the lens of a green energy supplier. This gave us more insight into each user type as if they were a customer at a green energy supplier. This lens forms an expectation of how a user type will behave as a customer and is based on their motivational needs. Important factor is that this lens is an expectation and not tested in real environment of a green energy supplier.

Free spirits

The profile of the free spirit within the world of green energy suppliers is a bit more complicated. As free spirits are motivated by autonomy, they are probably motivated more if they can get in control of their energy usage in a way that they can choose themselves. It is expected that they do not want one predetermined option, but can choose between multiple things and information sources to get the feeling of autonomy over their energy consumption. It is expected that this group is more likely to switch, as they expect more of an energy supplier than just delivering green energy or a financial attractive contract. If a supplier succeeds in giving a feeling of autonomy to a free spirit user type it is expected that such an individual is less likely to switch to others.

Philanthropists

Due to their focus on meaningfulness, it is expected that philanthropists choose for green energy due to its meaningfulness relative to sustainability. This means that being sustainable is a great motivation for them and that they do not expect a reward except for contributing to a more sustainable country. As a direct consequence of this, it is expected that philanthropists are less likely to switch to other energy suppliers if their experiences meet the sustainability requirements they face. They must have the feeling that they are not affiliated with an energy supplier for nothing, but that it is for a purpose. Next to that they want to use the system for purpose or for feeling that they can be of purpose to others.

Achievers

For energy suppliers, achievers can be motivated by giving them tools to master their energy usage. These tools can be tasks or challenges that persuade them to become more sustainable. Feedback on how they are performing and what they can do to further improve will motivate them to fulfil these tasks and challenges. They must really feel that they have learned something new and that the reached progression is rightly deserved. The challenges can have different focusses, namely a monetary or sustainable focus. Depending on what a customer wants to see these focusses can be highlighted more. If an achiever user type can be involved in challenges and tasks they will enjoy a system more and user engagement will increase. As an increase in user engagement has a direct effect on the chances of a customer retaining his contract this can be a positive development if well implemented.

Players

As players are motivated by extrinsic rewards they might get triggered to work on energy saving if it earns them an external reward. An external reward must then be something offered to players outside a gamified application after they performed well enough. The most obvious external reward might be a discount on a service, product, or their contract. Another possibility for an external reward might be a coupon which could for example be used within a webstore. These external rewards can be earned via several ways to keep players interested in using a gamified application, for example via reaching a specific number of points, badges, or achievements. Probably the most important trigger for players is money, as it is an external reward. Therefore, it might be that this user type is more likely to switch to another energy supplier for an external reward. Many energy suppliers lure their customers with welcome gifts or discounts. It is expected that an individual belonging to the user type player is likely to switch to others for a high external reward, even if they are satisfied with the services of his current supplier.

Socialisers

Socialisers are motivated by relatedness and want to interact with others to create social connections. Their motivational need of relatedness and need to interact with others can be stimulated via a gamified application. It seems likely that this type of group wants to connect with others. This could be done at various ways, for example by inviting their own friends to play together or by connecting to other households in the Netherlands who face the same challenges as them. Within such a social network this group can be challenged to work together or run in a competition with others to stimulate their energy savings. Such a

social network will form the core motivation of socialisers to make use of the application as they would like to explore and improve their social status.

Disruptors

Disruptors are motivated by change and form a complex group. They often form a small percentage of the group but can be very powerful. Disruptors can be of great assistance but can also cause a lot of trouble. These people are probably the group of customers that is into energy data as well. They are interested within the concept and seek the internet for new interesting facts. This group will probably help to find mistakes within a gamified energy application. To appeal to this group a system must not be full of mistakes and within the case of an energy saving application. The facts and calculations on their energy consumption have to match reality, otherwise disruptors will probably find out and become less enthusiastic.

2.5 Expectations of customer group Pure Energie

Earlier research performed by commercial marketeers on the customer base of Pure Energie already showed three main customer groups: green driven, demanding, and price driven customers. These customer groups were determined during a customer inquiry with the use of a survey. Each group has his own characteristics and expectations of Pure Energie.

The *green driven* customers find it important that their energy is green as they consider sustainability very important. They expect that their energy supplier delivers only green energy to its customers and is fully focussed on creating a more sustainable situation within the Netherlands. If an energy supplier meets their expectations on this front they are satisfied and will not have a tendency to switch to another supplier. Therefore, this group forms a large part of the regular customer base of Pure Energie. Green driven customers form the largest customer group of Pure Energie.

The group of *price driven* customers do care about the financial part of green energy, unlike the green driven customers. Although they are most of the time interested in green energy, they will choose for the cheapest supplier within this segment. They are more likely to switch if other companies offer a lower contract price. This customer group is the second largest customer group of Pure Energie.

Finally, the *demanding* customers form the last group that was determined. Earlier research by Pure Energie showed that this group is the hardest to retain, since they expect more from energy suppliers than just delivering energy and the basic possibilities online. The demanding customers score high on pro activity and expect that an energy supplier offers extras to its customers. For example, by offering extra tools to get more insight into their energy usage as they are willing to learn more about their energy consumption. They also expect an energy company to continuously innovate its services and keep up with the times. This is the customer group which is the hardest to retain as their expectations of energy suppliers will continue to rise. With the use of satisfiers, this group can be made happy, they want to be proactive and get that extra step that they do not receive at other suppliers. Gamification can respond well to the demand of this customer type, it can be just that extra step that is necessary to keep this group of customers satisfied. Although this group is the hardest to retain, it forms the smallest customer group of Pure Energie.

Next to the three-way division of customers of Pure Energie the literature also shows another three-way division shown in Table 3. Table 3 shows three different customer segments, based on their goals regarding energy saving feedback systems [5]. Looking at these different three-way divisions we can see that these divisions lie close to each other. Therefore, it is expected that these three-way divisions have overlap with each other. Looking at the three customer groups of Pure Energie and the three customer segments by Gölz and Hahnel [5] we expect overlap between these groups based on their main and sub goal towards energy systems. Green driven customers of Pure Energie seem to have the same goal as customer segment three from [5]. Price driven customers motivations are the same as the motivations of customer segment 1 from [5]. Lastly, demanding customers motivations link with customer segment 2 from [5]. The links are based on the main and subgoal of each customer segment from both three-way divisions as depicted in Figure 4.

Figure 4 shows a new three-way division. However, these divisions are expected based on the information available on these customer groups which does not directly mean that this expected overlap is true. If we look at the goals of each of the three groups a striking detail becomes clear. If we keep moving one group to the right in Figure 4, we see that the subgoal of the right group is equal to the main goal of the previous group on the left of them. Suggesting that the more to the right in Figure 4, the more important several motivations become. The first group (green) is only interested in saving energy and avoiding inconvenience. The second group (yellow) main focus is saving costs, however this group is also interested in saving electricity and therefore also a bit green driven. The last group (orange) wants to have fun within a system and learn more about electricity saving and besides also wants to save costs, which makes them also a bit green and price driven as well. Summarizing this finding, it seems like the three customer groups of Pure

Energie build up on each other. Starting with a solely group the green driven customers only focussed on being sustainable. Secondly, the price driven customers build upon the green driven group as their main focus is reducing costs, but at the same time they are also interested in green energy. Lastly, demanding customers are interested in learning more and have fun, building up on green and price driven customers as they are interested in being sustainable and reducing costs as well. Despite these expectations, it is not certain whether they will be true in practice. Although it seems likely, there might be deviations within these overlaps.

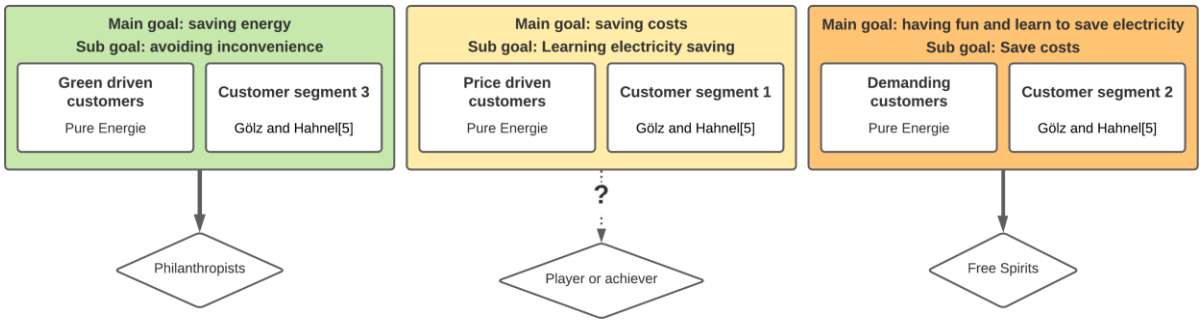

Figure 4: Overlap between customer groups determined by Pure Energie and customer segments of Gölz and Hahnel [5] and user type Hexad scale [15]

So now, we see three different customer groups with their own goals, but it does not say anything on how we can design a personalized gamified solution for them. The Hexad scale can help to determine the user types of each of the customer groups and makes personalization possible. If we look at the customer groups from Figure 4 we expect some causal relationships with some of the user types from the Hexad scale. Because of this overlap it is expected that some user types will be stronger visible than others in the customer base of Pure Energie. For example, a similarity is visible between the green driven customers and the user type *philanthropist*. Tondello [15] describes a *philanthropist* as an individual who is motivated by purpose. Their behaviour is often leaded through altruism and they are willing to give without expecting a reward [15]. *Philanthropist* tend towards having serious fun, which means that having fun is important for them, but at the same time a task must be meaningful. If philanthropists are considered as customers of an energy company, it is expected that this group will choose green energy because of its importance in relation to sustainability. Being part of a more sustainable world is what they strive for and they are willing to give for it as price is less important for them. These characteristics make that *green driven* customers and *philanthropists* lie close to each other.

When we look at the demanding customers through the lens of an energy supplier, chances are that this group will score high on the *free spirits* type from the Hexad scale. The need to feel autonomy over systems and in this case their energy consumption matches with the question of demanding customers expecting more than only basic functionalities of their energy supplier. Next to that they expect a good price and sustainable energy, they want to have fun and learn more about how to save energy. The urge of free spirits to want to have fun and their highest chance on going to another energy supplier might make them the most suitable type for a gamified solution. As if applied well, such an application might increase their positive thoughts on the brand of Pure Energie.

Finally, the *price* driven customer group is more difficult to link to a user type from the Hexad scale. They strive mostly for an affordable contract which is not directly linked to one of the motivations of the user types from the Hexad scale. However, the user type *player* gets triggered by extrinsic rewards which could also be a lower price and could therefore be linked to the motivation of achievement which could also link them to *achievers*. However, the exact link between this customer group and user types seems not as strong as the other two combinations.

Looking at the three groups within the context of energy savings shown in Figure 4 and their expected connections with the user types from the Hexad scale, we see that each group lies close to one of the motivational needs of the SDT theory [13, 14]. The first group who have a green focus are expected to be philanthropists and thus motivated by purpose. However, philanthropist lie close to socialisers based on their motivational needs [15, 55]. Meaning that the intrinsic motivation relatedness from the SDT can be an important motivation for this user group. The second group with main focus on price is expected to have a link with the player or achiever type from the Hexad scale, who also lie close to each other looking at motivations [15, 55]. Meaning that the intrinsic motivation competence of the SDT might be a trigger for the individuals belonging to this user group. The last expected group are free spirits and their main motivational need matches directly with the intrinsic motivation of autonomy from the SDT [15]. These clearly visible links might suggest that designing for intrinsic motivations might be of great importance while designing an energy saving application.

Looking at the expected links between the customer groups of Figure 4 and the user types we can link each group to the three main motivations of the user types from the Hexad scale. Earlier in this chapter we showed that the user types from the Hexad scale can be divided within three main motivations, as depicted in Figure 3. Each of the three groups from Figure 4 can be linked to one of more of these main motivations as is shown in Table 6. As originates from both Figure 4 and Table 6 the user types add up to each other from green customers to the demanding customers. Where for the green customers only social motivations are important, the demanding customers find more than one motivation important. As explained earlier we expect that green driven customers will match most likely with the user type philanthropists. Demanding customers will most likely match with the user type free spirit. For price driven customers it is a bit harder to determine an exact user type, but it is expected that they are motivated by achievement. Important for both the user type players and achievers. However, these links are only an expectation and not a proven fact.

Table 6: Expected links of main motivations of Hexad scale with customer groups of Pure Energie. A 'X' shows a group expected main motivation and a '+' shows a sub motivation of a customer group. The abbreviation 'cust' in the table stands for customer.

MOTIVATIONS [55]	GREEN	PRICE	DEMANDING
SOCIAL	X	+	+
ACHIEVEMENT		X	+
AUTONOMY AND CREATIVITY			X
	Cust segment 3 [5]	*Cust segment 1 [5]*	*Cust segment 3 [5]*

Looking at the literature, these user types philanthropists, free spirits, and achievers are the strongest motivations [55]. These user types are closely followed by socialisers and players, while the disruptor type scores on average the lowest [55]. Earlier research on the Hexad applied for energy saving showed achievers and philanthropists most identified within a sample, with socialisers and free spirits following closely [59]. If the distribution within the customer group of Pure Energie is equal to the findings of the literature, philanthropists, free spirit, and achiever will receive the highest scores on average. As it is already expected that philanthropists and free spirits have overlap with the green and demanding customers, it is highly expected that these two groups will frequently occur in the customer base of Pure Energie. Following the findings of the literature the user type achiever should also form a large group of customers, which could be the price driven ones. However, extrinsic rewards are important for this group, which is mostly linked to the user type player. A hexad survey conducted among customers of Pure Energie will show whether the most occurring user groups are indeed philanthropists and free spirits. Although it is more uncertain it is expected that these user types will be followed by the user type achiever or player. For achievers this is because it is proven to be one of the strongest motivations. While on the other hand, the motivational factors of the user type player match with the motivational factors of the price driven customer group.

Looking back at the literature we can conclude that the Hexad scale [57] is an often used method to allow for personalisation within gamification design. An important step made in the literature about the Hexad scale is its empirical validation which proves that the survey determining an individual's user type is effective [55]. For personalizing for an energy saving application two already determined models in the literature seem to be valuable, namely the Hexad scale [57] and the model designed by Gölz and Hahnel [5]. The model of Gölz and Hahnel [5] can be of big importance for designing a gamified energy saving application as it is the only model found describing customer segments within energy saving applications. Striking about personalized gamification performed via the Hexad scale is that user types can be linked to motivational affordances also game mechanics [56]. Which might suggest that this is a good strategy to design personalised gamification. This is supported by the research of Kotsopoulos et al. [59] who were able to link specific motivational affordances to user types within the context of gamification used for energy conservation among employees. As it is already proven successful for energy conservation personalization using different motivational affordances for user types should be considered. Furthermore, Wee and Choong [24] showed correlations between the motivational needs of the SDT [13] and motivational affordances in the context of a gamification energy saving campaign. As the user types of the Hexad scale rely on the motivational needs of the SDT, these design elements could be of great importance when designing gamification for energy saving [57]. To sum up, the literature analysis pointed out two three-way divisions for customer groups which can be followed for designing gamification and the Hexad scale is suggested to be a suitable strategy to start personalisation.

3 Methodology

This chapter introduces the global methodology applied in this study. It shows the general steps taken to answer the main research question of this study. The more in-depth steps taken for each individual method are discussed in the corresponding chapters in this document. However, the reasoning behind the chosen methodologies will be explained within this chapter.

3.1 Method applied in this study

The personalized gamification solution developed within this master thesis is designed using the method proposed by Knutas et al. [63] which supports designing algorithm-based personalized gamification. However, this study focusses on designing a personalized gamification solution and therefore does not take the part about algorithm-based solutions into account. Due to this reason the original method by Knutas et al. [63], as depicted in Table 4, was revised and rewritten leaving out the parts focussing on an algorithm-based design, but keeping the elements focussing on designing for personalized gamification. This resulted in leaving out step six of the original method, which is about choosing a suitable machine learning algorithm. Instead, a suitable structure for customization of gamification elements was created. However, this new step was included in the rapid prototyping phase. The other steps from the original method by Knutas et al. [63] were kept. The resulting steps applied during this study are depicted in an overview within Figure 5. Figure 5 also shows the sub methods which were applied during each step. These will be further explored in section 3.2.

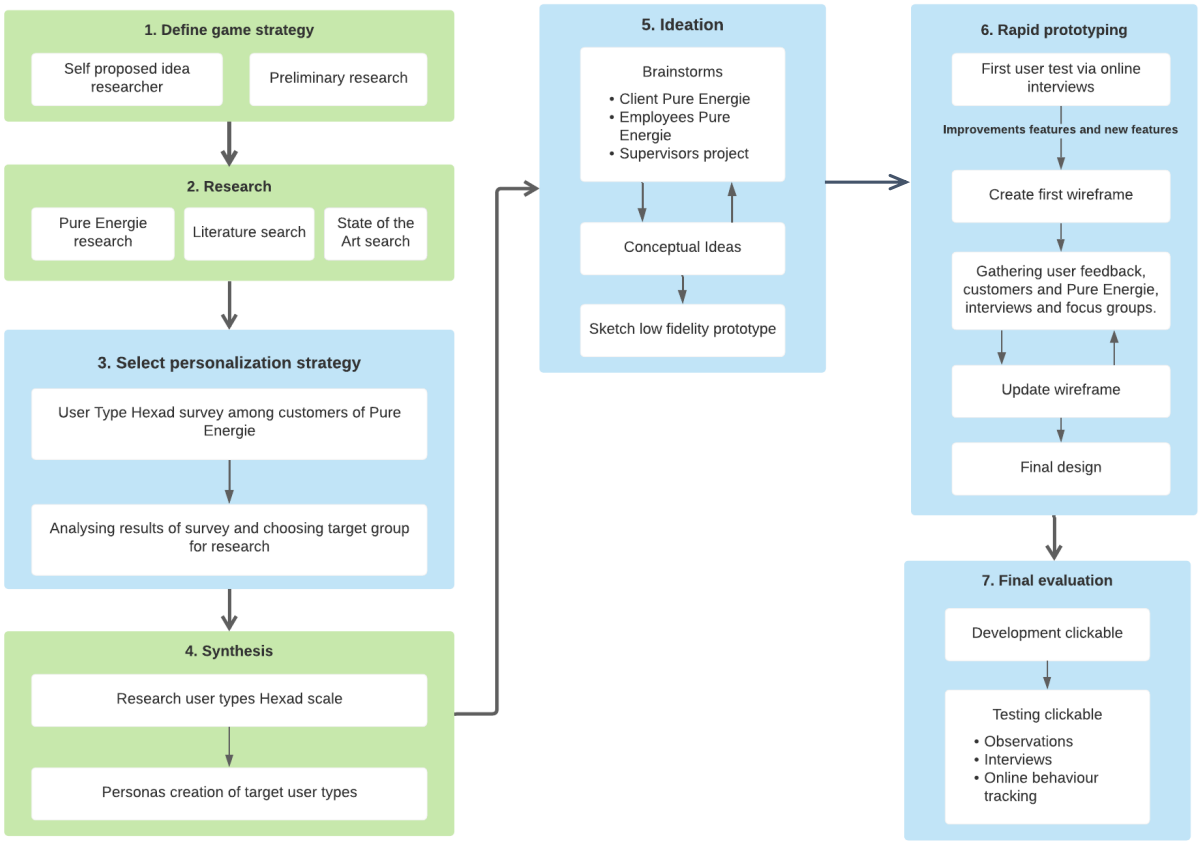

Figure 5: Methodological overview of methods used during this thesis project. Diverse methods were applied across seven different stages. The green parts involved research performed in the research topics, the preliminary part of this research. Blue parts involved methods applied during this study.

The first six steps in Figure 5 are all retrieved from the method by Knutas et al. [63]. The sixth step named *'rapid prototyping'* follows a human-centred design process according to the International Organization for Standardization (ISO) [64] as depicted in Figure 6. This design approach is a system design method focusing on the user interaction with a system to improve user experience. This means that the target users are involved in the design process from the very beginning and following an iterative process. Human-centred design according to ISO 9241 [64] consists of four main phases: *(1)* understand and specify the context of use, *(2)* specify the user requirements, *(3)* produce design solutions, *(4)* and evaluate design against requirements. However, during this research the design was not continuously updated based on user requirements, but on user feedback. This user feedback formed new input for the iterative process in which changes were gradually introduced to optimize and improve the design. During each design round the opinion from the stakeholders was also taken into account. The last step in the method, called '*final*

evaluation', was added by the researcher conducting this study. This last step was used to test the final hypotheses on an interactive design.

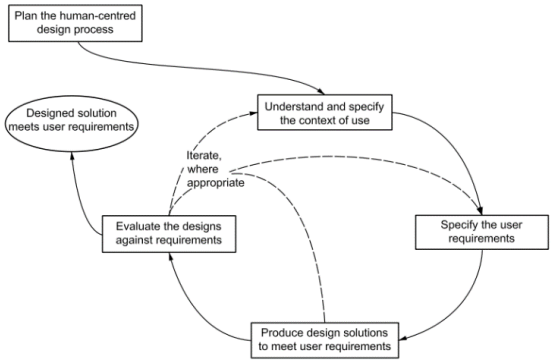

Figure 6: Illustration depicting the iterative human-centred design process as defined by ISO 9241 [64]

3.2 Overview of sub methods conducted in this study

For each of the steps listed in Figure 5 several sub methods have been applied. These sub methods consist of both qualitative and quantitative research. In the upcoming paragraphs the goal of each step is described together with the rationale behind the applied sub methods. More detailed information about the respective sub-methods is given in the corresponding chapters in this document.

Step 1: Define game strategy

Within this step the overall gamification strategy was determined [63] . The target outcome behaviour, target audience, and constraints and requirements were formulated. This step is partly carried out during the preliminary phase of this study where the specific research question originated. In addition, the executed research topics study [65], performed preliminary to this master thesis study, also resulted in requirements and constraints for the game strategy designed for this study.

Step 2: Desk Research

The desk research consisted of three separate parts, namely a systematic literature study, state of the art analysis, and stakeholder analysis which were already performed during the preliminary phase of this study. The goal of this step was to get a basic understanding of the literature and available information helpful to answer the main research question. During the systematic literature study the background theory on gamifications and its possibilities for personalization and the energy world were explored (chapter 2). For personalized gamification, the focus was on the User Type Hexad scale. The motivations, needs, and hurdles of each user type belonging to this scale were described. In addition, each user type was described through the lens of a green energy supplier, the stakeholder of this study.

The state-of-the-art study was carried out to get insight into the already existing energy saving applications. Both applications developed for the (commercial) market and research studies were used. The used gamification elements, main goals, and approaches to stimulate energy saving behaviours were described. Insights from this study were used during the ideation phase, performed in step 5 of this study. The state-of-the-art study is shown in Appendix B.

Lastly, a stakeholder analysis was performed in which both the online channels as the already existing information on the customer base of Pure Energie was explored. An interview with the stakeholder gave more information about the online channels of Pure Energie. Each online channel and its functionalities were summarized and the use of some gamification elements was already seen. Based on this research, the choice for developing a gamified application for the customer portal was made. The stakeholder analysis is listed in Appendix D. Secondly, the existing knowledge on the customer base of Pure Energie was gathered. A research performed by commercial marketeers showed three main customer groups of Pure Energie. These groups were placed next to the results from the literature search, which resulted in expectations towards the user types of the customers of Pure Energie. These expectations helped us to understand for which individuals we had to design.

Step 3: Select personalization strategies

The goal of this step is to choose a framework to profile the users within a target group based on a personalization approach [63]. The User Type Hexad scale [54] was chosen as personalization strategy,

also advised by Knutas et al. [63] who proposed the method applied in this thesis. In addition, the Hexad scale is proven to be an effective personalization technique within the literature. The choice for the Hexad scale was already made during the research topics phase of this study. The Hexad scale was used to get more insight into the present user types within the target group, the customers of Pure Energie. To determine the user spectrums of the customers of Pure Energie a 24-itemed validated survey [55] was implemented within the customer portal of Pure Energie. This quantitative study (N = 275) was performed in the same way as was applied by [55]. Results on this survey showed the scores on each user type, as a user spectra in which the sum of each of the four questions per user type were added just as done in [15]. However, for analysis the main user type of each participant was determined using the highest average score on a type. A more detailed description of the sub method applied in this step is given in section 4.1. The results of this survey were used to be able to make a focus group which interest were further explored in the other steps performed in this study.

Step 4: Synthesis

In this step, the personalization strategy was further explored. In the previous step three main user types were chosen as target group for this study, namely achievers, free spirits, and philanthropists. The information about these user types retrieved from the systematic literature search and stakeholder analysis was put together in a design strategy. Besides, requirements for implementing specific game elements were set using the main findings of the literature search on energy saving applications and stakeholder analysis. This information together with other results from step 2 gave a starting point for the first conceptual ideas during the ideation phase.

Step 5: Ideation

The goal of the ideation phase is to generate first ideas and to develop them into conceptual sketches. The personas and requirements created in the previous step, together with the information on already existing applications was used as starting point for the ideation process. Several mind maps were made, and conceptual ideas were discussed with both employees of Pure Energie and the supervisors of this study. Concepts were reflected upon and failing ones were discarded and promising ones were further discussed and explored. From these mind maps several conceptual ideas were designed which in the end resulted into the first low-fidelity prototype. This low-fidelity prototype consisted of sketches which were used as input for the first user interviews performed during the rapid prototyping phase. The ideation phase and its results are described in more detail in section 5.2.

Step 6: Rapid prototyping

The activities performed in this step are used to work towards a high-fidelity prototype, which makes this step actually a *'generation phase'*. During this phase conceptual ideas were rapidly prototyped resulting in gamified designs, following an iterative process as proposed by [63]. The design was continuously updated using a human-centred design approach [64], in which the designs were updated based on user feedback. The process started with testing the first low-fidelity prototype resulting from the ideation phase (step 5). The designs were discussed during an interview with customers of Pure Energie (n = 9). The results of this interview were used to make a new design iteration. Several iterations have taken place based on feedback from the client Pure Energie and its customers. Customer feedback was next to the first interviews gathered through two focus groups (n= 4 & n = 6). The iterative process resulted in a final design forming a gamified dashboard and energy editor. Chapter 6 describes the rapid prototyping phase in more detail.

Step 7: Final evaluation

During the final evaluation phase an interactive high-fidelity prototype was tested. This last step was performed to see whether the design meets the user requirements, the final step of the human-centred design process by ISO [64]. The final designs resulting from the rapid prototyping phase were made interactive using the program Axure[5]. The resulting clickable was tested by a set of customers via an interview. Within this interview customers were asked to create their ideal dashboard and to click through the different designs. During this final evaluation the final hypotheses were tested using three different evaluation methods, namely by analysing answers given by participants, chosen elements for the dashboard, and clicking behaviour. The behaviour of participants within the clickable was tracked using Hotjar[6]. A more detailed description of the final evaluation is given in section 7.1.

[5] Axure, version 9, downloaded from https://www.axure.com/.

[6] Hotjar, basic version, https://www.hotjar.com/.

4 Identifying target group Pure Energie

Before the designing phase for a gamification application for Pure Energie was started the target group of Pure Energie was identified. Because the effects of gamification are highly user dependent, tailored gamified solutions are proven to be more successful than one-size fits all approaches [15–18]. This research focusses on whether design choices have an effect based on individuals preference towards user types from the Hexad scale [15]. To be able to research this the preference of customers of Pure Energie towards these user types is identified using the validated User Type Hexad survey [55]. This chapter consists of four sections. Firstly, the method (section 4.1) that is applied for this survey is explained. This section is followed by the results (section 4.2) from the survey. Lastly, the discussion and conclusion (section 4.3) are elaborated.

4.1 Method

In the following sections I describe the method that is applied to identify the target group of Pure Energie with the help of the User Type Hexad scale. The survey questions, procedure, implementation and analysis are separately discussed.

4.1.1 Questions survey

To be able to create a personalized gamification solution for the customer group of Pure Energie a survey is distributed within the company's customer group. The survey that is used is the User Type Hexad survey designed by Tondello et al. [55]. The User Type Hexad survey is a tool which determines the preference of an individual towards the six different motivations out of the Hexad framework [54]. The User Type Hexad survey consists of 24 questions, but the total survey used in this study consisted of 28 questions. The first four questions were about customer satisfaction towards the customer portal. These questions contextualized the research, a requirement for aligning all Pure Energie's stakeholders. These questions were used to avoid negative customer attitudes towards the brand, as they showed that the overall goal of the survey is to improve the customer portal. It was expected that this might not have been clear for several customers, since the questions out of the Hexad scale are about personality traits. The four introductory questions can also help to gain a basic understanding of customers' current attitudes towards the customer portal. The four introductory questions are depicted in Table 7. Another measure taken to prevent a negative attitude towards the brand, is that the approach used was to let users participate by clicking on a notification. In this way, customers were not directly asked to participate, but can choose themselves by clicking on a link [66]. The next section (4.1.2) explains this self-selecting approach in more detail.

Table 7: Introductory questions of the survey

Q1: I often make use of the customer portal.
Q2: The customer portal meets my expectations.
Q3: I actively use the customer portal to monitor my energy consumption.
Q4: The customer portal gives me sufficient insight into my energy consumption.

The other 24 questions consisted of the empirically validated questions of the User Type Hexad scale survey of the survey which can determine individuals preference towards the six user types [55]. However, these questions have only been empirically validated in English and Spanish. This research focused on Dutch-speaking individuals and translating the survey into Dutch could lead to a decrease in the validity of the survey. To overcome the validity problem as good as possible it was researched whether the User Type Hexad survey was already translated to Dutch by other researchers. To the knowledge of the researchers, only one these performed at the KU Leuven applied a Belgian version of the User Type Hexad scale survey [67]. However, this thesis research did not used the empirically validated survey [55], but the first version of the User Type Hexad survey [15]. The validated version of the Hexad survey differs from the original version of the Hexad survey as some questions differ in structure or word usage. In addition, some of the questions in the research of Ooge [67] were no direct translations of the original questions form the Hexad survey as the word order was changed. For example, one of the original questions of the Hexad scale is *"interacting with others is important for me",* and Ooge [67] translated this sentence to *"ik vind interactie met anderen belangrijk",* which is not a direct translation of the question. Due to these reasons we choose to base the questions in Dutch on the questions of the validated User Type Hexad scale survey of Tondello et al. [55] by using reversed translation and check with the original questions from [55]. Appendix E shows the 24 questions of the User Type Hexad scale [55] together with the Dutch translation used in this research.

Each participant received the 28 questions in the same order. The first four questions indicating the satisfaction towards the customer portal were listed in the same order as mentioned above. The other 24

questions were shown in randomized order and shown without the corresponding type as advised in [55]. However, the randomized order of questions was the same for each participant. All the 28 questions were answered on a seven-point Likert scale, from totally disagree to totally agree, as recommend by [15, 55]. The seven steps on the Likert scale all had their own anchor and were directly translated as used in the original Hexad scale as shown in Table 8. The next section describes the procedure of the survey and explains the steps customers need to take to participate in the survey.

Table 8: Descriptions of the seven steps of the Likert scale used as answer options in the survey

Totally disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Totally agree

4.1.2 Procedure survey

The goal of this survey is to determine the target group of Pure Energie with respect to the Hexad scale. An often used method to make predictions on the population is called *random sampling (or probability sampling)* which can be used if users are required to log into networked resources [66]. In a probability sample, the chances of a participant being selected for the sample are equal for every individual and each selected participant will receive the same invitation to participate [68, 69]. A probability sample was made of the customers of Pure Energie meaning that a large group of customers were invited to participate in the survey. However, this group was randomly chosen of the customers of Pure Energie and did not include any inclusion or exclusion criteria. The selected participants all received the same invitation to participate. Although participants were randomly sampled, a method called self-selection was used as well. Normally, self-selected surveys are forming non probalistic samples as users click on a links on a website or social network [66]. This self-selecting principal was applied to not avoid any negative attitudes towards the brand of Pure Energie as was asked by stakeholders of Pure Energie. The self-selecting approach was implied through a notification on the personal dashboard of the customer portal saying *"Participants wanted for research customer portal"*.

From the moment that the self-selecting approach started by showing the notification on the dashboard customers could take various actions as depicted in the flow diagram in Figure 7. The choices that a customer could take within the procedure are explained with the help of this Figure 7. The survey was presented to the customers by means of a notification on their dashboard within the customer portal. Customers could choose whether they wanted to participate. From the moment the notification was shown on the dashboard, a customer had three options. The first option was to click on the delete button to remove the notification from the dashboard. In that case, the notification was no longer displayed and the customer did not participate in the research. The notification also disappeared when a customer logged in three times without responding to the notification. The last option was to participate in the survey via a button in the notification. In this scenario, the customer was directed to a page that explains the purpose of the survey and task. The customer had to accept the terms and conditions of the survey on this page to before starting the survey. The terms and conditions mentioned that a customer could choose whether he wanted to participate and could stop at any time. It was also explained that the anonymized results are used for a graduation research and that they might be contacted for follow up research. After accepting the terms and conditions the customer was directed to the page with questions. The survey could only be submitted when all questions had been answered. A customer could close the survey at any time and continue it via a notification shown on the dashboard. After completing the survey the customer was forwarded to a page in which he was thanked for his participation.

4.1.3 Implementation survey

The survey was implemented within the customer portal. Several pages and a database had to be developed to carry out the survey within this online environment. A database was created to log every step of the customer, so that it could be kept track of what actions a customer had taken. Each action was logged with a timestamp as well. To realize the front end of the survey three HTML pages were created. Participants were directed to the first page after accepting the notification and included an explained the survey and its conditions which could be accepted or declined. When accepted participants were directed to the second page including the survey questions. After handing in the questions participants were directed to the third page was the thankyou page. Each page was styled conformed the style guide of Pure Energie with the help of SCSS. After a final test, the extra pages and database were published within the customer portal environment of Pure Energie.

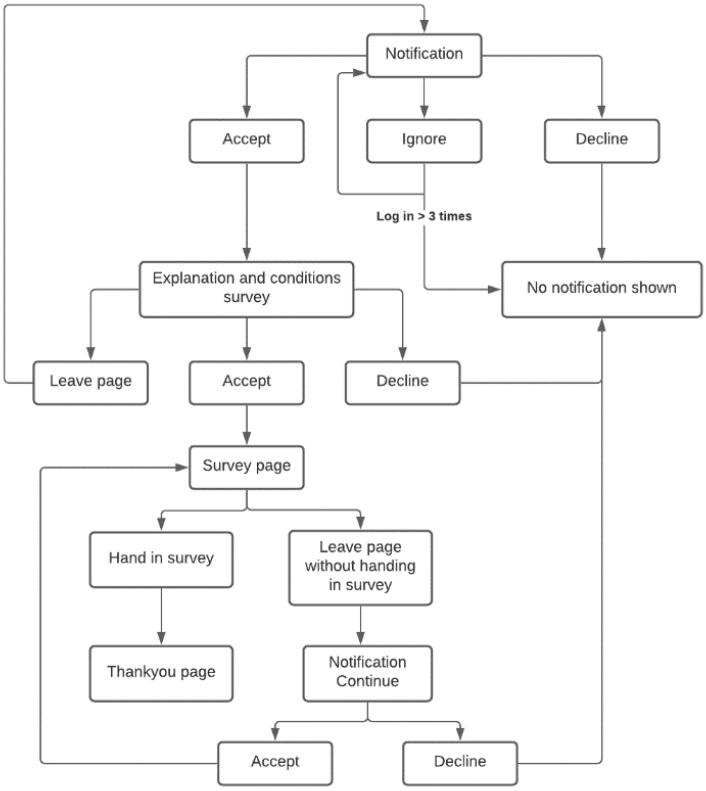

Figure 7: Flow diagram of participating in survey

4.1.4 **Analysis**

Data selection for analysis

Before the data analysis started a data selection was made on the retrieved answers of the survey. All responses from the survey were extracted from the database and imported into Microsoft Excel. As a first step the incomplete surveys were filtered out of the data, such that the user type of each participant could be determined. But before the user type spectrum of participants was determined a few more filtering steps were applied. Results that suggested unattended participation on the survey were filtered out as well using two methods. First, the surveys in which participants gave the same score on the Likert scale for every question were filtered out. Although the occurrence of this is considered very unlikely due to the present questions. Secondly, the response time of participants to the survey was determined with the help of the time stamps. Lower outliers based on response time were filtered out to prevent using unattended participation results during analysis. The survey response that remained after these filtering steps were considered as valid and used for the analysis.

Analysis customer portal questions

The first four questions of the survey were separately analysed as the average was computed for each question. In addition, it was examined whether there were differences in answers based on the differences in user type spectra of the customers.

Analysis User Type Hexad scale

The 24 questions belonging to the User Type Hexad survey have been analysed separately. Scores were given for each of the six user types per participant as suggested by Tondello et al. [15]. The scores are based on the four questions belonging to each user type. Each question is answered on a 7-point Likert scale with each answer assigned a score from 1 to 7. The scores belonging to each point on the Likert scale are shown in Table 9. After the scores were assigned to each question, the scores of the questions corresponding to each subscale (user type) were added. For better readability the scores of the subscales are represented by the sum of the items instead of the mean [15] , meaning a maximum score of 28 per user type. From these scores the mean and standard deviation were computed for the as also performed

in the research of Tondello et al [55]. The user spectrums, and the mean and standard deviation values, were calculated for the whole population and for men and women separately.

Table 9: Answers of Likert scale with assigned scores

Totally disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Totally agree
1	2	3	4	5	6	7

4.2 Results

From the invited customers, a total number of 334 customers has participated in the survey. However, only 274 surveys were completely answered and counted as valid responses. Invalidity was found in two different forms. In total 46 surveys were not completely answered and therefore not considered during the analysis. Another fourteen survey answers were invalid due to a too short response time or due to no variety in answers on the Likert scale at all. During this analysis the 274 surveys determined as valid were used.

The results are explained through three separate sections. First, the results of the four introductory questions are given (section 4.2.1). Secondly, the overall scores of the participants are given (section 4.2.2) followed by the results based on gender (section 4.2.3).

4.2.1 Introductory questions

The mean on the four introductory questions as depicted in Table 7 were calculated per main user type as shown in Table 10. The mean scores are calculated using the scores that are presented in Table 10.

Table 10: Mean scores on introductory questions calculated per main user type

	Fr Sp	Phi	Ach	Pla	Soc	Disr
Q1: often make use of portal	4,46	4,72	4,72	4,80	4,48	6,00
Q2: portal meets expectations	3,98	4,34	4,08	4,08	3,88	5,00
Q3: monito energy consumption	4,88	4,91	4,77	4,88	4,68	4,33
Q4: sufficient insight into energy consumption	4,23	4,42	4,26	4,12	4,16	4,33

4.2.2 Overall scores on Hexad scale

When only looking at the main user type of participants philanthropists are most frequently present, followed by free spirits, and achievers respectively as shown in Figure 8. Of the total number of participants the main user types are present as follows, 26% are philanthropists, 19% are free spirits, and 13% are achievers. Socialisers (5%), players (9%), and disruptors (3%) are less present within the set. The remaining 26% consists of participants who do not have one main user type, but a set of two or three user types on which is scored equally. The occurrences of the different user types in this set of participants are shown in the

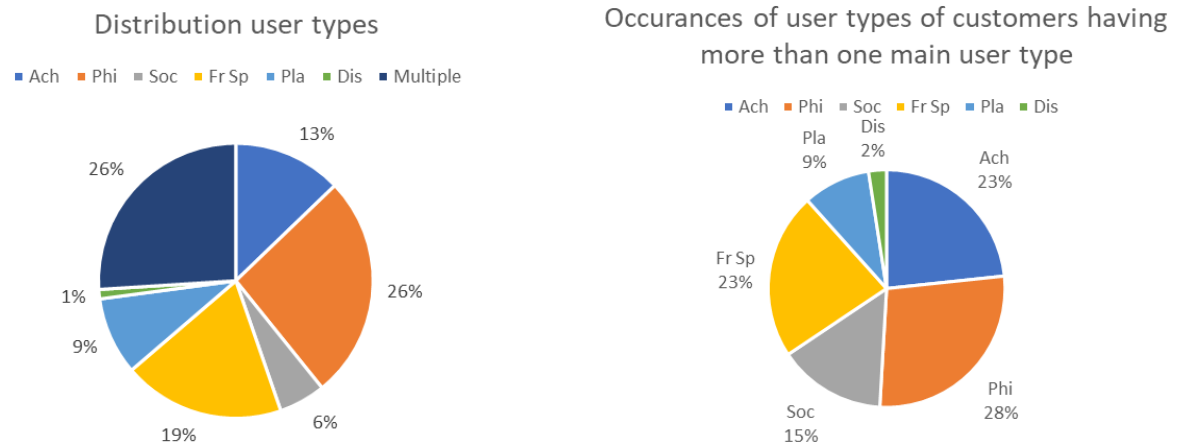

Figure 8: Distribution of main user types among all participants (left circle diagram) and distribution of user types for customers having more than 1 main user type (right circle diagram)

right diagram of Figure 8. Again philanthropists, free spirits and achievers are the most occurring user types.

The results showed within Figure 8 are supported by the results of the mean and standard deviation computed for each user type as depicted in Table 11. For better readability, scores are represented as the sum of each user types subtype instead of taking the mean (i.e., the maximum value for each subscale is 28 retrieved from four questions). A visual inspection reveals that philanthropist scores the highest mean, followed by free spirits and achievers. The other types score remarkable lower on the mean. Also remarkable is that the three user types with the highest mean score the lowest standard deviations, suggesting that these are most consistent throughout the whole sample.

Table 11: Mean and standard deviation of the calculated scores for each of the six user type dimensions from the Hexad scale

User Type	Mean score	SD
Philanthropist	23,06	3,51
Socialiser	20,44	4,45
Free Spirit	22,45	3,35
Achiever	22,36	3,67
Disruptor	15,57	5,01
Player	19,77	4,70

Table 12 presents the bivariate correlation coefficients and significance levels between each Hexad type and all others. We followed Tondello et al. [55] by using Kendall's τ instead of the more commons Person's r because of the user scores being non-parametric.

Table 12: Bivariate correlation coefficients (Kendall's τ) and significance between each Hexad user type and all others

User types	Philanthropist	Socialiser	Free spirit	Achiever	Player
Socialiser	0,313*				
Free spirit	0,175*	0,112*			
Achiever	0,29*	0,206*	0,339*		
Player	0,126*	0,178*	0,035	0,264*	
Disruptor	0,045	0,046	0,199*	0,092	0,069

* $p < 0.01$

4.2.3 Scores on Hexad scale gender based

When looking at the gender of the participants more men completed the survey than women, 76% to 24% respectively. However, the gender is based on the information out of the profile of the customer, which does not directly indicate that the person of this gender has completed the survey. It could be that within a family a man has registered a contract on his name, while his wife always checks the customer portal and has completed the survey. Besides it does not consider a beyond dichotomous view of gender. Concluding, we did there was not ask for gender in the survey gender cannot be determined. However, we still look at the results as if the gender matches the information of the customer profile, which only includes the option man or female. This information was used, because later in this study we also examined whether we could identify differences between men and women. Although the results are shown below, no conclusions are drawn from them, they only function as information for later research.

Figure 9 shows the distribution of user types per gender, taking men and women into account as explained earlier. A first visual inspection reveals that more large differences between both genders lie within the user types free spirits, socialisers, and achievers. The occurrences of the user types for both men and women having more than one user type were also determined and are shown in Figure 10. Here the largest differences are seen in the user types disruptor, socialisers, and free spirits.

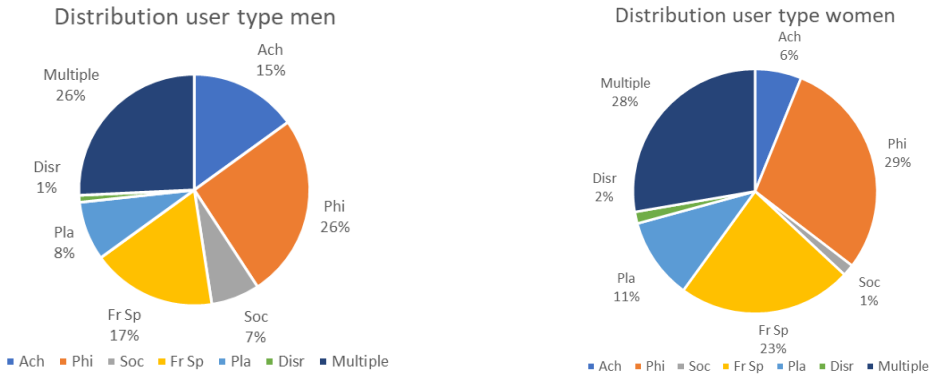

Figure 9: Distribution of main user types for men (left) and women (right)

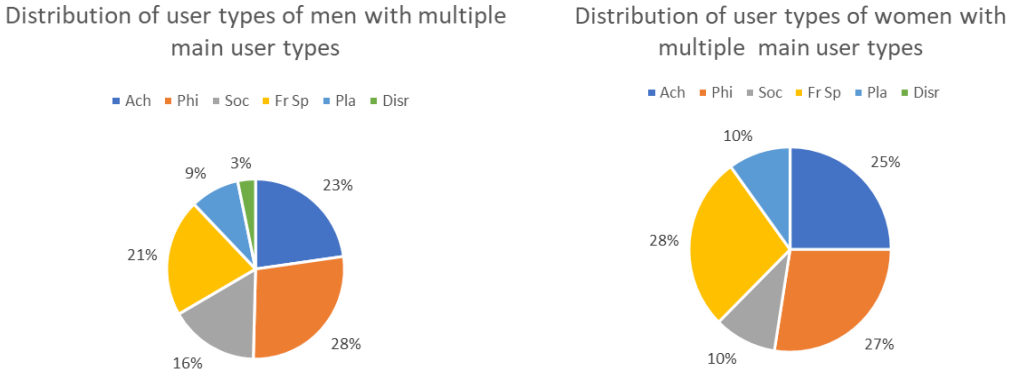

Figure 10: Distribution of user types for customers having more than one main user type for each gender (left men and right women)

4.3 Conclusions and discussion results Hexad survey

The analysis of the first four questions not belonging to the Hexad survey show that there are no big differences between user types except for the user type disruptor. However, only a limited number of participants have disruptor as main user type which could have caused a bias in the results. Question 2 reached the lowest average score for every user type except disruptors. Suggesting that customers of Pure Energie are not that satisfied about the current customer portal.

The most occurring main user types identified within the participants of the survey were philanthropists, free spirits, and achievers. As expected, philanthropists and free spirits were found as large groups present as user types. We were more uncertain about what user type to expect as third largest group present in the customer base of Pure Energie. Section 2.5 explained that both achievers or players could also be largely present. Results now show that the intrinsic user type achiever is more present among the participants than the extrinsic user type player. These results match with earlier findings from the literature which show that the user types linked to intrinsic motivations are most present [55].

Looking at the overall computed mean and Standard deviation for each user type dimension in Table 11 we see that our results not really differ from those earlier reported by Tondello et al. [55]. Within the customer base the user type disruptor is almost not present. Earlier performed work also showed the disruptor being the least common user type [55]. That the user type is so less occurring within the customer base of Pure Energie might be because of a bias within the participants or that the customers of Pure Energie simply do not belong to disruptors. Socialisers are also not so present as in other researches [55]. This might be explained by socialisers lying close to philanthropists, which was an already expected correlation and is also proven in Table 12. Due to the proven positive significant correlation between philanthropists and socialisers it might be that within the context of a green energy supplier individuals more quickly belong to philanthropists than socialisers as impact on sustainability is an important factor within this context.

We also computed the bivariate correlations between each user type and all others. As in previous work, we found partial overlapping between several user types. However, some of the observed significant correlations differ from those reported by Tondello et al [55]. They showed correlations between the disruptor and achiever and the disruptor and player ($p < .01$), but our results do now show these

correlations. Correlation results are supporting the findings of [55] which states that the user types from the Hexad scale can be divided into three groups based, as disruptors are only significantly correlated to free spirits, players are significantly highest correlated to achievers, and socialisers to philanthropists.

Chapter 2 already described the expected link between the already defined user groups of Pure Energie and the different user types from the Hexad scale. Although the results match the expectations it is not sure whether there actually is a link between the user types from the Hexad scale and the already defined groups. Unfortunately, both results had too less matching overlap in participants to confirm the link between these groups. Although only a few customers participated in both researches, their earlier defined group matched with the expected user type. However, this only counted for 16 participants, of which no conclusions can be drawn.

Although gender assumptions have to be made carefully, because the gender is not certain, the results from the survey do not directly match earlier literature findings about gender differences. Literature suggests that women score slightly higher on intrinsic motivations than men, but on the other hand men score slightly higher in disruption on average [55]. When looking at the results and then only at the main user types this does not apply to the participants of this survey as women score both slightly higher on disruption and the extrinsic user type player than men. However, women do score slightly higher on the intrinsic user types free spirit and philanthropists. On the other hand, men score higher on the intrinsic user types socialisers and achievers. Although some differences are found conclusions cannot be drawn with certainty due to uncertainty of the gender of participants. Besides only the main user type is taken into account and there is not looked at the overall spectrum of individuals, which could give a different view on the results looking at the differences on gender.

4.3.1 Limitations of the Hexad survey

The first four questions used as introductory questions are normally not used in combination with the Hexad survey. The effect of these questions on the answers on the Hexad survey are unknown. Although it is expected that these do not have a large effect, because the results shown in this study match with the on average found numbers per user type [55]. Although we present results based on gender difference it is unknown whether this really matches the real gender of every participant as this was not asked within the survey. Besides we did not take the dichotomous boundary of gender into account, but this was also not a possibility at the time of conducting the research within the customer portal.

Only a small number of the total customer group of Pure Energie participated in the survey. And even the selected group was only notified via their dashboard within the customer portal. Therefore, the results might be biased, since this might have caused that only actively visiting customers of the customer portal participated in the research. The results only show the main user types found for each participant, however individuals must be seen as a spectrum of user types rather than one single main user type. Although the choice of target group is based on the numbers of the main user types present in the target group following research tries to look at the whole spectrum of an individual. However, the main user type of an individual will always be the focus.

4.3.2 Implication further study: choice of target group

The most occurring user types identified within the participants of the survey were philanthropists, free spirits, and achievers. To limit the scope of this study, it was decided to focus on these three user types during the other phases of this research. Although for women the user type player is more present than the achiever type, there is still chosen to not focus on the player type, because in overall contribution the user type achiever is stronger. Besides the user type achiever is an intrinsic user type whether the user type player is extrinsic. The choice to focus on the achiever type means that this research can fully focus on the intrinsic motivations of individuals. The choice for three user types makes it possible to research the differences between these three user types within gamification for energy saving.

Although many of the participants tend towards preference towards one user type they consist of a spectrum of user types. Therefore, we keep looking at participants as having a spectrum of user types with a main preference towards one player type. Since the three most common user types are philanthropists, free spirits, and achievers, these are further explored. The results of this study support earlier expectations of philanthropists being related to the green driven customers of Pure Energie, demanding customers being related to free spirits and the price driven customers to achievers. They also support the earlier expected relations to the customer segments of [5] as depicted in Table 6. However, further research is needed to further explore the expected relations between these groups. Further research will focus on designing personalized gamification for incentivizing energy savings for the three user types philanthropists, achievers, and free spirits. Their link to the already existing customer groups of Pure Energie will be further explored as well.

5 Design ideation

During the design ideation process, content, features and a first visual design strategy were ideated. Inspiration was drawn from existing theory on energy saving applications and preferences of the user types achievers, free spirits, and philanthropists towards gamified elements and their expected behaviour within the environment of a green energy supplier (section 2.3 and 2.4). Based on these findings together with other important findings from the literature out of Chapter 2 we set up a design focus for each user type together with some design requirements.

The ideation phase focussed on developing a gamified solution for the web environment of the customer portal. This environment suits best, because all customers have access to this portal. There is no app available for every customer yet, although this will be developed in the near future. The customer portal is being restyled at the moment of writing and extra features are added. The design of a gamified solution fits well in this process and implementation in the near future is possible. The process of creating the first low-fidelity prototype for the customer portal is described in section 5.2. In the last section, the design of the first low-fidelity prototype is further explained.

5.1 Design focus user types and requirements

Based on the literature from Chapter 2, some design focuses for each user type were set up. The designs should take the three user types achiever, free spirit, and philanthropists into account. Designing for philanthropists should focus on designing for purpose. The gamified solution should be able to show philanthropists their impact on the environment. It should also help them to increase this impact. For free spirits designing for autonomy is important. They design should give them the feeling that they can choose their own strategy for energy saving. Nevertheless, the application should still help them to be able to reach savings. Free spirits are also looking for fun, so interactive designs are probably appealing to them. The last user group, the achievers are searching for competence within an energy saving application. Motivational affordances matching the user types motivations are shown in Table 5. Furthermore, the application should at least contain a part of the following elements: information provision, social connection, user interface, feedback and performance status should at least be partly incorporated into the energy saving application [20, 42]. A rewarding system, was removed from this list, because it's an external motivation and we are solely focussing on intrinsic motivations in this study.

5.2 Ideation process towards first low-fidelity prototype

This section briefly describes the process of how the first low-fidelity prototype was created. The design focus out of section 5.1, performed desk research, and the state-of-the-art findings were used as inspiration for the ideation process. The first conceptual idea started as a tool which allows customers to reduce their energy consumption, as the goal of this thesis is to make customers more sustainable. However, the tool needed to achieve the feeling of purpose, competence, and autonomy for philanthropists, achievers, and free spirits respectively. A mind map was made about the elements that could support these motivations and at the same time incentivize energy savings. The first initial idea resulting from this mind map was an engine in which several elements could be virtually added to a customer's own smart meter data. By adding for example elements such as solar panels or a jacuzzi to the static consumption the effect of these elements on your energy usage could be shown. This effect could be given both on the financial side as well as the impact side (energy usage). This configuration tool could be added to the current consumption overview of the customer portal in which energy consumption is displayed in a graph.

A configuration tool could give free spirits the feeling of autonomy by letting them put their own elements together. It can also support purpose and competence by showing the environmental and financial impact of changes in a household giving customers an idea on how to become more sustainable. However, the idea behind this tool is not real gamification as it does not include any motivational affordances. Besides a graph contains numerical data which many people do not easily understand [49]. To take a step closer to gamification and to create more insight without only showing numerical data the idea came up to create a clickable house in which people could add/delete elements. Now new elements could not only be selected in an overview, but could be drawn into a house to make it more attractive and interactive. In this way, the data also becomes less abstract and is probably easier to understand for many people. Besides the interface becomes more attractive and enjoyable compared to the previous concept which is very important in energy saving applications [20].

The concept of a configuration tool of a house already comes closer to gamification. However, the tool itself consists mostly of motivational affordances linked to the free spirit. The house allows for exploring, giving a customer the room to move and explore within a house and make their own decisions. This behaviour is linked to the motivational affordances exploration and branching choices stimulating autonomy the motivational need for free spirits. Although the tool mostly matches the motivational need for autonomy, it

also has some links to motivational affordances belonging to purpose and competence. For example, the house allows customers for learning new skills which is a motivational affordance linked to an achiever. The motivation of philanthropists, purpose, can be stimulated via the motivational affordance of meaning as the tool allows to understand the impact that they can create. Next to these motivational affordances, the tool also allows for implementing easter eggs, hints, nice visualizations, and feedback on usage. However, this concept does not include that much of personalization options for each user type. It may include several motivational affordances matching with user types it does not allow for direct personalization. Besides, it also raised the question whether such a tool would improve energy savings on the longer-term. A tool in which the effect of virtually made interactive choices is shown does probably not trigger customers to come back to it very often. Adding more gamified elements could do the trick as the amount of gamification components is a significant predictor for positive ratings for energy saving applications [42].

We used a mind map to research the possibilities of adding more gamification elements into the design. The motivational affordances linked to the user types achievers, free spirits, and philanthropists from Table 5 were all written down together with each possibility the element had in an energy saving application. We rated the ideas from the mind map on level of importance whether they matched the classical elements of an energy saving application. This rating is based on earlier research which states that an energy saving application should at least contain the elements of information provision, rewarding system, social connection, user interface, and performance status/feedback [20, 42]. The elements challenges, feedback, points, levels, profile, comparisons, and competition scored the highest ratings and were further explored. This exploration resulted in the idea of combining the elements within a dashboard design next to the concept of the house.

Several design sketches for both the design of the dashboard and the design of the configuration tool which is from now on called the '*energy editor'* were created. The final sketch was further developed into a first low-fidelity prototype which is explained in section 5.3. An overview of the different sketches leading to the final design of the first low-fidelity prototype are shown in Appendix F. Although the elements included in the dashboard addressed the motivations of each user type, the dashboard not allowed for any personalization options. During the evaluation of the first low-fidelity prototype customers preferences and options for personalization are further explored.

5.2.1 Stakeholder involvement during ideation process

The final sketch resulting from this ideation phase was formed step by step as earlier explained in section 5.2. This step by step approach can be linked to the persuasive design principle of tunnelling [70]. Tunnelling is using the system to guide users through a process or experience and provides opportunities to persuade along the way [70, p. 492]. However, here we use it as a way to get stakeholders aligned with the persuasive gamification elements itself rather than persuade the end-user. This tunnelling approach was used, because we experienced that implementing gamification was not directly retrieved positive by every stakeholder which was cause through different reasons. The concept of gamification was not completely understood as it was more seen as a real game environment. This thought on gamification made some stakeholders not want to introduce gamification to customers resulting in rejections of several gamification designs. However, by introducing each element step by step and iteratively expanding the design the thoughts on gamification slowly changed. We noticed that the idea behind gamification becomes clearer for individual's unknown with the concept if designs become more concrete for example with the use of sketches.

Even with this tunnelling approach gamification was not fully embraced by every stakeholder. This was caused by still not completely understanding the concept of gamification and the question whether gamification should really be implemented within a customer portal. Therefore, more basic gamification elements were used and ideas such as a character walking through a house are not further explored. The step-by-step expansion of the sketches for the dashboard and energy editor ultimately resulted in an initial design with which customers can be interviewed about gamification stimulating energy saving behaviour.

5.3 First low-fidelity prototype

The first low-fidelity prototype resulting from the ideation phase are shown in Figure 11. This prototype is created using the drawing application Goodnotes on an iPad. The prototype does not directly lay in line with the style manual of Pure Energie. However, further in the process we will work towards wireframes which do take the style manual of Pure Energie into account.

As earlier explained the gamified solution depicted in Figure 11 consists of several gamified elements. The customer starts on a personal page forming a dashboard. On this page the status and activities are shown in an overview. More information or other actions can be started via clicks. The dashboard page includes

several motivational affordances which are described in Table 13. Table 13 describes the application of the motivational affordances and the reasoning behind its importance for the application.

Figure 11: First low-fidelity prototype with on the left the dashboard design and on the right the energy editor design

Table 13: Motivational affordances included in dashboard of low-fidelity prototype for the dashboard

Motivational affordance	**Description**	**Reasoning**
Personal profile	Profile picture with personal name and tag that you have within the game.	Part which allows for personalization of the application stimulating the feeling of autonomy and thus linked to free spirits [24].
Points	Users can gather green points for being sustainable	Belonging to the category performance status an essential part of energy saving applications [20, 42] linked to achievers [56] and free spirits [59].
Levels (progress)	By earning more green points the user can reach a higher level. The current level is shown and there is also given feedback how many points until the next level is reached	Belonging to the category performance status an essential part of energy saving applications [20, 42]. In earlier research linked to achievers [56, 57] and free spirits [46, 59] .
Competition	Users can compete with other customers in competitions	Belonging to the category social connection an essential part of energy saving applications [20, 42] and linked to achievers [24].
Feedback on savings	Feedback on monthly reached savings is shown to see progress.	Linked to philanthropists and achievers [56]. But belonging to the category information provision an essential part of energy saving applications [20, 42], so probably motivating for every user type.
Metaphors	Energy usage is compared with for example the number of trees or kg CO2 or money.	Helps customers to understand energy data better [50]. As philanthropists are expected to be motivated by their impact, this will probably appeal to them more than to free spirits and achievers.
Comparisons	Users can compare their energy consumption with others.	Often used method by energy companies that helps customers to compare their energy usage compared to other situations, also advised in [6]. Allowing for feedback and learning important for philanthropists [56].
Challenges	Users can play challenges to become more sustainable.	Often used method in energy saving applications and linked to achievers [24, 56, 57] and free spirits [46, 56].

The ‘energie editor’ is the second part of the low-fidelity prototype and is shown in Figure 11. The idea behind the energy editor is that customers can use it as a tool to get more insight in their energy usage and become more sustainable. It warns customers about products which increase the energy consumption largely an informs about sustainability measures. Within the energy editor customers can click through a house and add or remove devices or change consumption behaviours to receive feedback on their clicked actions. The energy editor contains the following motivational affordances: non-fixed structure, simulation, feedback, tips, learning, purpose/meaning, and characters. The element non-fixed structure linked to free spirits [24, 56, 57], is present in a way that customers can choose their own way through the house. There is no path determined and all sort of combinations can be made. The house goal is to inform customers about the possible sustainable measures that can be taken in a household. Providing these opportunities along with explanations, tips, and feedback encourages customers to learn about and understand the purpose of these actions important in energy applications [20, 42]. Besides learning and purpose work motivating for philanthropists [56].

Feedback on changes chosen in the energy editor is shown in three ways via numerical data in a graph, metaphorical information in numbers, and game progress. The graph shows the already determined expected consumption (based on smart meter data) together with the expected consumption based on the changes made in the household. Customers are already used to this type of visualization as it is already used in their consumption overview on the customer portal of Pure Energie. However, these type of visualizations are not always understood [49], and therefore the two other ways of giving feedback on impact are chosen. The second manner of giving feedback is done via numerical data together with metaphorical data showing the monetary and sustainability impact of changes already proven to be successful in [50, 51]. The numerical data shows the impact on both gas and electricity usage in m^3 and kWh respectively. The metaphorical data represents money as a piggy bank and kg of CO_2 as the amount of trees also applied in [50, 71]. Lastly, feedback is given on what effect changes have on a customer’s game progress which makes the connection to the elements shown on the dashboard. This part of feedback consists of the effect on the number of points, the level, and ranking within competitions. An extra element within the energy editor is a character which leads you throughout the house. The character explains the effects of choices if necessary and gives tips on how to become more sustainable.

6 Design generation during rapid prototyping phase

After creating the first low-fidelity prototype, the design generation phase also called the rapid prototyping phase as defined by [63] started. This design generation phase consisted of several steps with as result a high-fidelity prototype. The high-fidelity prototype was realised during an iterative process in which improvements were implemented based on feedback from customers and different stakeholders. The first section describes the evaluation of the first low-fidelity prototype. Secondly, the results of the other iterative design steps are noted. This design generation phase is focussed on mapping the opportunities for gamification for the three selected user types.

The design phase consisted of an iterative process in which feedback of users was gathered to improve the gamification design. Following the human centred design method feedback and knowledge were continuously used during the iterative process. This generation phase really focussed on designing for the three different user types, achievers, free spirits, and philanthropists. Designs were continuously improved based on the feedback of both users and Pure Energie. This process started with the evaluation of the low-fidelity prototype. The results were implemented into a first wireframe which was discussed in two focus groups which resulted in a final high-fidelity prototype.

6.1 Evaluation first low-fidelity prototype

The generation phase started with an evaluation of the first low-fidelity prototype resulting from the ideation phase described in Chapter 5. Customers belonging to the user types achiever, free spirit, and philanthropist participated in the evaluation which was conducted as an interview. This section consists of several subsection describing the procedure, results, and conclusions from this first evaluation round.

6.1.1 Procedure

To better understand the user needs a semi-structured interview is held with a selected group of customers. The customers selected for this interview were all employees of Pure Energie or acquaintances of them as stakeholders asked to not directly reach out to a large group of customers again with the first prototype. The semi-structured interview allowed for adapting questions based on the interviewees answers. The questions asked were all open-ended questions, so participants were not limited to certain answers.

Materials and procedure

Each participant joining the interview had already participated within the survey in which the spectrum of his user type was determined. Before the interview started each participant was asked to sign the informed consent form, see Appendix I. Before the start of the interview the participant was asked if there were any questions unanswered and that he can withdraw from the interview at any time. The semi-structured interview was held via Microsoft Teams, due to the circumstances around the corona pandemic. The interview lasted a maximum of 45 minutes. Tending in danger of lasting longer than the set time the researcher wrapped up by asking the most important questions left. Each interview ended with asking the participant whether he had anything left to not to the researcher. Although the interview was semi-structured a timetable for the interview was set up to help the researcher keep track of the time during the interview, see Table 14 . The main parts of the interview were not scheduled, because the order of questions might differ for each participant. However, the order of the four main parts of the interview were predetermined. During the interview a protocol was followed, the protocol included the materials, predetermined questions and timetable, see Appendix G.

Table 14: Timetable semi-structured interview first sketches

Procedure	**Approximate duration**
Introduction	
Introduce activity and ask for questions	3 minutes
Semi-structured interview	
Opinion towards energy companies and Pure Energie	5 minutes
Sustainability activity	5 minutes
Proposal for energy saving app	5 minutes
Discuss sketches	25 minutes

Wrap up	
Thank participant	2 minutes

Analysis

During the interview the researcher made notes on the answers of the interviewees. The interview was summarized before the analysis was applied. Summarized transcripts are condensed versions of the questions asked by the researcher along with the participants comments [72, p. 252]. We choose this format since details such as word crutches or misunderstandings were not relevant to this study. The summarized transcript consisted of qualitive data which was used to create an affinity diagram. The findings were grouped per user type within this affinity diagram to see whether there were trends visible within user types. Due to the limited number of participants and the exploratory nature of this research not only similar findings were listed. Outstanding findings that seemed valuable for this research were also noted by the researcher and added to the diagram, so valuable information did not get lost. Besides the results of each participant were used to determine the motivation towards *different* gamified elements that were discussed. Each element is labelled as not motivating, moderately motivating, or highly motivating using a -, +-, and + respectively.

6.1.2 Hypotheses

Before the test some hypotheses were set up based on the earlier created design focusses for user types. It was expected that the user types would have more interest into the gamified elements that are linked to them according to the literature. The expected results for each user type are shown below:

Achievers are more interested into competition and comparing with others, because of their motivation by competence.

H1: Achievers are most interested in the following gamified elements: competition and challenges.

Free spirits are more interested into the options for personalization and would like the elements which are more linked to autonomy.

H2: Free spirits are most interested in the following gamified elements: energy editor, personal profile, and personalization data.

Philanthropists as they are linked to the motivation need of purpose, it is expected that this user type is really interested into the effect of their savings and how they can increase their impact.

H3: Philanthropists are most interested in the following gamified elements: comparisons and metaphors.

Besides the expectations of each user type, it is also expected that some of the elements are going to be liked by every user type. Concluding from the literature, some elements were seen as crucial elements within energy saving applications.

H4: The following elements will be motivating for achievers, free spirits, and philanthropists: points, levels, feedback, progress in numbers, and hints.

6.1.3 Results

In total, nine customers participated in this first evaluation. The test group consisted of customers of Pure Energie who already participated in the online survey. There were three participants per main *user type* (achievers, free spirits, philanthropists) interviewed. The different profiles based on the Hexad survey [54] of the participants are shown in with the total score they reached for each user type. For each *user type* one women and two men were selected as participants, so the differences between genders could be researched.

The interview consisted of four main phases. In the first phase, the participants were asked about their opinion on Pure Energie and its online services. During the second phase the participants were asked about their attitude towards sustainability. Thirdly, participants were asked what they want to see within an energy saving application. Lastly, the created sketches for this interview session were shown and discussed with the participant. The results of these phases are discussed separate from each other in the following paragraphs.

Interest towards green energy suppliers in general and Pure Energie

Most of the customers specifically choose a green energy supplier over a grey energy supplier. However, some choose for Pure Energie, because of monetary reasons where others choose for them because of the values of the company. The customers who had chosen Pure Energie, because the companies vision fitted their norms and values belonged to the group of philanthropists. Two of the customers choose Pure Energie as energy supplier, because they also bought their solar panels here.

Attitude towards sustainability

All participants were already doing several things to become more sustainable, some at larger levels than others. However, all participants were willing to become more sustainable, but not everyone wanted to invest a large amount of time in exploring the possibilities.

Proposal of energy saving application

The participants were all enthusiastic about the idea of an energy supplier helping you to become more sustainable. They gave different suggestions for such an application and had different thoughts on what would motivate them personally. Table 15 shows the different elements mentioned per user type.

Table 15: Proposed ideas including elements and main messages proposed by every user type group

User type	Proposed ideas
Achievers	Trigger to become sustainable, badges, competition with others
Philanthropists	Insights energy usage, feedback on progress, comparison with others, competition with others, hints, notifications if needed, create awareness about energy consumption
Free spirits	Feedback, needs to trigger to become sustainable, challenges with numbers and facts, become more aware of energy consumption, personal advice, hints

Discussion of sketches and ideas

The main results found on every element included in the low-fidelity prototype are summarized below. Each element discussed in the interview is summarized separately. More extensive results on each participants opinion about the gamified elements are summarized within Appendix H. Next to the opinion about motivations towards gamified elements, there was also room for suggestions or improvements.

Points are mostly retrieved positive by achievers, however they are missing a clear goal to work towards when earning points. One free spirit mentioned to be motivated more by points through an external reward and one philanthropist proposed that points should be about the impact you create.

All participants were positive about receiving **hints** about how to reduce their energy consumption. They all suggested that personalized hints would motivate more than general hints. Achievers would like to see hints related to points. Free spirits would like multiple options and concrete answers to specific problems within hints.

Feedback numbers were experienced positive by all participants. Achievers would like to get more insight into how they achieved progress. Philanthropists want to see more about their own impact and state that feedback on their progress might be more comprehensive. Philanthropists therefore liked the metaphors the most of all user types, as these showed their impact clearer. Both philanthropists and free spirits would like to compare their own usage with earlier years/months.

Achievers and free spirits are motivated by the **profile**, and mostly by the fact that you can personalize them. Philanthropist are less motivated, but will probably try out the element in a real-life application.

The **energy editor** was experienced different among the participants, but generally positive. The interactive and visual part about the tool is appreciated by all. However, the tool would improve if it would be made more personal, meaning better fitting to your own personal situation. Besides achievers would like to see that they can achieve anything in the house (points or challenges). Philanthropists are more interested into seeing impact of devices in a house. Some participants mentioned that the connection between the overview, house, and selected elements needed improvement. Like this participant who mentioned: *"I miss an overview within the energy editor in which my actions are stored and I can easily see the effect of my separate chosen actions".*

Competitions were mostly appealing to achievers. They are interested in competing with others and would play with friends. Two participants from both philanthropists and free spirits would not join competitions or

play with friends. On the other hand, the other two participants are interested in competitions. These participants would like to compete only with acquaintances.

Comparisons are mostly liked by philanthropists and they are mostly interested in comparing with other equal households. One of the philanthropists came up with a completely new idea *"comparing within region or neighbourhood might also be fun*". Free spirits are interested in comparisons and one of them wants to compare only with its own previous usage. The other free spirits name interactivity and comparing with friends and family. Achievers want to compare their usage with others, and the more specific this information is the more interesting it becomes.

Personalization characters are really liked by free spirit as they see it as a fun addition to really make it a personal page. The other two user types do think it is fun, but they do not see it as a motivating element.

Every user type mentioned that **challenges** are missing an overview of what has already been performed. For example, an achiever mentioning: *"An overview would give me feedback on what I already achieved and would work extra motivating for me".* All user types liked the element challenges, but each user type would like to see some changes. Achievers would like to compete with others such as friend and family. Philanthropists would like to play challenges matching their own energy usage and that these can help them to increase their impact. Free spirits want to see more information about a challenge and want to choose their own challenges and be able to change them over time.

Levels were liked by all achievers, but philanthropists and free spirits had mixed ideas about this element. Achievers really liked the competing element of levels, but it would be more fun if you can see this compared to others as well. Free spirits and philanthropists were missing a goal for the level and did not completely understood the added value of the element. Besides philanthropists would like to see what impact causes what extra level and free spirits would like to be able to perform more to earn a higher level.

Every participant addressed that if the has more **personalisation data**, so depicting their own situation, it would be more motivating to work with it. Personalisation was suggested in type of challenges, profile, energy editor, and hints.

Participants were also asked what they would like to see in addition or would like to change about the existing elements on the low-fidelity prototype. This question was asked after participants had seen the sketches. The proposed elements and changes are shown by user type and summarized in Table 16.

Table 16: Proposed elements by participants during first evaluation round after seeing sketches

User type	Proposed improvements
Overall	**(1)** More personalization. **(2)** More interactive design. **(3)** More visualizations. **(4)** Clear differences between gas and electricity usage.
Philanthropists	**(1)** Plants growing, for example growing a forest or plant based on achievements or points. **(2)** Receiving more feedback. **(3)** Overview on what is already achieved. **(4)** Need to be challenged if I am already doing well. **(5)** Help to keep behaviour, goal setting **(6)** Interactive comparisons with region. **(7)** Combine points with goals, one suggests external rewards. **(8)** clear hints or extra information
Achievers	**(1)** Badges to show achievements. **(2)** changeable names. **(3)** Compete with others, also friends. **(4)** Choose avatars. **(5)** Leader board. **(6)** Hints with points or quests. **(7)** Combine points with external rewards. **(8)** Share on social media. **(9)** More information about how performing relative to others
Free spirits	**(1)** More interactivity and clicking options **(2)** More extensive information. **(3)** Animations and seasonal effects. **(4)** Interactive comparison tool **(5)** House should be more lead in energy editor. **(6)** Profile more options to assign your own home (maps, characters). **(7)** Progress in badges. **(8)** Choose own challenges. **(9)** More triggers to come back for every week/month. **(10)** get more insight in energy usage compared to for example car ride. **(10)** more hints in different ways

6.1.4 Conclusion and discussion evaluation low-fidelity prototype

From the results retrieved from the individual interviews an overview of every participants motivation towards the different gamification elements were made as depicted in Table 17. The motivation towards the gamified elements means the way a participant perceived it and how likely it is for them to use the functionality in a real-life application.

Table 17: Overview of motivations of participants towards gamified elements

	Ach 1 ♀	Ach 2 ♂	Ach 3 ♂	Phi 1 ♂	Phi 2 ♂	Phi 3 ♀	Fr Sp 1 ♂	Fr Sp 2 ♀	Fr Sp 3 ♂
Points	+-	+	+	-	-	+-	-	+-	-
Hints	+	+	+	+	+	+	+	+	+
Feedback numbers	+	+	+	+	+	+	+	+	+
Profile	+-	+	+-	+-	-	+-	+	+	+-
Energy editor	+-	+	+-	+	+-	+	+-	+	+
Competitions	+	+	+	-	-	+	-	+	-
Comparisons	+	+-	+-	+	+	+	+-	+	+
Personalisation characters	+-	-	+-	+-	+-	+-	-	+	+
Challenges	+	+	+	+	+	+	-	+-	+
Levels	+	+	+	+-	+-	-	+	+-	-
Personalisation data	+	+	+	+	+	+	+	+	+
Metaphors	+-	+	+-	+	+	+	+-	+-	+-

Results on hypotheses

Table 17 shows that some elements were experienced motivating by all user types. These are seen as probably essential elements for energy saving applications. This counts for hints, feedback in numbers, and personalisation (data). Hints and feedback on progress can be linked to information provision and performance elements, essential elements for energy saving applications according to Alskaif et al. [20]. Personalisation, the possibility to reflect on their own situation as good as possible is not listed in [20], however other research show that personal situation does have an effect on the motivation of user types within an energy saving application [22]. These three elements seem to be essential for energy feedback systems.

Looking at hypothesis 4, we see that indeed feedback, progress, and hints are liked by every user type. However, personalisation data was expected to be mostly linked to free spirits, but all user types liked this element. On the other hand, levels and points were expected to be motivating for every user type, but only achievers were enthusiastic about them. The mixed reactions on these elements of the other user types, seem mostly because these elements do not have a direct link to other actions within the game.

The other three hypotheses were stated about the individual preferences of each user type towards game elements. The stated hypotheses from section 6.1.2 were tested using the data from Table 17. We expected that achievers would be mostly interested in competitions and challenges. Results showed that indeed next to the main elements achievers were mostly motivated by competitions and challenges. They are eager to compete with others and improve their own skills. Achievers did not completely dislike any of the elements, only one achiever disliked personalisation characters. Their motivation against the other elements were all positive or somewhat positive. Suggesting that achievers were not demotivated by any of the elements although their liking competition within elements the most. This element of competition emerges in two different ways. Some achievers want to focus most on improving their sustainability where others have a more monetary focussed goal.

For philanthropists it was expected that they would be mostly motivated by metaphors, and comparisons next to the main motivating elements. This hypothesis was proven right as these elements were positively received by philanthropists, as these elements help them to get insight in their own impact. Looking at the other gamified elements competitions and points were mostly disliked by philanthropists. The dislike of two philanthropists is because they want to focus only on their own consumption and not on others. However, the third philanthropist is enthusiastic about competitions. The difference between these two user types is that the woman liked competitions and the two men were not liking competition. Suggesting that not every philanthropist opinion on competition is the same and gender might be a difference within this. Philanthropists were not motivated about points, but mentioned that if some goal was coupled to them it might become more interesting. Overall philanthropists seem to care about their impact and do mostly want to focus on learning how to reduce their own energy consumption.

The third hypothesis stated that free spirits are mostly motivated by the elements energy editor, personal profile, and personalization data as they stimulate the feeling of autonomy. Results show that free spirits do score highest on their motivation towards these three elements, next to the main motivating elements,

proving this hypothesis. Free spirits score high on personal profile compared to other user types, but their motivation towards the energy editor and personalization data does not differs from the motivations of achievers and philanthropists. This result suggests that personalization data and the energy editor can also work motivating for other user types next to the free spirits. Free spirits scored lowest on motivation towards points and competitions. Their motivation on points was low, because they did not understand the link except for reaching a higher level, but this was also not found very motivating by this user type. Their negative opinion towards competition resulted from them not being interested in competing with others. However, a small overview of their own performances compared to others seemed fun to them. Free spirits, seem to be the group who already knows more about energy consumption and is interested into making use of different gamified elements to have fun, learn more, and save energy.

More factors that seem important

Most of the elements that were found motivating for specific user types in the hypotheses were found true during this interview. However, some parts of hypothesis were rejected or different elements seem to belong to the same hypothesis as well. While some gamified elements were experienced motivating by specific user types, such as challenges for achievers, we also saw that there were no major differences in motivations between user types for other elements. Besides, there are also differences in motivation towards elements within each user type group. These results suggest that not only the user type of an individual determines whether he is motivated by a gamified element. This is also supported by earlier research who state that existing energy saving behaviours and age make a difference [22]. Others also state that the impacts in energy savings differ by gender [73].

In this study the factor of existing energy behaviours seems to influence the motivation of individuals as well. For example, individuals who already take a lot of energy saving measures, mostly philanthropists, are questioning what such an application might bring extra for them. Besides, they are wondering how they can retrieve points if they are already acting sustainable. If the application takes such motivations not into account the motivation of people who already are having energy saving behaviours might be less than others who are not living sustainable yet.

When we look at

Table 17, we see that women's responses do not differ much between user types. Within the responses of men there is much more differentiation. This might suggest that the Hexad scale is predicting more accurate on motivational attitude towards gamification elements for men than women. However, this is only an assumption, the number of participants is too less to say anything significant about this. Nevertheless, some differences in motivations between men and women were noted in this study. Women were a bit more focussed on the impact of energy saving behaviour and men were more focussed on the numbers of energy or money saved.

Main take away to further iterative process

Overall we noticed that individuals did not have big differences on their motivation towards specific elements. Individuals found the way of how an energy saving application should approach them more important than the use of specific elements. If elements were not appealing to individuals, it was most of the time because the approach of the element did not motivate them. If this was the case, most of the individuals could propose a change to the element to make it appealing for them while keeping the gamified element itself. What is striking about these proposals is that they changed the elements that they disliked towards the motivation of their main user type from the Hexad scale, as defined by Marczewski [54]. Suggestions for improving elements that were already liked by individuals were also given a better fit with using their main motivational layer. Besides most of the participants agreed that the of the combination of gamified elements made the application complete and more interesting. This suggests that addressing users' key motivations is more important than using specific elements. Personalization will then not be applied between gamified elements, but within gamified elements. This resulted in some design strategies for the iterative design process during the generation phase. These design strategies explain the overall thought as the direction of the design for each user type and is listed in Table 18.

Table 18: Design strategies resulting from evaluation first low-fidelity prototype

User type	**Focus point**
Every	More elements, more visualization.
Every	Must be able to fit to the personal energy consumption situation of a household.
Every	Some level of autonomy seems important for every user type as they like personalization features.

Achiever	Design focus of the dashboard should be more towards stimulating competence. By adding extra features who support this feeling and include elements of competence in existing gamification elements. Allow for cooperating and playing against others.
Free spirit	Design of the dashboard must focus on stimulating autonomy. Free spirits must have a multiple set of options in which they can steer their own energy saving process. this group wants to get more out of the system and they already have a basic understanding of their energy consumption, so they want to be challenged.
Philanthropist	Design of the dashboard must focus on their own impact. Other energy households are less important, they want to learn more about their own consumption and create more impact. Mostly wanting more feedback.
Every	Energy editor must include more functionalities and a better overview of what you can add.

6.2 Iterative design process

The conclusions from the first evaluation round were used to create a first wireframe for the gamified application. The wireframe designs were updated iteratively based on feedback from both customers and stakeholders. This section describes the steps taken from first wireframe to the final prototype design.

6.2.1 First wireframe

The iterative process focussed on applying personalization within gamified elements based on the results of the first evaluation. The chosen method for personalization within elements is based on Apples strategy for the Apple Watch[7]. This works as follows: the clock of the Apple watch consists of various basic elements, including for example a background, type of hands, and display. Users can adapt these basic elements to their preferred style and thus create their own watch in this way. We can apply the same for an energy saving application consisting of various gamified elements. An application consists of several game mechanics and users can choose between several options per element. The differences between elements are based on the main motivations of the user types. Based on this idea the first wireframe prototype was created using the design strategies from Table 18. The differences in elements were only based on content, while the appearance was tried to keep the same. In this way it was prevented that participants would choose a design based on the appearance, because the intrinsic motivation is important and not the way the element looks like.

In addition, the suggestions given by user types shown in Table 16 were taken into account. Based on these results we choose to add an extra interactive challenge related to the points, badges, and a leader board. The already implemented gamified elements from the first low-fidelity prototype were also used. Only the element of the household competition was taken out as this could be implemented within the other elements.

Now that the elements and way of personalization were determined the first wireframes of the dashboard and energy editor were created. These wireframes are created using Adobe XD[8] and look more like a real web environment. It included several changes in comparison to the first low-fidelity prototype. The style guide of Pure Energie was used to create wireframes matching the style of their customer portal. As one of the design guidelines was to make the design more fun, playful icons[9] were used. The stakeholder first reviewed the designs which resulted in some small adjustments of colour use to fit the design more to the style guide, these changes are visible in Appendix J. The final design of the first wireframe of the dashboard is shown in Figure 12. The goal of the visual design was to support the motivations of each user type. The wireframe does not show all the options for each element, but they will be explained below and can be found in Appendix J.

The top left block consists of the profile and includes different gamification elements. In this block a profile picture can be chosen and personal information is shown such as the players name, points, and title. The level is shown in a progress bar. There are three different design options for the profile picture, resulting from proposals from the first evaluation round. The first one is still a character which users can build, the

[7] Apple, “Apple watch-wijzerplaten toegelicht”, https://support.apple.com/nl-nl/guide/watch/apde9218b440/watchos, (Accessed January 15, 2021)

[8] Adobe XD version XD 37, downloaded from https://www.adobe.com/nl/products/xd.html

[9] These icons were retrieved from flaticon.com and were accessed from the Premium version without the need to credit the creators.

second one is creating your own home or showing a google maps picture which was mentioned by free spirits. An extra added element to this wireframe is the interactive challenge. This resulted from that participants were missing an extra motivator to earn points. Since this research focusses on intrinsic motivations there is chosen to couple the points to an interactive challenge of which users can chose from. Each challenge represents an intrinsic motivation of a user type. The first one is to earn points to allow for growing a plant and later on a forest, which is linked to philanthropists who are interested in $C0_2$ reduction coupled to trees, but it is also a fun element which could work motivating for free spirits. The second challenge is about saving a polar bear, a fun element in which easter eggs can be added easily and linked to free spirits. The third element is about competition and linked to the motivation of competence of achievers. The last challenge is about becoming a green household and is designed to stimulate the feeling of purpose of philanthropists. The block in the bottom left is also added and functions to let users learn more about how they can reduce their energy consumption. This way of learning is designed in three different manners, namely a weekly quiz, did you know, and a weekly tip. Each user type wants to learn more about how they can reduce their energy consumption, but the way they want to learn more is different. Achievers mentioned a quiz form, philanthropists both mentioned did you know and tips to learn more.

Going to the middle column of the design, the element at the top gives individuals feedback on their performance. Feedback can be seen per month or year and the amount of electricity and gas savings are shown. These values are compared to three different values, money, kg of CO_2 and the number of trees. It is expected that philanthropists are most interested in kg of CO_2 and number of trees. Money is an important factor for some users and it is unsure whether this factor really matches a specific user type. The element in the middle is added in this wireframe and forms the leader board. Three types of leader boards exist, namely for friends, region, and all customers. Friends can be invited to compete against each other and were mostly proposed by achievers. Philanthropists indicated that they would like to compare within their own region and free spirits want more extensive information and are therefore expected to be more interested into the overall leader board. The bottom block shows the last added element based on the first evaluation the received badges. There are two designs of badges in one of the designs three reached badges are shown. The other design also shows still to be reached badges as well. According to the literature free spirits are motivated by unlockable content [56, 57] and therefore the still to be reached badges are added into one design.

The element at the top of the right column are the challenges already incorporated in the first low-fidelity prototype. There are four different designs made for these challenges. The first one focusses on saving to increase environmental impact and consist of challenges that you can easily perform on your own. This type of challenge is specifically designed for philanthropists who seem to want to increase their own impact on their own. The second design focusses on choosing your own saving goals and suggests challenges that can help you reach this goal. This goal-setting idea resulted from the first evaluation as some participants wanted to work towards a saving goal as preferred by philanthropists who are already performing energy saving behaviours. Setting a goal helps them to get more insight into their impact. The third design is called ‘are you the greenest’ in which users need to compete against or cooperate with each other to complete challenges. This type of challenge is designed to stimulate the feeling of competence and is therefore expected to be chosen by achievers. Within the last design users can create their own challenges stimulating autonomy, the intrinsic motivation of free spirits. The element in the middle is the link towards the energy editor and the last element at the bottom of the column are comparisons. Three different designs of comparisons were made, namely compare with own consumption, comparable households or households in region. These three types of comparisons were mostly mentioned during the first interview, and there is not yet a link between these different designs and user types.

Next to the dashboard, a wireframe of the energy editor is made as depicted in Figure 13. The house was made more prominent in the design and a character that explains the process is kept. More options for tuning the house have been added as well. In the top left corner an overview shows the impact of the changes applied in the house in a graph and in numbers. Users can also see what kind of effect their changes have on their game progress. Lastly, there is an information overview about the Pure Energie Meter (PEM). This meter can read more detailed consumption data from a smart meter. The idea is that if a user has a PEM, the data in the house can be showed more accurate. An advantage for the customer, but also for Pure Energie as this can increase the sale of this meter.

The energy editor is not styled differently for each user type, however the tool itself can be used for various goals. It can support the demand for autonomy and personalization by allowing users to choose their own path and coupling it to a personal situation. Besides, the energy editor can help users to learn more about what and how they can accomplish energy savings. Besides the effect of changing energy consumption behaviour on the gamified elements, such as interactive challenge and level, can be seen. The energy editor is an interactive tool, with a completely different interface than the dashboard. It allows users exploring the energy consumption within their household.

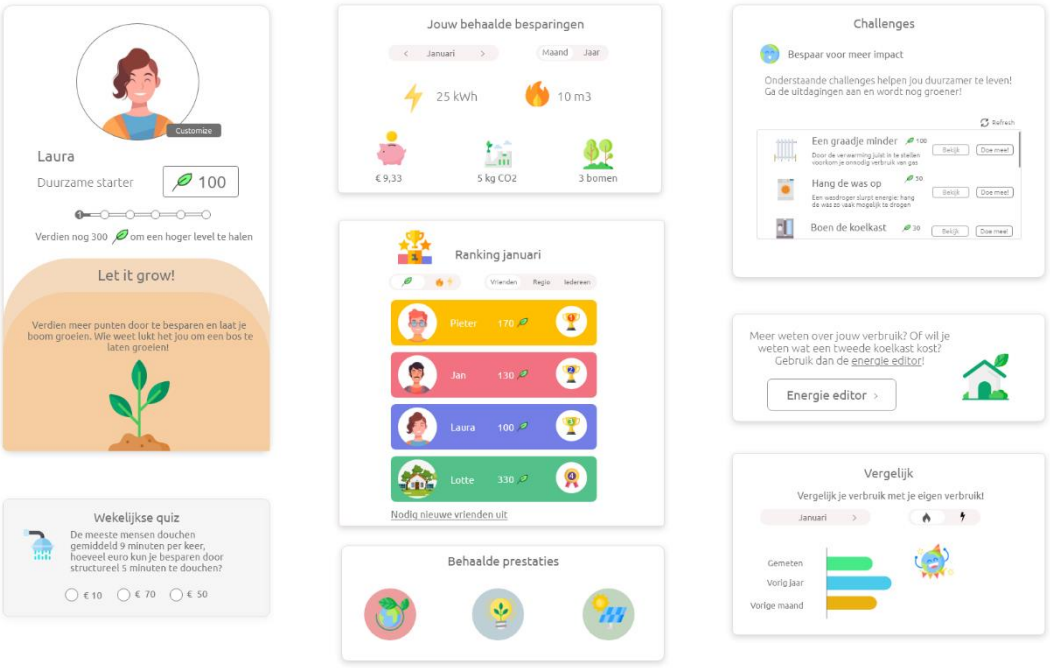

Figure 12: First wireframe design of the dashboard

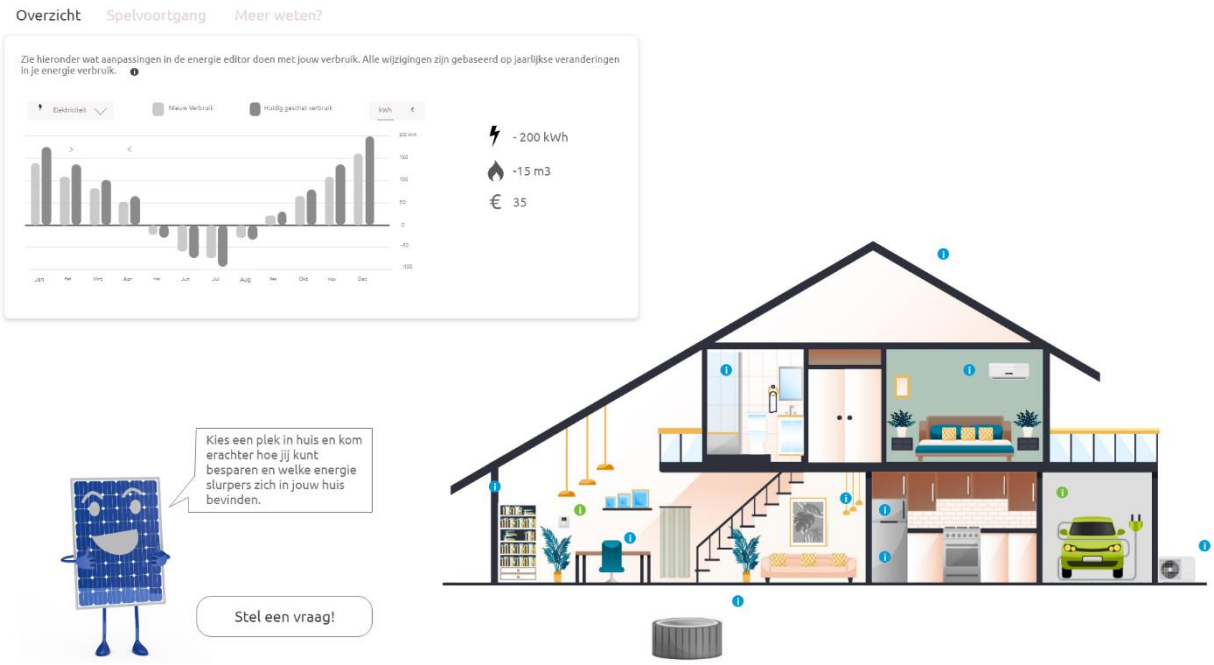

Figure 13: First wireframe design of the energy editor

6.2.2 Iterative process towards final design

Before the final prototype was designed several design iterations took place. We updated the design based on feedback of both customers and the stakeholder. Design iterations initiated by the stakeholder resulted in small style design changes. These changes were suggested by the stakeholder to bring the design closer to the current style guide of Pure Energie. More in-depth feedback on the designs was gathered during focus groups with customers.

First focus group

The first focus group was performed with four customers who also participated in the Hexad survey. Within this focus group each user type was present, one free spirit, one achiever, and two philanthropists. The goal of this focus group was to find unclarities in the design and to get insight into whether the design guidelines were applied well for each user type. During the first focus group with customers the researcher

started with showing the overall view of the dashboard as depicted in Figure 12. This design was discussed together with the different design options for each element. The researcher started the discussion was by asking the participants what they thought they were seeing. Unclarities were discussed and if needed explained. Secondly, the preferences of individuals towards the design options for each element were asked. The discussion on the different preferences of the participants led to more insight into the thoughts of each user type and whether they matched with the design created for their main motivation.

At first, participants found the design of the dashboard overwhelming, but after a closer look they understood it and liked the use of different gamification elements. Looking at the interactive challenges participants acted as expected, the free spirit liked the ice bear challenge, the achiever the competition, and the philanthropists choose for the house and growing plant. These choices were based on what motivated them the most and were based on the intrinsic motivations of each user type. Different choices were also made for the profile picture and the free spirit suggested that adding your own profile picture would be nice as well. The leader board was experienced differently, the free spirit was not directly interested, but the achiever really liked the part of competence. Both the achiever and philanthropists were enthusiastic about competing with friends and region. The designs of the challenges were a bit confusing for the participants. One of the confusing parts was that only one design allowed for goal setting. They suggested to add this for every design and the achiever mentioned that money could be added as goal as well. However, one of the philanthropists mentioned that a goal would work demotivating for her. The free spirit was enthusiastic about choosing your own goals and challenges. The achiever liked the competition design the most and the philanthropists liked the impact design.

The free spirit was enthusiastic about seeing the still to reach badges, however the achiever would only like to see the badge when one is reached and leave the rest as a surprise. Philanthropists did not have a clear preference on the view of badges. Comparisons were experienced positive by every user type. The achiever would like to be able to compare with friends too. The free spirit indicated that he liked all the comparisons, but comparing with own usage the most and mentioned if it was possible to incorporate the influence of weather in the comparison on your own usage. The free spirit also indicated that comparing to other type of homes and family compositions was also interesting for him. Philanthropists were most interested in comparing with region and comparable households. From the designs which allow for learning the quiz was most liked by all participants except one philanthropist who chose for the weakly tip. All others chose for the quiz, because it allowed for interactivity.

As second step during the focus group the designs of the energy editor were shown. One design showed every element above the house and the other design had a submenu via which the information parts could be opened. All participants preferred the menu structure, because this made it less crowded and clearer. Participants experienced a few uncertainties about the energy editor. They found it unclear how the energy was structured and how they should work with the tool. Other suggestions given for improvement were that the house could be expanded more and more colours could be used. The free spirit would also like an indication of the investments if applied in the energy editor. Others were not that interested into adding this feature.

In general, all participants liked the energy editor, the possibility to make choices is appreciated by all. However, there is room for improvement. The largest improvement can be made that individuals will understand how the energy editor works from a static design. A suggestion given by the philanthropists was to add a list of elements which were added to the energy editor. The free spirit, also mentioned that he would like to place the elements on positions of choice in the house. Philanthropists and the achiever did not feel anything for this feature as they expect that it would become less clear if this is added.

Overall, the results of the focus group showed that each user type was most of the time interested into the design specifically designed for his or her motivation. Suggesting that this way of designing a personalized energy saving application, and thus the applied personalized design strategy is effective. However, final evaluation must still be performed to find out more about this. From the results, several points for improvement were gathered and are presented in Table 19. These points for improvements are used within the next design iteration.

Table 19: Suggested improvements on first wireframe following from focus group

Dashboard	**(1)** Add option to add own profile pic (free spirit). **(2)** Only show just reached badge (achiever) **(3)** Show more metaphors for energy saving (free spirit). **(4)** Allow goal setting for each type of challenge. (achiever) **(5)** Add more choices for goal setting **(6)** Add more comparisons (free spirit).
Energy editor	**(1)** Menu style must be further explored. **(2)** The use of the energy editor must become clearer. **(3)** Add a list of elements that are selected in the editor **(4)** More use of colours and elements.

Towards final design

The design strategies used to design the different elements seem to be effective. However, the design was still iterated based on the results from the focus group as shown in Table 19. The improvements on the dashboard involved six steps. The option to add a picture of choice into the profile was added. An extra design for the badges was made, only showing the last earned badge, with the option to look into the already reached badges. More metaphors could be chosen for energy feedback, namely generation time with wind turbine, car ride in kilometres, and an element of competition. The challenge designs were reduced to three designs keeping the challenge for impact, the challenge for competence, and creating your own challenge. Goal setting was allowed for every type of challenge and could be set to consumption goal, monetary goal, or no goal. Lastly, more options for comparisons were added, namely comparing with different types of households and comparing with friends. As last step, some elements were relocated on the dashboard page.

Next to the dashboard a new design iteration for the energy editor was made as well. The design with menu structure was further developed and a list of elements was added in the design. This list helps users to see what they have adjusted in the energy editor, so they can keep track of their actions more easily. Besides the elements involved in the menu part have redesigned using more colour. The design iteration performed in this phase are shown within Appendix J.

The iterated design was shown to the stakeholder again, which resulted in some new design improvements. The stakeholder advised to use less different colours and focus more on the use the two blue colours from the style book. This resulted in changing the background to light blue and replacing the other colours in the design with a shade of blue. As a final check the designs were again showed within a focus group consisting of six customers who also participated in the survey. The goal of this focus group was only to check whether there were still unclarities about the design. The six participants of this focus group consisted of customers of Pure Energie, but were also employees. We choose to invite employees for this focus group, because this could be easily arranged preventing any delay in the study and this did not create any biases because it was a last short feedback round. Both wireframes and all the design options for the dashboard were discussed. Based on this discussion no further changes were performed on the dashboard. However, participants had still trouble with understanding how the energy editor was configurated. To make this clearer, a configuration step was added to the editor. In this configuration step, users could select the characteristics of their home, which allowed for making the energy editor even more personal. This last step resulted in the final wireframe designs which are further explained in the upcoming section.

6.2.3 Final prototype design

The final prototype design consists of two different pages. The first page forms the dashboard including several different motivational affordances. Each motivational affordance forms a fixed element on the dashboard. However, there are different design options for each of the motivational affordance. This allows the participant to choose between the several elements during the final evaluation and create his or her ideal dashboard. Figure 15 is the starting view of the dashboard in which some elements are not shown yet, these are replaced with a white block explaining the goal of the element users can choose. By clicking on the white block, the design options will appear and allow users to scroll through them. The different design options for each element are shown in Table 20. Figure 14 shows the four final designs for the visual challenge, an overview of all the final designs for every gamified element can be found in Appendix J. The second page forms the starting view of the energy editor, depicted in Figure 16. The energy editor has a menu which lets the top left block change. Besides several elements have already been implemented in the house, showing what a situation could look like. Appendix J also shows all the different designs and elements involved in the final design of the energy editor.

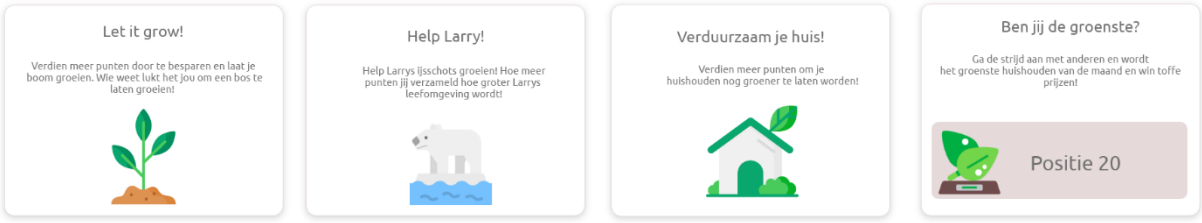

Figure 14: Final designs of interactive visual challenge game element

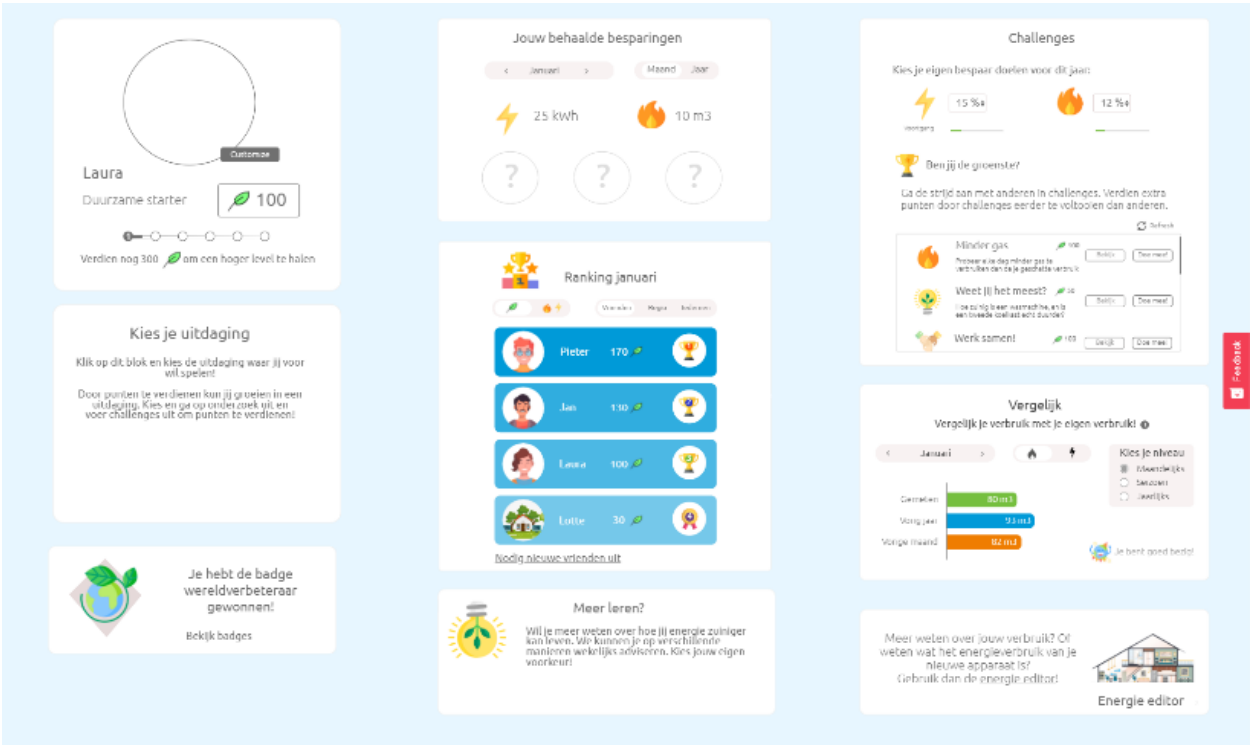

Figure 15: Final wireframe design of the dashboard

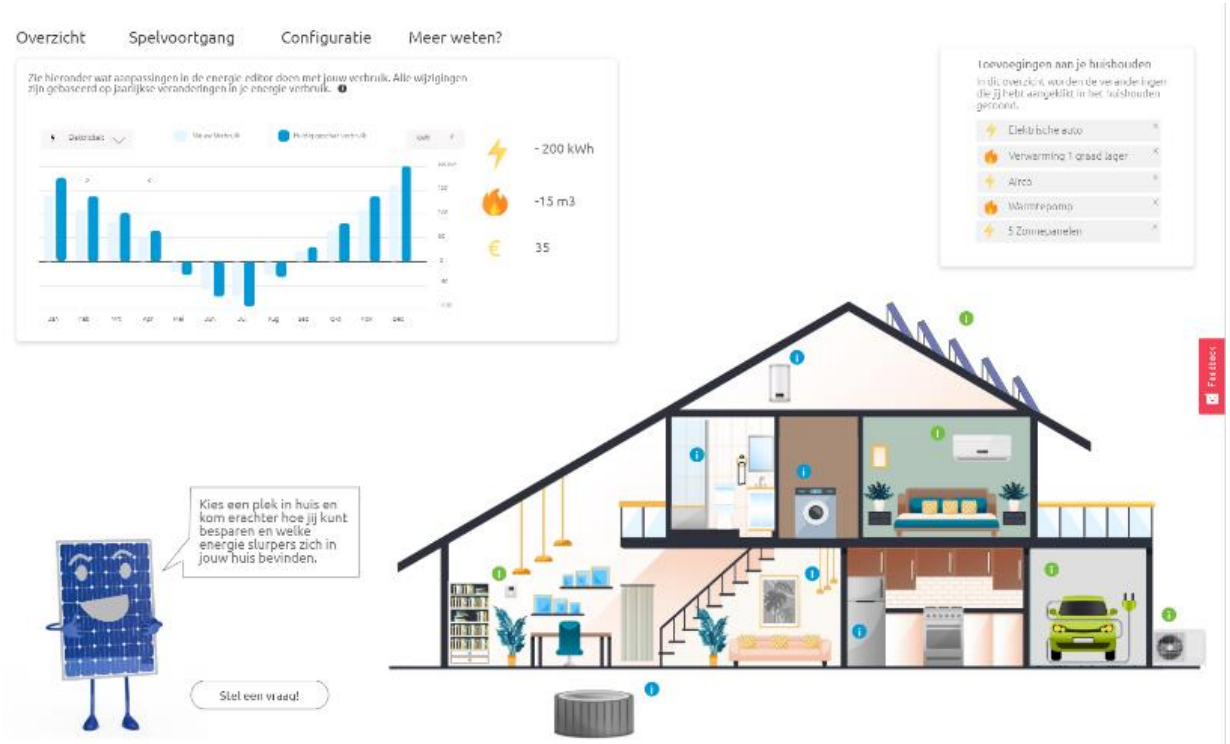

Figure 16: Final design of the energy editor

Table 20: Motivational affordances with options to choose from implemented in the final dashboard design

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Metaphors	Piggybank money	Number of trees	Kg of Co2	Generation time windmill	Performance against others	km car ride
Comparison	Own usage	Households region	Friends	Comparable household	Other type households	
Profile	Character	Google maps	Character house	Upload own picture		
Visual challenge	Larry ice bear	Plant growing	Competition	Make sustainable house		
Challenges goal	kWh and m3 in %	Euros In %	No goal			
Ranking	Friends	Region	All customers			
Learn more	Did you know that	Quiz	Hint			
Challenge type	Are you the greenest	Save for impact	Create own challenge			
Level	Progress bar	Mystery level				
Badges	Show last 3 badges	Show last badge				

The different options for the gamified elements from Table 20 are designed for the three user types: achiever, free spirits, and philanthropists. Every element its goal is shortly described. Metaphors allow for comparing energy savings with information more understandable for individuals. Comparisons allow for comparing your energy consumptions compared to different categories. Profile shows a user's name and the user can choose a profile picture by creating a character, choosing location, or adding a picture. The visual challenge is coupled to points in the design and allows for playing for something interactive and growing within this challenge. Challenges consists of goals and the type of challenge. Goals can help individuals to increase savings and receive feedback, challenge types are different approaches to start energy saving behaviour. Ranking is done via a leader board which can show your position compared to friends, the region or all customers. The learn more triggers users about learning about their energy usage and this can be done through a quiz, hint or did you know approach. The level can be shown as number or in a progress bar. Lastly, badges can be shown per 3 or only the last badge is shown.

Table 21 shows the expected preferences of user types towards the game design elements. These expectations are made based on the earlier gained results and the expected main motivation of each user type towards an energy saving application. Meaning that achievers will be focused on competence and saving money. Free spirits will be focussed on autonomy, gain a lot of information and having fun and philanthropists focus on increasing their own impact as they are motivated by purpose.

Table 21: Expected preferences of user types towards gamified elements in high-fidelity prototype

	Achievers	Free Spirits	Philanthropists
Metaphors	Piggy bank money, performance against others	All	Number of trees, kg of CO2, km car ride
Comparisons	Friends	Comparable households, other type households	Own usage or households region
Visual challenge	Competition	Larry ice bear or plant growing	Make sustainable house or plant growing.
Challenges goal	Euros	kwh and m3 or euros	No goal
Ranking	Friends	All customers	Region
Learn more	Quiz	Tip	Tip or did you know
Challenge play	Are you the greenest	Create own challenge	Save for impact
Level	Progress	Mystery level	Progress
Badges	Show last badge	Show last 3 badges	Show last 3 badges

7 High-fidelity prototype final evaluation

This chapter describes the final evaluation conducted in this study. The goal of this final evaluation was to determine whether user types would perform the expected behaviour within the clickable of the final designs. This final evaluation consisted of testing the interactive prototype created from the final designs with customers of Pure Energie. Participants had to create their own ideal dashboard while thinking out aloud. The second task was to click through and play with the energy editor, again while thinking out aloud. After each task participants were asked about their decisions during a semi-structured interview. At the same time their clicking behaviour was monitored. This resulted in three different types of results: namely type of dashboard elements chosen, qualitative data from interviews, and quantitative data on clicking behaviour. The results from all these different methods were considered while testing a set of hypotheses.

This chapter starts with explaining the method applied during this final evaluation followed by giving the hypotheses. Results of the final evaluation are given in section 3 and this chapter ends with the conclusions and discussions taken from this final evaluation.

7.1 Method

This section describes the method applied during this final evaluation. First, the process of going from final design to an interactive prototype is described. Secondly, the procedure applied during this final evaluation is described. Lastly, the method applied for the analysis is elaborated.

7.1.1 Creating the clickable design

The final designs resulting from the generation phase were transferred into an interactive design. This design was developed within Axure[10], which allowed for creating a clickable that could be shared online. Both the design of the dashboard and energy editor were made interactive. Within the design of the dashboard each design option for every gamified element was implemented. Each gamified element was made clickable, so participants could click through the possibilities. The energy editor was made clickable as well. Users could click through this page to get insight into the possibilities of such an application. However, some features were not fully worked out in the design due to time restrictions. For example, the energy editor did not allow for giving feedback on changes or making all changes in the house. Resulting in a more static design not showing the possibilities for configuring your own home or changing anything within the house and receiving feedback on energy consumption. To be able to share the designed clickable with participants the designed was put on the cloud of Axure. This made it possible to share a link with participants so that they had access to the high-fidelity prototype. Uploading the design to the cloud of Azure also allowed for connecting the high-fidelity prototype with Hotjar[11]. Hotjar is a tool to get insight into how visitors are really using a website and allows for collecting user feedback. Each visit of a participant to the high-fidelity prototype was monitored using Hotjar. The actions taken on the site were saved and the number of clicks were tracked.

7.1.2 Procedure

We invited a total of 15 customers to participate in this study via mail. For each user type (philanthropist, achiever, free spirit) we selected three males and two females having the user type as main user type. Inclusion criteria existed of that a participant earlier participated in the survey for determining his or her user type spectrum. Participants were reminded if no reaction was given for participation. We strived for at least four participants per user type.

Each participant wanting to participate in this final evaluation was shortly introduced about the procedure via mail explaining the goal, time, and tasks of this test. They also received the consent form if not yet signed before the interview. Only participants who had signed the consent form, shown in Appendix I, could participate within this research. The semi-structured interview was held via Microsoft Teams, due to the circumstances around the corona pandemic. The interview lasted a maximum of 40 minutes including introduction and completion. In case of the interview lasting longer than 35 minutes the researcher wrapped up by asking the most important questions left. Before the start of the interview the participant was asked if there were any questions unanswered and noted to the fact that they could withdraw from the interview at any time. Each interview ended with asking the participant whether he had anything left to note to the

[10] Axure, version 9, downloaded from https://www.axure.com/.

[11] Hotjar, basic version, https://www.hotjar.com/

researcher. The interview followed a protocol, including the semi-structured interview and a timetable, see Appendix K.

After the introduction the interview started with sharing a link with the participant through which the clickable prototype could be accessed. The participant was asked to open this link in his browser and to share his screen with the interviewer. This allowed the interviewer to observe the actions taken by the participant. After successfully sharing the screen with the interviewer the first part of the test started. During this first phase participants were asked to create their ideal dashboard while pragmatic thinking-aloud. During this process the interviewer observed and listened to the participant and answered any questions if needed. After the participant had created the ideal dashboard a short semi-structured interview started. The semi-structured interview gave direction through the interview, but also allowed for adapting questions based on the participants answers. The questions asked were all open-ended questions, and went deeper in on the reasoning behind the participants choices. After completing this semi-structured interview participants were asked to open the page of the energy editor.

On the energy editor page participants were asked to click around and to describe what they were seeing and thinking of the elements. For this procedure the think-aloud method was applied again. The participant did not have a time limit for clicking through the energy editor, except for the situation where the time set for the interview ran out. The interviewer again observed the actions of the participant and listened while making notes of the things that were heard and seen. After the participant was finished the semi-structured interview went further. First, the opinion and motivation towards the energy editor and the different elements were asked. Secondly, the overall gamification solution was discussed with the participant. During these last questions we tried to get insight into whether such an application would trigger sustainable behaviour and an increase of online engagement. The interviewer wrapped up by asking whether the participant had anything left to note. After which the participant was thanked for participating in the research.

7.1.3 Analysis

Although the link was shareable, the decision was made to conduct the final analysis as an interview rather than just sharing the link and storing the participants' interactions online. This choice was made because interviews allowed to obtain more in-depth information about why certain decisions were made by participants. It gave the possibility to not only look back at the facts and clicking behaviour of participants, but to also ask questions about participants decisions afterwards and to get insight into their thoughts about the designs. Questioning the participants about their choices afterwards was done to check whether the choices really match a participant's thoughts, since the effect of us researchers looking at the choices of participants might result in participants giving social expected answers not matching their real thoughts. During each task on both pages the participants actions were observed and notable facts which could be actions or things mentioned while thinking aloud were denoted by the researcher. In addition, a screenshot was taken and saved of the participant's ideal dashboard.

The procedure applied let the interviewer observe and listen to the participant and gain insights into clicking behaviour as well.

7.2 Hypotheses final evaluation

Based on the results from previous interviews and findings from the literature some hypotheses for the final evaluation were set up. Hypotheses were made for both the observation, interview and automatic analysis were made.

For the observation part hypotheses were set up about the expected choices of elements on the dashboard were made for each user type. These expected elements were resulting from earlier gained results and literature findings.

H1: it is expected that the user types will choose the designs expected to match their main motivation as is shown in Table 21.

H2: Personalization to personal situation is important for every user type

H3: Free spirits will show more clicking behaviour than other user types

Hypothesis two resulted from the findings out of the previous chapter that not only free spirits are interested in the energy editor, but that every user type seems to be interested in the fact that the energy editor can be personalized to a home situation. This seems an important motivator and interesting personalization opportunity for gamified design focussed on energy saving. The first hypothesis changed compared to the hypothesises we started with during the first evaluation of the low fidelity prototype (section 6.1.2). We found out that not using different game mechanics per user type was an effective personalization strategy,

but using motivation-based design within game mechanics seems promising. The expected choices for designs per user type are shown in Table 21. The last hypothesis results from the fact that free spirits seem to be more interested into what is behind every game mechanic and are often interested in learning more about the facts involved in energy saving.

7.3 Results

The final evaluation consisted of thirteen customers participating in an interview. Of the thirteen participants four belonged to the user type achievers, five to free spirits, and four to achievers. Each user type consisted of one female, except for the free spirits in which two female participants were present. The other participants were all men.

An example of a create dashboard by a philanthropist is shown in Figure 17. All design elements chosen by the user types are summarized within Table 22. The preference of user type towards elements are summarized using percentages. All participants mentioned that they would use the application if Pure Energie would offer it. On average all participants gave the designs a 4,5 out of 5 points. Showing that the designs are appreciated by the participants, one participant called the designs a *"great addition for an energy supplier"*.

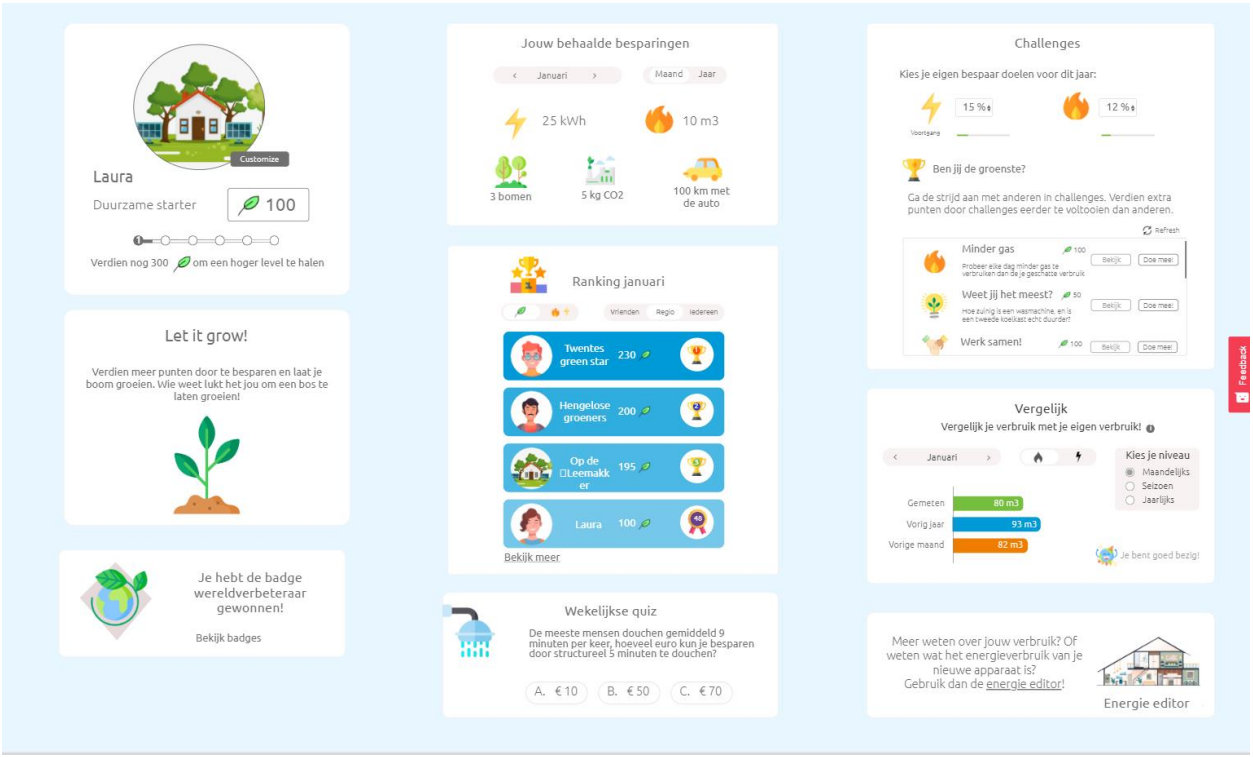

Figure 17: Created dashboard by one of the participants belonging to the user type philanthropist

Table 22: Chosen designs in dashboard by user types

Metaphors	Piggybank money	Number of trees	Kg of Co2	Generation time windmill	Performance against others	km car ride
Achievers	**33,33%**	16,66%	16,66%	-	**33,33%**	-
Free spirits	**26,66 %**	13,33 %	13,33%	20%	13,33%	13,33%
Philanthropists	8,33 %	**33,33%**	**33,33%**	-	8,33 %	16,66%
Comparison	Own usage	Households region	Friends	Comparable household	Other type households	
Achievers	-	**50 %**	16,66%	16,66%	16,66%	
Free spirits	**38,46%**	15,38%	7,71%	23,07%	15,38%	
Philanthropists	**50%**	-	-	**50%**	-	
Profile	Character	Google maps	Character house	Upload own picture		
Achievers	25%	-	-	**75%**		
Free spirits	-	-	20%	**80%**		

Philanthropists	**75%**	-	25%	
Visual challenge	Larry ice bear	Plant growing	Competition	Make sustainable house
Achievers	-	25%	**75%**	-
Free spirits	**60%**	20%	-	20%
Philanthropists	25%	**50%**	-	25%
Challenges goal	kWh and m3 in %	Euros In %	No goal	
Achievers	-	**75%**	25%	
Free spirits	**100%**	-	-	
Philanthropists	**50%**	25%	25%	
Ranking	Friends	Region	All customers	
Achievers	**100 %**	-	-	
Free spirits	20%	20%	**60%**	
Philanthropists	25%	**75%**	-	
Learn more	Did you know that	Quiz	Hint	
Achievers	-	**75%**	25%	
Free spirits	**80%**	20%	-	
Philanthropists	-	**50%**	**50%**	
Challenge type	Are you the greenest	Save for impact	Create own challenge	
Achievers	**75%**	25%	-	
Free spirits	-	20%	**80%**	
Philanthropists	-	**100%**	-	
Level	Progress bar	Mystery level		
Achievers	**100%**	-		
Free spirits	**60%**	40%		
Philanthropists	**100%**	-		
Badges	Show last 3 badges	Show last badge		
Achievers	**50%**	**50%**		
Free spirits	**60%**	40%		
Philanthropists	**75%**	25%		

All participants were positive about the design of the energy editor and it was understood by everyone. Many participants mentioned closely to: "*fun to play with and being actively engaged in energy saving"*. Every participant mentioned that it was fun to create their own dashboard and mostly free spirits were really interested in all the design options what was expressed in looking at every design option more than once. All participants found it interesting that the designs can help to save energy and are triggering. One participant described this as follows: *"a completely new approach to consumption and sustainability in which you are triggered to be more active with the matter".*

However, many participants mentioned that they would use the dashboard more often and only go back to the energy editor if interested in how to save energy. Many participants would like to couple the Pure Energie meter to the house so they can build their own house and monitor their energy. A stereotypical quote describing this: *"if I can use the Pure Energie meter to more actively monitor my house in such a visualisation I would directly purchase it if it's not too expensive"*. After explaining the costs of the Pure Energie meter to the participants, they were still interested in buying one if such an application as the energy editor was reality. It was often mentioned that the energy editor was a tool not seen before and interesting for buying products and testing the effects. One philanthropist mentioned that he would like to have an explanation of the calculations in the energy editor too.

Table 23 shows the number of clicks/actions per participant made on both the dashboard as well as the energy editor page which is gathered via Hotjar. Both the mean and standard deviation of the number of

clicks were computed per user type. Visual inspection shows that the average number of clicks of free spirits is much higher than the average clicks made by philanthropists and achievers. The average number of clicks between achievers and philanthropist do not differentiate only with one click from each other. The standard deviation from clicks between achievers and free spirits does not differ, but for philanthropists this number is considerably lower.

Table 23: Number of clicks per participant and mean and standard deviation per user type

	Ach	Ach	Ach	Ach	Fr sp	Fr sp	Fr sp	Fr sp	Fr sp	Phi	Phi	Phi	Phi
Clicks	147	95	127	118	198	234	179	185	201	128	122	104	137
Mean	121,75				199,4					122,75			
SD	21,56				21,36					13,94			

7.4 Discussion and Conclusion

All user types created their own dashboard. However, free spirits mostly liked creating their own dashboard and mentioned that they would like to create their own dashboard. Some participants belonging to the other user types mentioned that they would prefer a standard dashboard, but still want to be able to change elements if they were not happy about them. Looking at the average clicking behaviour we clearly see that free spirits (199) have more clicks than philanthropists (123) and achievers (122). Supporting the set hypothesis that free spirits would show more clicking behaviour than the other user types. This behaviour was also observed during the test as free spirits were really interested what was behind each element and whether there was more information for both the dashboard and energy editor: *"what does this show or do"* was a quote often made by this user type. This matches the second hypothesis that free spirits click more within the application. Suggesting that they really explore the application.

By visually inspecting Table 22 we see that free spirits choose more different options than the other user types. They can choose elements expected to their motivation, but also select elements matched to philanthropists and achievers. Suggesting that even though their main motivation is autonomy they can also have interests in the alternative designs matching motivations of the other user types. Another thing noted for free spirits is that they want to see a lot, for example for the comparisons all free spirits were interested in at least 2 comparisons whereas other user type mostly one mentioned one design. Supporting the thought of free spirits being demanding customers as they can find are interested in more aspects of energy saving and like to retrieve new information. The most obvious differences between user types are visible within challenge type and goal, learn more, ranking, and visual challenges, see Table 22 . For these elements it was expected that user types would have different preferences. The expected preferences were all true supporting the first hypothesis except for the learn more element. These findings suggest that the personalisation design approach used within this study is effective. Meaning that motivation-based design, focussing on the motivation belonging to an individual's main user type, can be applied within a game mechanic to make it attractive for an individual.

What was not expected was that philanthropists would choose elements about money. However, this happened for both the metaphors and challenge goal. The philanthropist choosing for this explained that this was because it is something you can directly relate to and understand easily. However, the main focus of this participant was still saving energy and did not had a big monetary focus. This can be explained by the quote made by one of the philanthropists: *"I easily understand the concept of money, although saving money in the case of energy usage is not a motive for me*". This might suggest that even though a metaphor or depiction might be related to a specific motivation, the underlying metaphor can be different. In this case this occurs for metaphors and goals involving a monetary focus as it provides a comprehensible comparison between saving money and saving energy.

The designs involving competition scored highest on achievers. The challenge involving competitions was even only chosen by achievers. That there are also some choices not expected, such as a philanthropist choosing an element matching competition or money might be explained by users forming a spectrum of user types and not a single motivation. By inspecting for example the profile of the philanthropist choosing the elements involving price we saw that the achiever type scored second highest within the user spectrum. Although user types sometimes made different choices for designs deviating from the expectations their main motivation was still the same as the motivation of their main user type. Meaning that philanthropists are motivated by purpose which is translated into impact for energy saving. Achievers are motivated by competence, but can be both interested in sustainable and monetary information. Free spirits are motivated by autonomy, are often looking for fun, and want to learn more about energy saving changes.

Finally, looking at the second hypothesis we observed that every user would like to change the energy editor to his or her personal home situation. These results suggest that designing for personal situation is important and confirms the second hypothesis. *"It is really interesting if you could simulate your own household if this allowed for more comprehensive and personal advice on energy savings, it would even be better if it takes into account the measures that I already take*". This quote implies that not only personal home situation is an important personalization factor, but also existing environmental behaviour, which was supported by the answers of multiple participants.

8 Discussion

During this study, we researched how personalized gamification can be designed for stimulating energy saving behaviour within the context of a green energy supplier. To research this the method designed by Knutas et al. [63] was followed in which the User Type Hexad scale [15] was chosen to determine the different user types within the customer base of Pure Energie. Through an iterative process, a personalized gamification solution was designed by continuously improving the designs based on customer and stakeholder feedback. The final designs consist of a dashboard and energy editor. The dashboard allows for customizable personalisation by letting the user create their own dashboard through choosing between different designs based on main motivations of user types. The dashboard forms a profile page which stimulates users to incentivize energy savings and helps them to keep track of their progress. The energy editor is a tool in which a user can simulate his own home situation from type of home to type and number of devices. After finishing the simulation, the user can take actions within his simulated house to see the direct effect between cause and effect. This helps them to create more understanding about energy consumption and makes them aware of opportunities for energy saving all in an interactive manner.

This chapter provides the discussion of the results that were generated towards the design of the final high-fidelity prototype and its evaluation. The results of the different evaluations and final validation are discussed and compared with the literature from Chapter 2. From this discussion, we propose a new framework explaining the different design focusses which cover personalization for energy saving applications. Furthermore, the contributions and limitations of this research, along with recommendations for future work on this topic are provided. Finally, the added value of this research for green energy suppliers is explained.

8.1 Adapted method for designing personalized gamification

The method applied in this study is based on the proposed method by Knutas et al. [63] for machine learning algorithm based personalized content selection. Their method is based on Deterding's five steps on gameful design [62]. However, the findings of this research did not focus on applying machine learning for personalization, but on customization by the user for personalisation. Therefore the method of Knutas et al. [63] was adapted leaving the parts focusing on the machine learning algorithm. After this adjustment, there was still one step missing, namely a final evaluation of the developed design. This final evaluation was added as a last step in the method within this study to be able to validate the design and final hypotheses. Such a validation step is critical to see whether the design really works as expected and is therefore advised to be implemented within this method. This has led to an adapted model called personalized persuasive gamification design process which is depicted in Table 24. This newly proposed design process deviates from the of Knutas et al. [63] by stepping away from machine learning and adding a final evaluation, still taking into account Deterding's [62] five steps on gameful design. However, during the fifth step we also advise to follow a human centred design approach [64] for iteratively improving the gamification designs.

Table 24: Personalized persuasive gamification design process partly adapted from of Knutas et al. [63, p. 13599]

Design step	Activities	Source
1. Define gamification strategy	Define the context where gamification is applied and the desired behaviour outcome. Identify a) target outcome, b) target audience and context, and c) constraints and requirements	Step one Deterding's five steps on gameful design [62, p. 316]
2. Research	Perform background research. Identify user needs, motivations, and hurdles and determine gameful design fit.	Step two Deterding's five steps on gameful design [62, p. 316]
3. Select personalization strategies	Choose a personalization framework based on gamification context, user needs, and user research to identify differences in target group.	Step introduced by Knutas et al. [63]
4. Synthesis	Formulate activities, challenges, and motivations for identified personalization groups.	Step three Deterding's five steps on gameful design [62, p. 317]
5. Ideation	Use findings from research and results from step 4 to develop first ideas for persuasive gamification. Prioritize ideas and develop first storyboard concepts.	Step four Deterding's five steps on gameful design [62, p. 318]

6.	Rapid prototyping	Use human centred design approach to develop gamification designs through iterations. Build prototype, playtest, analyse, and ideate promising design changes and repeat this process as long as necessary.	Step four Deterding's five steps on gameful design [62, p. 319]
7.	Final evaluation	Use an evaluation method to test whether the personalized designs match the expectations of users.	Novel step to evaluate design

The method of by Knutas et al. [63] was designed to create supervised machine learning algorithms that enable the selection of personalized game elements based on the user type and system context. However, this study suggests that it is also effective to create personalized gamification by allowing the user to customize their own gamification solution. Within this study representative user styles from the population got motivated and took pleasure out of choosing their preferred design out of a selection. This raises the question why we should automate personalized gamification using machine learning if we can also let the user customize it themselves. Nevertheless, users in general choose the designs matching the motivation of their main user type from the Hexad scale. Suggesting that using a machine learning algorithm to choose a preferred design of a user could be functional if a main user type can be determined as well. Because of this reason it might be useful to test whether a population for a specific gamification designs prefers choosing their own gamification designs or retrieving a suggested gamification design by an algorithm before starting the design process. When users take pleasure out of choosing their own designs from a selection, the newly proposed process out of Table 24 can be applied. However, if choosing designs takes too much time and effort for users the method of Knutas et al. [63] will be more suitable.

8.2 Identified user types within the context of a green energy supplier

To determine the user types of customers of Pure Energie the validated User Type Hexad survey [55] is used. Philanthropists, free spirits, and achievers were the most identified within our sample followed by players, socialisers, and disruptors respectively. This supports earlier research that states that the user types philanthropists, free spirits, and achievers are the strongest motivations within the Hexad scale [55]. These user types are closely followed by socialisers and players, while the disruptor type scores on average the lowest [55], which is the same within the result of this research. However, these findings were not focussed on the energy world. Earlier research on the Hexad applied for energy saving showed achievers and philanthropists most identified within a sample, with socialisers and free spirits following closely and players and disruptors being least popular [59]. Our findings differ from the findings of this study, since philanthropists and free spirits were mostly identified in our sample and socialisers and disruptors being least popular. The differences between these findings might be, because the participant of our study belonged of customers of a green energy supplier and the participants from [59] were employees.

8.3 Motivation-based personalized gamification over element-based personalization

The results of this study support the earlier findings from the literature, that personalized gamified solutions are more effective than one-size fits all approaches [15–18]. From the first interviews with participants in which the low-fidelity prototype consisting of only one design was shown, emerged that individuals had negative opinions on some gamified elements. However, after creating different designs of these same gamified elements participants became positive about them. Besides, within the participants of the final evaluation round there were clearly different preferences towards the designs of elements. Showing that personalization is a key feature to make an energy saving application fitting more to an individual.

The Hexad scale of Marczewski [15] was designed to understand more about user psychology in a gamified context. However, correlation analysis also showed the usefulness of the Hexad model as measure of predetermined design elements [15, 55]. Research on the Hexad scale for stimulating energy saving behaviours also suggested that the Hexad model can indicate the preference of end-users towards specific gamification design elements [59, 74]. Because of this characteristic personalization with use of the Hexad scale is often performed through applying different gamification elements for each user type [24, 46, 56, 59]. However, this study showed a different approach for personalization within a gamified application, namely a motivation-based approach instead of the often used element-based approach. Designing within a specific element based on the main motivation of an end-user was proven to be successful showing that within a gamified application personalization can be applied in another way as well. As participants preferred game mechanic designs matching their motivation behind using an energy saving application we suggest that this is a suitable approach for personalized gamification in an energy saving context. As the main motivation of a user type forms the attitude and expectations towards a gamification solution,

designing for this motivation can also be applied in other contexts rather than only for an energy saving goal. This finding does not imply that the Hexad scale is irrelevant, since it still helps to understand the psychological motivations of individuals and therefore works inspiring for creating a fitting design space.

Although this research suggests using motivation-based design as personalization approach instead of an element-based approach, it cannot be proven that the Hexad model is not functional for element-based personalized design. This is supported by the research of Ween and Choong [24] who found nine game elements supporting the three needs of the SDT theory [13, 14] (autonomy, competence, and relatedness) for incentivizing energy saving. Each need was supported by different game design elements, since the needs of the SDT are also main motivations of free spirits, achievers, and socialisers this suggests that specific elements may be more motivating for some user types than for others. Findings from this research support this as well, since for example free spirits were found to be more exploring user types than others and got fun out of looking for easter eggs and getting to know the application as their clicks during the final evaluation were way higher than other user types. Therefore, we suggests that within motivation-based design for a gamification solution within the context of energy saving forms a suitable personalization approach. However, small improvements to increase the satisfaction of end-users can still be reached through the use of specific gamification elements mostly preferred by the specific user types.

The fact that most individuals can like a specific game mechanic if it matches the motivation of their main user type from the Hexad scale can also have another cause than just participants preferring motivation-based design. For example, researches state that information provision, feedback, rewarding system, social connection, user interface, and performance status should at least be partly incorporated into an energy saving application [20, 42]. A research specifically focussed on a gamified application for energy saving suggested that an application should at least involve the game elements: progression, levels, and points [59]. The results of this study imply that information provision, feedback, and progression are indeed important parts for every individual to better understand their role within an energy saving application. In addition, the level of interactivity within a gamified application seems related to a positive user experience. Although this is hard to prove based on the results, we saw the user experience becoming more positive throughout the design process as the design increased in interactive possibilities. The gamified elements levels and points were experienced positive by most participants as they indicated improvements in energy savings. This research did not focus on whether these elements are indeed essential, but it was still shown that adapting the design of these main elements based on a user's type intrinsic motivations improved the user satisfaction towards the design. So, while it is very likely that some elements are essential to a gamified energy saving application, personalization within these elements is still a valuable addition.

Although most participants acted as expected during the final evaluation, some choose for designs that were not matching the expected preference of their main user type. A possible explanation for this can be that individuals form a spectrum of users which can make them interested in motivations of other user types as well [15]. However, it can also suggest that the Hexad scale is not a holy grail when it comes down to predicting design preferences for gamification. Van Houdt et al. [75] findings even suggest that particularly intrinsic motivations towards the environment predict preferences for gamification strategies whereas user types fall short. However, their research made use of one design version with different gamification elements and looked at how different user types interacted with the design. Meaning that there was not such a design approach as designing specifically for a user type. Based on our results we do not agree that the user types of the Hexad scale fall short in predicting gamification strategies, as the model helps to explain the main motivation of users within an energy saving application. The main motivation of a user type can also be translated to how such a user type would act within a specific context, and in this case within the context of energy saving. This fact makes the Hexad scale a helpful tool for creating a fitting personalized design space. In the case that an individual deviates from the design matching his or her main motivation, the customization approach still allows to satisfy this user. Which again supports the relevance and effectiveness of the different designs created for a specific game mechanic.

8.4 Other important factors for personalization and persuasive principles within gamification design

Different observations from the interviews conducted in this study suggest that there are more important factors than only someone's user type when designing a gamified energy saving application. Possible factors resulting from this research are gender, age, existing energy saving behaviour, and home-situation. Earlier research already supports the thought that existing environmental behaviour is important for a gamified solution [22]. When it comes down to gender and age research on the Hexad scale already showed differences based on these factors [55]. Orji et al. [76] already emphasized the importance of these factors by questioning for who to design, relating to aspects such as personality, gender, age, persuasibility, player types, emotional status, and situational variables. The results of this study indicate that personal home situation, already existing environmental behaviour, and gender can play a role as well to design for personalization.

By looking at the results of this study from a persuasive perspective, we see that the final design includes several persuasive design principles from Oinas-Kukkonen and Harjumaa [70]. These principles support persuasion in this case for the goal of energy saving, which can be of importance when designing an energy saving application. These persuasive principles which are included in the final gamification designs of this study are tailoring, personalization, self-monitoring, and simulation [70]. As the gamified solution shows tailored information relevant for the user group the persuasiveness increases. Offering personalized content, the focus of this study, also has a greater capability for persuasion [70]. The third persuasive principle included in the gamification design is self-monitoring which lets users keep track of their own performance. Lastly, simulation is also implemented in the energy editor which can persuade users to observer immediately the link between cause and effect [70]. The gamified solution designed in this study shows that the persuasive principles of tailoring, personalization, self-monitoring, and simulation together with the possibility of customization go well hand-in-hand when designing for persuading individuals to reduce their energy usage. Which suggests that using these persuasive principles within a gamification design can be effective for other persuasive goals in other environments as well.

8.5 Intrinsic versus extrinsic motivations in gamification design

This research shows that designing for a personalized gamified energy saving application can be done by focussing on intrinsic motivations of the user types philanthropists, achievers, and free spirits. Other research implies that intrinsic motivations are important motivators for energy saving behaviour, but also mention that extrinsic motivations can work motivating [43, 46, 47]. Others even say that external rewards should at least be partly involved within an energy saving application [20, 42]. Despite these results, an external reward system was not researched within this research. An external reward system was not used, because the three user types researched in this study are all based on intrinsic motivations. Because of the importance of these intrinsic motivations only designs supporting the intrinsic needs of individuals were researched. The importance of intrinsic motivations is also evident, since the intrinsic motivations of achievers, philanthropists, and free spirits rely on the SDT theory [13, 35]. A research that studied the effectiveness of game elements on evoking the three needs of the SDT theory did not show any external reward elements suggesting that intrinsically motivating behaviours are important [24]. In addition, the act of playing a game is generally more considered to be based on intrinsic motivations than extrinsic motivations [10]. Due to these reasons this study focussed only on stimulating intrinsic motivations rather than extrinsic motivations. Although external motivations might be helpful, there is more to be gained from stimulating intrinsic behaviours, since individuals then really want to perform actions based on their own feeling.

8.6 Tunnelling stakeholders towards gamification

During the development of the gamification designs within this study we experienced that gamification was not directly appreciated by every stakeholder. To prevent ideas for gamification being rejected due to unfamiliarity with the concept of gamification we advise a step-by-step approach to introduce gamification. Meaning that it is important that the ideas behind the concept of gamification should be carefully explained and the goal should be emphasized. By extending the gamification designs within an iterative process based on customer feedback, designers should be able to explain design and game mechanic choices to stakeholders. By involving customers on time in the process the effectiveness of gamification can be early tested. Based on reactions of customers the need for further development of gamification can be explained and defended towards the company stakeholders. This approach is advised for anyone introducing gamification within a commercial organisation where it is still an unknown phenomenon as it will help to work towards an overachieving goal and keep stakeholders informed and enthusiastic about the process.

8.7 Proposal of new framework for personalizing for gamification for energy saving

Before this study we already made an expectation of how three already defined frameworks could be linked to each other within a gamified energy saving application (Table 6). The first framework showed three main user groups within energy saving applications [5]. Secondly, we saw the overlap between user types from the Hexad scale, resulting in three main motivations within gamified applications [55]. Lastly, Pure Energie already defined three main user groups, namely green, price, and demanding customers. This study showed that these expected links are indeed visible between the three frameworks. This resulted in a new framework, combining the information of the three frameworks, explaining three main user groups of a gamified energy saving application within the context of a green energy supplier. The framework is based on the three user types from the Hexad scale studied during this research and is shown in Figure 18. This framework can help to design a personalized gamified application for energy saving by using different design focusses within elements based on each user type.

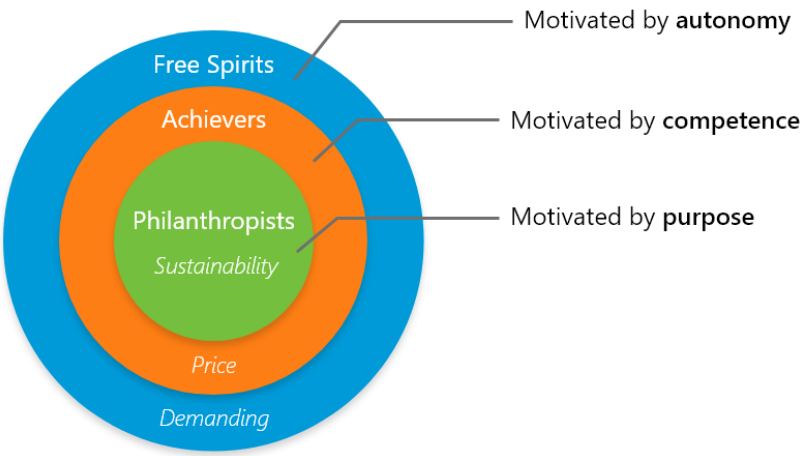

Figure 18: Proposed framework of main user groups within a gamified energy saving application focussing on green energy consumers

The framework from Figure 18 can be explained as follows. Based on this research we identified three main user groups as end-users for gamified energy saving applications in a commercial environment. The first group, the philanthropists, have one main motivation, being sustainable. The second group, the achievers are interested in price, but also in sustainability. Meaning that an achievers drive behind energy saving can both be related to price related as well as to sustainability. The last group form the free spirits, this group also consists of the demanding users. Meaning that free spirits find more factors important, but can also be driven by price and sustainability factors. So, when we look at Figure 18, the motivations of a user group become more complex by going out of the circle. Each user group and their main motivations and focus for design will be further explained below.

Philanthropists are motivated by purpose. They find **sustainability** and honesty important factors. They really look at their own impact and find it important to contribute to a more sustainable country. They are focussed on their own usage and can be reached through focussing on their impact.

Achievers are motivated by competence. This groups drive behind using an energy saving application can be both **price** or sustainability driven, or a combination of both. They want to be challenged and improve themselves through competitional elements.

Free spirits are motivated by autonomy making them the most **demanding** customer group. They are often already actively monitoring their energy usage and want to have extended functions to get more insights. Both price and sustainability or a combination of both factors can drive them as well. Although they are seeking for more information, fun is an important factor for this group as well.

We can explain the three customer groups from the pure framework in the same way as Gölz and Hahnel [5] presented their framework, but now by showing the three main user groups out of our proposed framework from Figure 18. Our new mapping, depicted in Table 25, defines three main customer groups within gamified energy saving applications in the context of green energy suppliers. One side note must be made that although autonomy is the main motivation of free spirits, it is to some extent important for the other two user types. This was suggested by this research as every user type enjoyed having the opportunity to choose his or her preferred designs within the clickable version of the dashboard design.

Table 25: Proposed three main user groups for gamified energy saving applications in the context of green energy suppliers resulting from this study

	Philanthropists	**Achievers**	**Free Spirits**
Main motivation	Purpose	Competence	Autonomy
Main goal	Increase impact	Improve themselves on price and/or sustainability level	Having fun and Learning to save electricity
Sub goal	Learn electricity saving	Save costs or become sustainable	Save costs or become sustainable

Communication orientation	Show their personal impact	Show their progress against others	Hedonic aspects
Additional focus	Saving energy	Saving energy	Saving energy
Promising add-ons	Elements representing own impact	Elements which show their own progress and progress compared to others	Elements involving autonomy and fun, allow for choice
Type of customers	Sustainable	Price	Demanding

8.7.1 Generalisation of framework

The proposed framework in Figure 18 is only explained based on three of the user types of the Hexad scale. However, socialisers, players, and disruptors also belong to the Hexad scale. This research did not focus on the motivations behind these user types, which causes that we cannot place them with certainty within our framework. However, earlier research showed overlap between user types based on their main motivations. Furthermore, by looking at the found correlations between user types we can predict where the other user types will be present in our framework. Meaning that socialisers are strongly correlated to philanthropists and will be part of the core circle of our model in Figure 18. Players are mostly correlated to achievers meaning that they are part of the middle circle. Lastly, disruptors are only significantly correlating with free spirits, meaning that they correlated to the outer circle, but are not directly correlated to the other user types as their motivation does not directly match with other user types. Therefore, we assume that these user types will not directly be part of the circles with their connected user types. Based on these findings we created a generalised framework of how the user types from the Hexad scale are related to each other as shown in Figure 19.

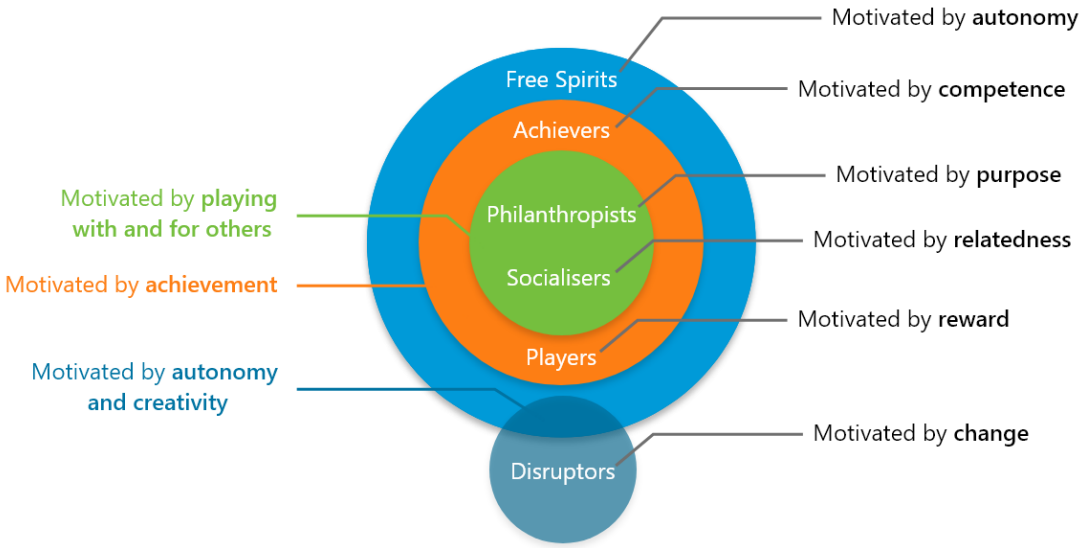

Figure 19: Proposed generalised framework representing relations between user types of the Hexad model. On the left the correlated motivations of user types are shown and on the right each motivation corresponding to each specific user type is shown.

Figure 19 shows the relations of the user types from the Hexad scale again in an inside out model. Each user type still has his own main motivation, but also has overlap with another user type, which causes them having a summarized motivation together. This shared motivation is shown on the left in Figure 19. It still implies that the further out of the core of the model the more demanding the user types become which makes it harder to design for the user types in the outer circle. This generalisation approach can help for designing personalized customizable gamification solutions for other environments outside the goal of energy saving. It sheds new light on the user types from the Hexad and their mutual relations. The generalised framework can function as a starting point for inspiration when designing for personalized gamification. However, this framework is still an assumption and more research is needed to prove that the placing of the other user types within this inside out model is correct in other contexts as well as in the context of energy saving.

8.8 Contributions of this study to HCI research on gamification

We made several contributions to the existing knowledge on gamified energy saving applications in this study. First, this research is the first to test the effect of personalized gamification on energy saving within a commercial environment of a green energy supplier. We also contribute to the existing knowledge of personalized gamification by proposing a design process for persuasive personalized gamification design as an alternative on the method of Knutas et al [63]. This research supports the importance of autonomy and factors such as personal situation and existing energy saving behaviour when designing personalized gamification for energy saving. Furthermore, we showed that using the Hexad scale for motivational-based design is a suitable personalization strategy. By designing different options for a specific game mechanic based on motivations of present user types a game mechanic can become interesting for every user type. Our results suggest that including the elements information provision, progress, interactive user interface, and feedback are creating a basic understanding for users within a gamified energy saving application. We also show that comparing already pre-determined user groups with user types from the Hexad scale based on motivations helps to predict gamified preferences of users within a gamified system. This research contributes to the existing HCI research on personalized gamification to incentivize energy savings by proposing an inside out design framework explaining the three different main user groups within an energy saving application and how to design for them. Finally, we shed new light on how the user types of the Hexad scale can be interpret following an inside out model based on the found correlations between the user types.

8.9 Contributions for green energy suppliers

This research contributes to the future focus on customer channels of energy suppliers. The result of this study, a gamified application, can have several benefits for energy green energy suppliers. Implementing personalized gamification within a customer portal is new and as far as the researchers involved not known to be previously applied by any energy supplier in the Netherlands. If applied well it might not only increase the positive stigma of users against a supplier, but can also help to distinguish from others in the competitive market. As more and more energy suppliers become sustainable, the differences between them keep getting smaller. Suppliers need to find other ways to stand out and gamification could be one of them.

Personalized gamification can help to understand more about the motivations of a customer. It makes it possible to recognize a customer's focus, which can be of great value for communication purposes. For example, if out of personalized data shows that the main motivation of a customer is to create impact and be sustainable, other communication can also focus on this motivation. A retention proposal can be made that responds to the impact a customer has made by being customer at Pure Energie. Or the focus of the monthly VKO can be laid upon the sustainable behaviour of a customers. Of course, this personalization can be applied for every type of customer. So, personalized gamification helps to learn more about customers and allows to make the whole communication process more personal. In this way, customers will feel that their energy supplier is really supporting their needs.

The energy editor, a tool created in this research can be helpful on other areas important for energy suppliers. It allows for promoting sustainable products that can be sold by energy suppliers. The focus of suppliers will change more and more to this kind of product selling. Think of solar panels, smart meters, isolation advice, charging stations for electrical cars, but also a water saving shower head. Marketing actions can be applied via the energy editor and if visible that customers are for example interested in solar panels by their behaviour in the energy editor, marketing can focus on offering such products to the customer. In this way, an energy supplier cannot only advice its customers on sustainability, but can also support them if they want to undertake action.

8.10 Limitations of study

This research has several limitations which are further described within this section. First of all, the number of participants forms a limitation. Although the number of participants in the survey was high, t the final evaluation included only 13 participants. Besides, these thirteen participants were also divided over different user types. Meaning that the final evaluation was performed with a maximum of 5 per user type. The limited number of participants of each group does question any statistical significance of the results, because different or more representative groups might have caused different results. Only partially the qualitative measures provide some depth in the findings that might compensate for the lack of breadth. However, findings of this research might also include a self-selection bias as customers who participated in the first survey were selected to participate in further research. Participants of the survey were able to choose by themselves whether they would want to participate. This might have led that only customers who are actively visiting and using the customer portal have participated in the survey resulting in the participants not correctly representing the actual customer base of Pure Energie. This could also have caused a specific user type being overrepresented in the group of participants. Since free spirits are most of the time actively

within the customer portal as they are already actively monitoring their energy consumption it might be that this user type is over presented. Due to them being more active in the customer portal this group might have been prompted more to fill in the survey than other user types being less active.

Moreover, this research only used a clickable as final validation to test participants motivational preference and behaviour. Although this is already an improvement compared to earlier research who only made use of static storyboards to show personalized gamification for stimulating energy saving [21], using a real world application will be more effective. Such an application would allow for researching everyday behaviour and therefore strengths and weaknesses of the application and long-term behavioural effects. As earlier research shows that the effectiveness of game design elements differs in both short and long term timespans [44], this makes it debatable whether the conclusions of this research will count for the use of an energy saving application on the long-term.

Furthermore, this research only focussed on the main motivations of participants based on their main user type from the Hexad scale. Although other researchers apply this approach as well, individuals must be seen as a spectrum of motivations rather than having one motivation [15]. Approaching the problem from out the spectrum view of motivations makes it more complex, but if applied well users' needs and hurdles could be better understood which could improve the design process.

Lastly, this research was performed using the customer base of one green energy supplier in the Netherlands. This makes it unsure whether these results will also count for other (green) energy suppliers. Since this research was applied on a customer base of a green energy supplier, the results will most likely differ for a grey energy supplier. Most differences for a grey energy supplier will probably lie within the customers focussing on green energy and achievers. The true green driven customers, finding sustainability very important, will probably not become a customer of a grey energy supplier. Achievers are probably more present at a grey energy supplier, since they often find the price component of energy important. As grey energy is cheaper than green energy, achievers are more likely to choose for a grey energy supplier. It is also unknown whether culture influences the experience within an energy saving application, so it might be that results at another energy supplier in another country will differ.

8.11 Future work

Based on the results and limitations of this research several recommendations for future work on personalized gamification for energy saving can be made. These recommendations will be discussed within this section. A first recommendation would be to validate the results of this thesis together with the proposed framework by conducting an experiment with a real application involving personalized gamification and with more participants, belonging to each of the three user groups of the Hexad scale. Such a research could also be performed with customers from multiple green energy suppliers, to test the transferability of the findings. A research with a real-life application allows for studying long-term behavioural effects on energy saving. In addition, the increase of participants allows for applying statistical analyses resulting in more reliable results than within this thesis study, of which importance is supported by [43].

Additionally, performing a long-term study in which an A/B study is applied can give insights into whether personalized gamification is a real added value in comparison to a one-size fits all approach. Although many state that personalized gamification has a better effect than one-size fits all approaches [15–18], it is unsure whether this is true for personalized customizable context designed in this study. Performing an A/B test in which one group is using a customizable gamified solution and the other group not, would give insights into these different approaches. Such a research can also contribute to the decision making of energy suppliers if personalized gamification is worth investing in as serious additional costs are involved when multiple solutions are offered.

When customizable personalized gamification is proven to be more effective than a one size fits all approach within the context of this study it can be researched whether this personalized gamification can be offered through machine learning algorithms. Knutas et al. [63] already designed a method applicable for this approach. A benefit of such an algorithm determining a user's preference towards designs of game elements is that a user does not have to create his own dashboard or application. If this process is done automatically, it saves time and users can directly start with the application. However, if mistakes in this process are made by showing elements which are not motivating for an individual the chance of adopting energy saving behaviours becomes less. Therefore, a combination between offering automatic personalized gamification together with keeping part of autonomy by allowing users to change elements by themselves might be the perfect solution. Further research in how such an algorithm can be made within this context is necessary before implementation.

A fourth recommendation is to investigate what effect a gamified solution has on the retention of customers at energy suppliers. The overall goal of this thesis is to help customers reduce their energy consumption and to increase customer retention at energy suppliers. This last part was not studied within this research.

However, the effects are of great interest for commercial parties such as an energy supplier. Earlier research showed that the amount of gamification is the only significant predictor of app ratings [42]. The use of game elements had minimal positive effect on app ratings, while behavioural constructs do not influence app rating [42]. This study applied a lot of gamification elements as recommended by [42], which is often not applied in earlier studies. Although many gamification components and game design elements were implemented in this study, it is still questionable whether the final design resulting from this study has a positive effect on app rating. This fact only increases the uncertainty about whether the design will influence customer retention. A long-term study on an put into use gamified application in which customers are followed can show the effect of the gamification solution on the level of retention.

Another recommendation is to also research the motivations of the other three user types from the Hexad scale. This study did not focus on the motivations of disruptors, socialisers, and players. However, it might be that create appealing gamification designs for these user types is important for energy suppliers as well. Although there are expected relations between these user types with the user types researched in this study it is unknown whether these are present and how they exactly relate. Therefore, future research might also focus on the possibilities of customizable personalized gamification design for the user types socialisers, players, and disruptors.

Since this research shows that focussing on designing for specifically motivation needs is a good strategy for personalization rather than matching gamification design elements to these motivations. Future researchers are advised to look further into the design possibilities for designing for motivation in the energy world, but also in other domains. The proposed framework of this study can be further explored in future research to see whether this is a successful design strategy for a larger group of participants. As a starting point existing user groups within a specific context can be compared with the motivations of user types from the Hexad scale. The expected overlap can then be evaluated using the Hexad survey [55] to check whether this also applied within other contexts.

Finally, design opportunities can be further explored and designed. This research only looked into the opportunities for gamification. However, serious games have already proven to be effective for stimulating energy savings as well [19]. Future research might also explore the possibilities of serious games for energy saving within commercial environments.

9 Conclusion

This chapter provides the conclusions that can be drawn from the results of this study in which is researched how a personalized gamified energy saving application can be designed considering personal preferences of users within the context of a green energy supplier.

To design a personalized gamified solution within the context of a green energy supplier the method designed by Knutas et al. [63] was used. However, this method was originally designed for designing a supervised machine learning algorithm that enables the selection of personalized game elements based on the user type and system context. This research showed that restructuring this method by leaving out the parts involving the machine learning algorithm and adding a final evaluation allows for iteratively designing personalized gamified solutions based on user feedback. This iterative process is not only helpful to gather and implement feedback of users in the design, but it is also a suitable approach to implement gamification into an organisation where it is still a relatively unknown phenomenon. Gamification can deter a stakeholder which can cause that its relevance and added value is no longer seen. This study showed that by using a tunnelling approach in which a gamified solution is slowly expanded helps to engage a stakeholder without losing his interest.

The results of the Hexad survey revealed three main user types among the customers of Pure Energie: philanthropists, achievers, and free spirits on who the design process focussed in this study. The user types socialisers and players were less present, and the user type disruptor was almost non-existent. Pure Energie already determined three main user groups (green, price, and demanding customers) before this study which are expected to have a link with the found user types from the Hexad scale based on the motivations of each group. Green driven customers are expected to have a link with philanthropists, price driven customers with achievers, and demanding customers with free spirits.

Different from previous research assuming that using different motivational affordances per user type allows for personalization, this research suggests that motivation-based designs within a gamified element is an effective personalization approach. By changing the content of a gamified element to the main motivation of an individual's user type the element can be made attractive and enjoyable to the individual. This finding resulted in different design strategies per user type when designing gamification for an energy saving application. For philanthropists, this comes down to designing for purpose which can be incorporated by giving them insight in their own impact and by allowing them to increase their impact. Achievers have a need for competence which they want to see back in energy saving applications through competitions with others, mostly with friends. Lastly, free spirits are motivated by autonomy, resulting in designing for having fun and learning about energy savings by allowing multiple options instead of one single defined route.

Personalization cannot only be achieved by designing for different motivations of user types, but also by adjusting designs to match personal situation and already existing energy consumption behaviour. This approach gives users the feeling that the application is really giving them personalized advice. Next to the importance of personalization some elements were found to be essential within an energy saving application. These include information provision, progress, interactive user interface, and feedback as they help to create a basic understanding within an energy saving application and increase user involvement.

The iterative design process for personalization resulted in a gamified design consisting of two pages, namely a dashboard and energy editor. These designs can be implemented within a customer portal of a green energy supplier, in this case Pure Energie. Customers can choose the look of their dashboard by choosing between the different designs for each game mechanic. The energy editor can be adjusted to a customer's home situation and shows where energy savings can be reached or what decisions will cause extra usage. The option for allowing users to choose between different designs for the elements on the dashboard creates a feeling of autonomy. Although autonomy is most important for the user type free spirits, as it is their main intrinsic motivation, it is not only important for them. Philanthropists and achievers were liking the opportunity to create their own dashboard and choosing between different designs for each game element. This suggest that autonomy is an intrinsic need which is to some extent an important motivator for each user type within a gamified solution.

As a final result, this study proposes a framework explaining the three main user types within a gamified energy saving application based on the predetermined types by Pure Energie and the user types from the Hexad scale. This framework helps to design personalized gamification solutions for energy saving purposes. The framework consists of an inside out model in which the user type philanthropist forms the core as they only find increasing their own impact important. One scale away from the philanthropists we find the achievers which goal within an energy saving application is improving themselves with a focus on saving money or increasing their impact. The outer range is formed by the free spirits, who can find both saving money and or increasing impact important, but their main goal is to have fun and learn more. Meaning that each step away from the core of the model, personalized design becomes harder as users interest grows. This model is also generalized including all user types of the Hexad scale shedding new light on the correlations between the user types.

The findings from this research provide an interesting view into the possibilities of personalized gamification design for an energy saving application. This thesis serves as a first step towards increasing sustainable behaviour and customer satisfaction and retention at green energy suppliers reached through gamification design. The findings of this research propose a method on how to introduce the technique of gamification in such organisations and a framework that describes the main user types present and how to design for them.

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Appendices

Appendix A: Method literature analysis

A systematic search for literature is conducted to answer the set of research questions about the background theory for this master thesis project. The background theory required for the thesis project can be split up in three main topics, namely (personalized) gamification, persuasive technology for energy savings, and existing gamified applications within the energy sector. These three topics are researched separately, but there is also searched for overlap of these topics in the literature. The literature search is performed in two data bases, namely Scopus and Google Scholar. The terms used during this search can be split up in two phases. The first terms were determined when no reading on the topics was yet performed. After some research into these topics, other terms emerged that were useful search terms. Search terms have been applied separately, but a search on combinations of them has also been applied. The list of terms for both phases are shown in Table 26.

Table 26: Applied search terms for literature search on the three main topics

	(Personalized) Gamification	**Persuasive technology**	**Existing gamified applications in energy sector**
First search terms	(personalized) gamification, designing (personalized) gamification	(personalized) Persuasive technology, persuasive technology applied with gamification, design of persuasive technology systems	Energy savings, gamified applications/solutions, gamification, persuasive technology, customer retention, energy sector/domain, energy consumption, consumers, energy companies
Later search terms	User types, Gamification User Type Hexad scale	Gamification User Type Hexad scale	Gamification User Type Hexad scale, metaphors

Most of the literature search was limited to the English language. However, a search in Dutch is conducted on already conducted theses within this topic. In addition to literature search, the reference lists of the most relevant articles on each topic were hand searched.

Appendix B: State of the Art energy saving applications

In this section, a number of existing applications focussing on incentivizing energy saving behaviour are explained. The applications range from developed by commercial energy suppliers to other parties.

Green choice

Green choice is one of the green energy suppliers within the Netherlands. Within their customer portal they advise customers on their energy usage. They also make use of gamification elements. however, these are not personalized or directly linked to existing information on their energy consumption. They offer quizzes and challenges that you can perform. Quizzes are for example on solar energy or light bulbs and are there to learn the customer more about these topics. You can also for example receive tips to lower your energy usage during night time or receive a card game with challenges that help you reduce your showering time. So different elements have been designed, but none are immersed with the application and are not personalized in any way. Besides these challenges are not easy to find within the application, which makes it not directly attractive to make use of it.

Vattenfall vijfdaagse[12]

This was a week campaign when Vattenfall introduced his new brand. Gamification was used to involve customers within the campaign. Customers could unlock sustainable rewards, an extrinsic motivation with the higher goal to make customers more sustainable.

Joulebug[13]

The mobile application Joulebug makes use of challenges, which they call actions, to motivate users to become more sustainable. Challenges can be played with a team and each user has his own profile. Activities can be post on a timeline which can be seen by friends, so the app is also a sort of social network. Besides the app encourages users to become more sustainable by encouraging users through notifications. The app itself has a very attractive user interface. The app also has a dashboard showing whether awareness changes into behaviour change. It allows for customization, a personalization method to match expectations of users.

My earth app[14]

My earthapp stimulates users to reduce their energy consumption is uses a diary format in which daily activities can be chosen to reduce energy consumption. As a reward for performing daily activities not numbers are used as a reward, but you can increase the ice flow of a polar bear. A very visual reward approach. the developers of this app choose to use a visual reward as carbon units are often too abstract for people.

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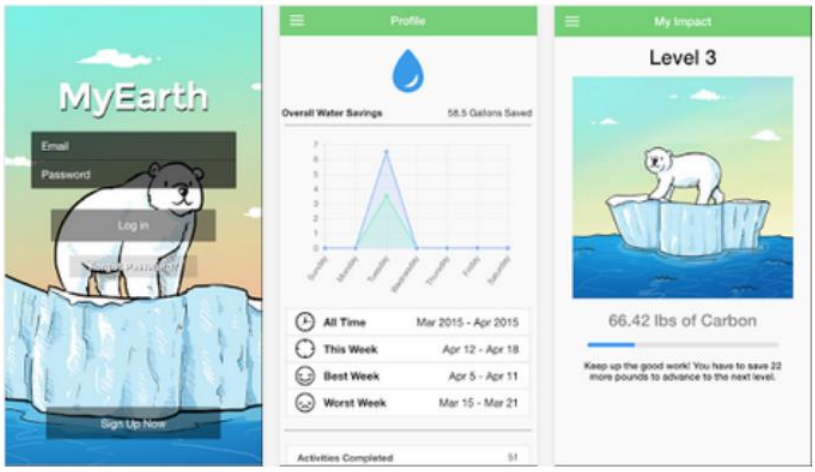
[12] Doornvogel, “Vattenfall vijfdaagse”, https://doornvogel.com/cases/vattenfall-vijfdaagse/

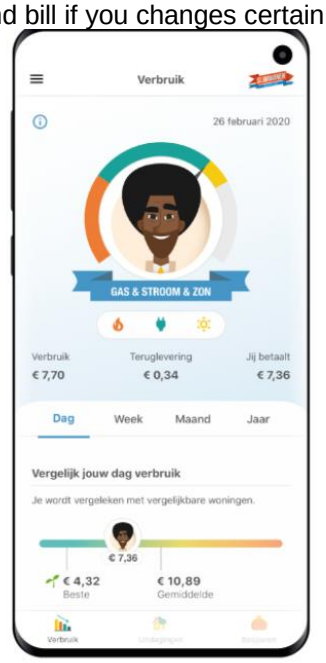
[13] Joulebug, https://enterprise.joulebug.com/

[14] Collen Kriel, “My earth app visualizes energy saving effort by letting you save a virtual polar bear”, https://siliconangle.com/2015/04/21/myearth-app-visualizes-energy-saving-efforts-by-letting-you-save-a-virtual-polar-bear/



Slim wonen app[15]

This application helps users to reduce their energy consumption. A user can create his or her own avatar within the application. The application is mostly focussing on reducing monthly energy costs. To be able to reduce costs the application shows tips and tricks to reduce energy usage. It shows the daily energy costs in numbers and in a graph and gives an indication of the amount of money that can be saved within a year. Users can compare their energy usage with comparable households. A social network can also be created which allows users to reduce their energy consumption in groups. As a group you can set a saving goal and work towards it. Another playful element is that users can play a competition with their monthly energy budget, the application will then help you to stay below your monthly budget by giving tips and remembering you to keep this behaviour change. The app also gives insight into the direct results on your energy usage and bill if you changes certain behaviours.



[15] Slim wonen app, https://www.google.com/search?q=slim+wonen+app&rlz=1C1GCEU_nlNL909NL909&oq=slim+wonen+app&aqs=chrome..69i57j0i22i30l4.2304j0j4&sourceid=chrome&ie=UTF-8

Appendix C: Literature personalized gamification energy world

Preference user types persuasive strategies in energy saving applications

Orji et al. [60] looked into the relationship between individual preferences for persuasive strategies and the six user types out of the Gamification User Type Hexad scale. This resulted in a large scale study including 543 participants that looked at how individuals belonging to different gamification player types responded to different persuasive strategies depicted in storyboards. The storyboards used in this research represented persuasive gameful health systems. Ten different often used persuasive strategies were depicted in storyboards: competition, simulation, self-monitoring, goal setting, customization, reward, social comparison, cooperation, personalization and punishment. Results indicated a positive significant result for the user type free spirit and personalization strategies. Philanthropists were found to be motivated by the persuasive strategy of simulation. Achievers were not motivated by any of the persuasion strategies, which might suggest that persuasion might not be an effective approach to motivate this user type. Although these links between the player types out of the Hexad scale and persuasive strategies were found, it is not said that these count for every research. This research was focussed on the health domain, and the effectiveness of persuasive strategies are context and intention specific [61]. It might be that the this study will give other results if performed in another context with another intention such as energy saving in the energy domain.

Other researchers looked further into this topic of personalization and looked into the relationship between the User Type Hexad scale and persuasive principles within the context of energy saving [21, 22]. The research of Böckle and Kwaku [21] highlighted design solutions to incentivize energy saving by investigating the relationship between the user types from the Hexad scale [15] and the six persuasive principles of Cialdini [77]. In the research of Böckle and Kwaku [21] each participant filled in the User Type Hexad survey and had to judge six designs of static storyboards in the context of energy saving on their effectiveness. The perceived persuasiveness of each storyboard was assessed on a seven-point Likert scale. The correlations showed that four HEXAD user types (disruptor, player, achiever, and free spirit) have a high tendency towards three persuasive principles (reciprocity, commitment and consistency, liking). There was no significant correlation found between the other user types and persuasive principles. Based on these results nine design guidelines were created for personalised gamified energy saving applications. Table 27 shows the design guidelines for achievers and players, none guidelines were created for the free spirits.

Table 27: Design guidelines by [21] for player types: Player, Disruptor, Achiever *[65, p. 325]*

Reciprocity (Player)
DG1: After receiving several extra badges or rewards by the application, the system provides access to new functionalities (e.g., advanced usage analytics) and asks the end-users to apply (call to action) those within their daily usage
DG2: The system offers extra points and asks end-users to set (call to action) their personal consumption goals for their current month
DG3: The system offers extra badges and asks end-users to use a certain device (e.g., light) in a more efficient way (call to action) in order to change their present energy consumption behaviour
Commitment and consistency (Achiever)
DG4: The application offers goal-setting functionalities in combination with levels and status (“e.g., energy-saving starter – energy-saving enthusiast etc.) and reminds end-users about their consumption goals, status, progression and suggest incentives in order to reach the next level (call to action - e.g., apply this well-known energy-saving tip and receive additional 50 points)
DG5: The system reminds end-users about their past energy-saving behaviour and comes up with new challenges in order to tackle them and improve their current consumption
DG6: The system provides several options for end-users to set their level of importance for reaching defined consumption goals and sends reminders and incentives in case of any negative deviations (e.g., reducing power for the fridge has been set as very important by you; reduce it now). Energy-saving goals are connected to certificates and status within the application Liking

As a follow up on the previous mentioned research [21], Böckle, Novak and Bick [22] explored the design possibilities at the intersection of gamification and persuasive technology to foster energy saving behaviour. In particular, they investigated whether there is a relationship between the user types of the Hexad scale and seven selected persuasive strategies (Competition, Simulation, Self-monitoring and feedback, Goal

setting and suggestion, Personalization, Reward, Social comparison). These seven strategies were selected, because they are commonly used within the persuasion literature and gamified system design. Besides, they investigated how users existing energy saving behaviours influence perceived persuasiveness. Within the research participants had to fill in a survey to determine their player type according to the research of [55] and environmental behaviour survey design by [78]. After filling in the survey each participant had to give each storyboard a score for the level of persuasiveness. Each storyboard represented a persuasive strategy and consisted of an illustration of a real-world prototype, developed by Koroleva et al. [51], of a persuasive system for stimulating energy saving. Each storyboard is described in Table 28.

Table 28: Storyboards used in [22] for each persuasive technology *[44, p.6]*

Persuasive strategy	**Storyboard example**	**Persuaded by player types**
Competition	After applying the suggested energy saving tip ("turning off all the lights"), the end-user could earn enough points to climb up the overall leaderboard and take the lead	Player and socializer
Simulation	By saving another 50 kWh, the end-user would fill up the last row within an energy-consumption simulation and increase their impact on the environment.	Socializer and philanthropist
Self-monitoring and feedback	The visualization informs the end-user of their consumption level, which has already exceeded the average consumption of last month	Philanthropist
Goal setting and suggestion	The goal is set to 20% and their current consumption is about to exceed the saving goal	Player, Socializer, and philanthropist
Personalization	Tailored energy saving tips, based on the end-user's past energy behaviour (e.g., try to fill up the washing machine completely in order to prevent additional and unnecessary washes)	Socializer and philanthropist
Reward	The system informs the end-user about the possibility of achieving the next possible badge in the category "kitchen appliances"	Player and socializer
Social comparison	The system informs end-users about their achievements on a monthly basis and compares the scores with another end-user within the energy saving environment	Player and socializer

The participants were reached via the application M-Turk and 480 valid responses were gathered. The most identified user types were socializer, player, and philanthropist. While participants with a high tendency towards the socializer user type cover almost all the persuasive strategies, the user types player and philanthropist are motivated to a limited number of strategies. The most preferred persuasive strategy was self-monitoring and feedback. There were no significant results found for the player types free spirit, achiever, and disruptor. However, it was found that the player type disruptor is demotivated by the persuasive strategy of goal setting and suggestion. This finding also strengthens the worry about the earlier positive correlation of the user type disruptor and reciprocity.

When looking at already existing pro environmental behaviour it was seen that people with a tendency toward energy saving have been persuaded by the following strategies: goal setting and suggestion, self-monitoring and feedback and simulation. These findings show that already existing energy saving behaviours do influence the level of persuasiveness of several strategies. In addition, they also identified a significant difference of energy saving behaviour between the lower (26-35) and upper age group (36-45) participating in this research. When looking at the environmental behaviour of people and their player type in the Hexad scale it was seen that people with a high tendency towards energy saving have a significant relationship towards free spirit and player. A negative relation was seen towards the disruptor type. This research shows that not only a player type determines if someone will be persuaded to incentivize energy usage. This fact depends on more facts, such as already existing environmental behaviour and age.

Appendix D: Stakeholder analysis

Pure Energie online channels/stakeholder research online environments

Pure Energie communicates with its customers via several ways. Customers can get insight in their energy usage via several channels, namely mail, mobile app, and customer portal. People interested into the services of Pure Energie can start by looking on their website. Once they become a customer, they get access to several sources in which they can get more insight in their energy usage and can arrange for example financial matters. Within this section the currently available communication channels are described.

Website

People interested into the services of Pure Energie can start by looking on the company's website. The website shows more information on the company and it services. Price information on energy contracts can be seen with the help of a calculator tool. With the help of this tool monthly payments can be estimated based on a person's energy usage and living situation. If an individual is interested in becoming a customer of Pure Energie, a contract can be concluded via the site. Other available information on the website includes a map that shows the wind and solar projects of Pure Energie, info on green energy and solar panels and contact information.

Customer portal

Every customer has an account on the customer portal, which can be used to look into contractual or financial information, and energy usage. When a customer has a smart meter and has authorized Pure Energie to get up the usage data the customer can see this information back within a graph. The graph shows the annual, monthly, and daily usage as well as the electricity usage per hour. The customer has only insight into his own usage and it is not compared to anything within the customer portal. Next to the graph, customers can look up their invoices and contractual details. When the contract is about to expire the customer gets a notification on his dashboard with a call to action to extend his contract for a new period. Customers can choose whether they renew their contract or switch to another energy supplier. Renewal offers consists of one year, three year or five year contracts. When a customer does nothing when his contract ends, the contract is automatically retained until the customer concludes a new contract or switches to another energy supplier.

To be able to understand customers usage better, a customer profile was added to the customer portal. This helps Pure Energie to get insight into the customers energy saving behaviour and can help to offer tailored solutions in the future. The customer profile consists of a list of twelve questions separated in three categories: your profile, your type of home, and your interests. The questions give insight into the customer living situation as well as his thoughts on sustainability. Table 29 shows the questions per section in the profile page. The customer himself can choose whether he wants to fill in the profile or not.

Table 29: Questions asked for the customer profile in customer portal

Questions per category	**Possible answers**
Your profile	
Number of residents	Number of choice
Type of residents	Students, single, living together, family with 1 child, family with 2 child's or more, seniors, others
Electrical car	Yes or no
Your type of home	
Construction year	Year
Type of home	Apartment, semidetached, terraced house, corner house, detached house
Energie label	Unknown or A till G
Solar panels	Yes or no
Your interests	
I make environmentally conscious choices in everyday life	5-point Likert scale

I take the environment and climate change into account by paying attention to my consumption.	5-point Likert scale
I think that I can contribute more to making the Netherlands more sustainable.	5-point Likert scale

Energy report (VKO)

Every month Pure Energie sends an energy report (VKO) to their customers who have a smart meter via mail. With the help of the VKO they provide insight into the customers energy consumption. The goal of this overview is to help customers save energy. The VKO allows customers to easily compare their current energy consumption with their consumption of previous months, or years and with the national average. The possibility of comparing the energy usage offers customers a more personalized experience. However, comparing with previous months and years is only possible if the customer was already a customer at that point. An example on the last page of this Appendix.

Pure Energie app

The app of Pure Energie is currently being developed and is in the test phase now. A selected group of customers can already make use of the app that comes together with a 'Pure Energie meter'. This extra box can be easily connected to a smart meter in the fuse box. As soon as the Pure Energie meter is installed it can be connected with an app called 'the consumption manager'. The app helps customers to get more insight into their energy usage by offering more possibilities than the customer portal. It tries to make where energy is being used in a household by allowing customers to add devices to the app. When devices are added, the app shows the amount of electricity or gas used by each device. The app also offers the possibility to view live energy consumption. Where the amount of electricity is updated every 15 seconds and the gas consumption every hour. In addition to this usage information, the app also provides insight into financial matters. It shows how a customer's monthly payment is built up and what their current usage is within their monthly budget. The app is especially interesting for people who own solar panels, because it shows how their monthly budget relates to the amount of solar energy generated. Overall, the app is intended to fit into the modern image of the company and offers real time data on energy usage. The data in the end of a month is equal to the monthly VKO that is received. However, in contrast to this monthly overview the app offers more information and the possibility to monitor energy consumption at any time.

Recognized gamified elements

Even though Pure Energie is not aware of it, their online communication channels do already include some gamified elements. The website itself does not offer any gamification elements. The customer portal offers the possibility to see the energy usage per hour, day, month, and year. This feature offers the customer the possibility to compare periods of energy usage with each other and can be placed under self-competition. Self-competition, meaning competition within oneself, is based on accepting a challenge and can be a motive for a person to reach a chosen goal and to prepare for it [79]. The VKO offers a possibility for self-competition as well by showing the difference in energy usage from a previous and year. The difference between the customer portal and VKO is that within the VKO this is directly presented towards the customer via plain numbers. Within the customer portal the customer has to look up the differences himself by searching for the right number in the graph. Besides self-competition the VKO also offers an element of competition by comparing a customer's usage with the national average. When looking at the app there is feedback applied, customers can see their live energy usage and see what type of device is on and what the usage is. The app therefore offers direct and live feedback of energy usage towards the customer. However, this feedback is shown as plain numbers towards the customer. These plain numbers might be hard for customers to understand if they lack knowledge on energy consumptions.

Conclusion

Although, it is unknown by the company itself they already make use of some gamification elements. However, these elements are not obviously used and not so strong. There are certainly possibilities for gamification in the online channels of Pure Energie. Most likely, these can be applied in the customer portal, app, and VKO. The portal and app offer dynamic environments which can be accessed by customers at any time. A disadvantage of the VKO is that data can only be disseminated monthly and must be presented statically.

Onderwerp: Maandelijks Energierapport juli 2019

Gegevens

Periode:	juli 2019
Naam:	**xxxxxx**
Adres:	**xxxxxx**
Woonplaats:	**xxxxxx**
Klantnummer:	**xxxxxx**

Overzicht energieverbruik

Met dit verbruikskostenoverzicht helpen we jou energie besparen met bespaartips en door je inzicht te geven in jouw verbruik.

Meer informatie over dit overzicht vind je op pure-energie.nl

Jouw elektriciteitsverbruik

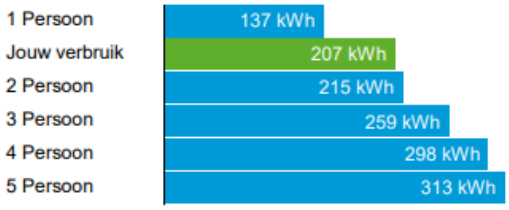
In vergelijking met jouw verbruik:

(normaal: 59 kWh, dal: 148 kWh)

Kan beter! Je verbruik is toegenomen

Gemiddelde elektriciteitsverbruik

Jouw elektriciteitsverbruik in vergelijking met het gemiddelde verbruik in Nederland per huishouden.



Verbruiksafhankelijke kosten: € 47,89
Totale kosten: € 47,15

Teruglevering

Je bruto elektraverbruik deze maand: 207 kWh (normaal: 59 kWh, dal: 148 kWh)
Je bruto teruglevering deze maand: 453 kWh (normaal: 361 kWh, dal: 92 kWh)
Je netto elektraverbruik deze maand: -246 kWh (normaal: -302 kWh, dal: 56 kWh)

Je hebt deze maand 453 kWh teruggeleverd. Dit is goed voor maar liefst €103,47!

Bedankt dat jij je steentje bijdraagt aan een duurzame toekomst. Samen maken we onze wereld mooier en schoner. Komen de gegevens niet overeen met het display op je omvormer? Dat komt doordat je op de slimme meter alleen kunt inzien hoeveel je hebt overgeproduceerd (en dus hebt teruggeleverd aan het net), terwijl je op de omvormer de totale stroomproductie ziet.

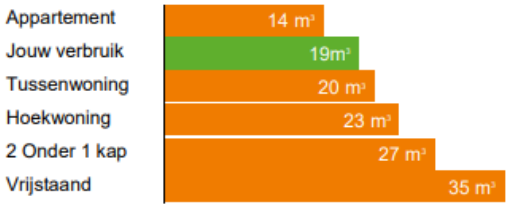
Jouw gasverbruik

In vergelijking met jouw verbruik:

Goed bezig! Je verbruik is gedaald

Gemiddelde gasverbruik

Jouw gasverbruik in vergelijking met het gemiddelde verbruik in Nederland per type woning.



Verbruiksafhankelijke kosten: € 16,59
Totale kosten: € 37,13

Goed nieuws! Met onderstaande tip(s) kun je geld besparen op je energierekening!
Wil jij minder elektriciteit verbruiken? Zie deze tip(s) voor volgende maand (augustus 2019):
Onderwerp: Energiebesparen tijdens je vakantie
Ga je op vakantie? Kijk voor je weg gaat of alle apparaten uitstaan. Dat is voordeliger en veiliger dan op stand-by laten staan.

Wil jij minder gas verbruiken? Zie deze tip(s) voor volgende maand (augustus 2019):
Onderwerp: De comfortstand van je ketel
Staat bij je combiketel de comfortstand voor warm water aan? In deze stand houdt de ketel steeds een klein beetje water warm. Zet de comfortstand tijdens de vakantie uit. Hoe je dat doet, lees je in de handleiding van je combiketel.

Voor meer bespaartips, neem een kijkje op de website van Milieu Centraal.

Goed om ook nog te weten
Je overzicht energieverbruik is gebaseerd op actuele standen en tarieven (verbruiksafhankelijke kosten). Hierop kan je besparen, wanneer je minder verbruikt, zal er ook minder verbruik in rekening gebracht worden. Daarnaast zijn er vaste kosten (verbruiksonafhankelijke kosten) die wettelijk zijn vastgesteld (netbeheerkosten, EB, ODE) en aansluitkosten/vaste leveringskosten. Deze kosten bedragen in totaal: € 19,80 (voor meer informatie zie tarieven).

Je maandelijkse termijnbedrag is gebaseerd op een standaard jaarverbruik (SJV). Je SJV is 3236 kWh en 1585 m³. Indien je langer dan een jaar klant bent geweest kan je tot 36 maanden terug je verbruik inzien. Log daarvoor in op Mijn Pure Energie. Indien je een p4 machtiging hebt afgegeven kan je vanaf dat moment je verbruik terugvinden in je verbruiksoverzicht.

Je elektriciteitsverbruik: juli 2016: 338kWh, juli 2017: 214kWh, juli 2018: 180kWh.
Je gasverbruik: juli 2016: 23m³, juli 2017: 22m³, juli 2018: 22m³.

Neem daarnaast eens een kijkje op de site www.energieverbruiksmanagers.nl voor producten en diensten voor meer inzicht in uw energieverbruik en zo méér te besparen met je slimme meter.

Tarieven
In dit VKO hebben we rekening gehouden met de volgende tarieven:

Elektriciteit:
Tarief Normaal: €0,099180 per kWh *
Tarief Dal: €0,085120 per kWh *
Energiebelasting: €0,11934 per kWh *
Opslag Duurzame Energie: €0,02287 per kWh *
Vaste leveringskosten: €0,19890 per dag (€6,17 per maand)
Netbeheerkosten: €0,63089 per dag (€19,56 per maand)
Vermindering energiebelasting: €-0,85376 per dag (€-26,47 per maand)

Gas:
Tarief: €0,302100 per m³ *
Energiebelasting: €0,35469 per m³ *
Opslag Duurzame Energie: €0,06340 per m³ *
Regiotoeslag (regio 8): €0,00102 per m³
Vaste leveringskosten: €0,19890 per dag (€6,17 per maand)
Netbeheerkosten: €0,46367 per dag (€14,37 per maand)

De tarieven zijn inclusief 21% BTW.
Daarnaast zijn er op jouw contract eventueel nog kortingen van toepassing, deze zijn niet meegenomen in het overzicht omdat deze geen onderdeel uit maken van je termijnbedrag maar als extraatje verrekend worden op je jaarnota.

* Deze kosten zijn verbruiksafhankelijk. Dat betekent dat hoe minder jij verbruikt, hoe meer jij kan besparen op deze kosten!

Mijn Pure Energie
Als klant van Pure Energie krijg je toegang tot jouw eigen online omgeving: Mijn Pure Energie. Hier kun je o.a. jouw meterstanden doorgeven, een verhuizing doorgeven, gegevens wijzigen of jouw energieverbruik inzien. Als je ons machtigt om jouw P4-standen uit te lezen, kunnen we ieder kwartier jouw slimme meterstanden uitlezen. In Mijn Pure Energie krijg je van ons een handig verbruiksoverzicht waar jij kan zien hoeveel je verbruikt per maand, dag en zelfs per uur.

Zonnepanelen
Wist je dat wij ook zonnepanelen aanbieden? Kijk op onze website voor meer info. De beste manier om te besparen op jouw energiekosten is door zelf energie op te wekken met zonnepanelen. Via onze Zon-check weet je al binnen een paar klikken of jouw dak geschikt is en hoeveel geld jouw zonnepanelen gaan opleveren. Met tien zonnepanelen bespaar je per jaar al gauw €500,- op je energierekening.

Termijnbedrag wijzigen
Denk je dat je termijnbedrag wel iets bijgesteld kan worden? Je kan jouw termijnbedrag zelf wijzigen via Mijn Pure Energie. Let wel op dat de hoogte van je verbruik erg seizoen afhankelijk is. Het termijnbedrag is een soort gemiddelde dat ervoor zorgt dat jij op basis van je standaard jaarverbruik naar verwachting voldoende betaald. Je betaalt dus in de zomer evenveel als in de winter. Zou je dit niet doen, dan was je termijnbedrag in de winter vele malen hoger dan in de zomer. Zie op onze website hoeveel gemiddelde huishoudens procentueel gezien in een bepaalde maand verbruiken.

Zie ook de vragen die andere klanten hebben gesteld:
Wat is het verschil tussen verbruiksafhankelijke en verbruiksonafhankelijke kosten?
Hoe kan ik berekenen of mijn voorschotbedrag toereikend is?
Waarom heb ik minder totale kosten dan verbruiksafhankelijke kosten?
Wat betekenen de smileys?
Help! Ik ben meer gaan verbruiken, wat nu?

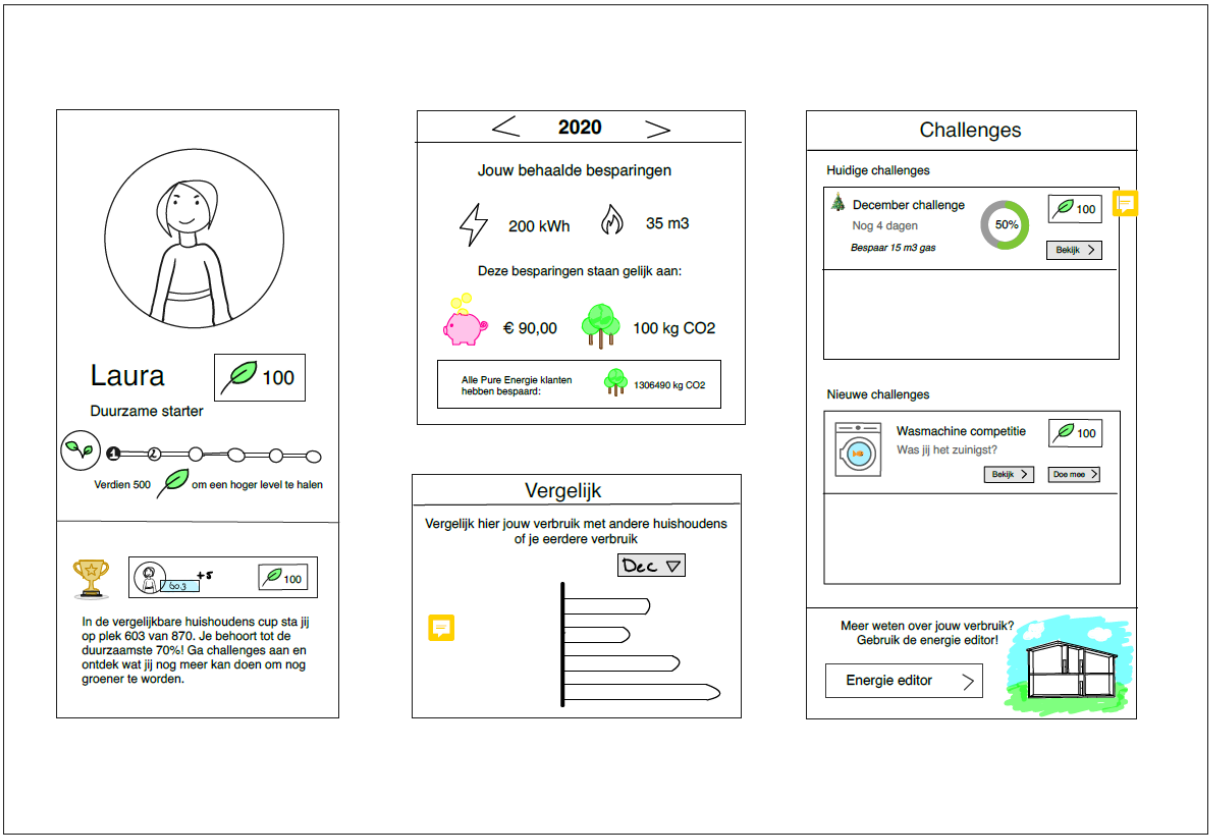
Appendix E: Questions survey English and Dutch

User type	#	**Question English from** [55]	**Question translated to Dutch**
Philanthropist	P1	It makes me happy if I am able to help others	Het maakt me blij als ik anderen kan helpen.
	P2	I like helping others to orient themselves in new situations	Ik help graag anderen om zich te oriënteren in nieuwe situaties.
	P3	I like sharing my knowledge	Ik deel mijn kennis graag met anderen.
	P4	The wellbeing of others is important to me	Het welzijn van anderen is belangrijk voor mij.
Socialiser	S1	Interacting with others is important to me	Ik vind interactie met anderen belangrijk
	S2	I like being part of a team	Ik vind het leuk om deel uit te maken van een team
	S3	It is important to me to feel like I am part of a community	Ik vind het belangrijk dat ik het gevoel heb deel uit te maken van een gemeenschap
	S4	I enjoy group activities	Ik geniet van groepsactiviteiten
Free Spirit	F1	It is important to me to follow my own path	Ik vind het belangrijk om mijn eigen pad te volgen
	F2	I often let my curiosity guide me	Ik laat me vaak leiden door mijn nieuwsgierigheid
	F3	Being independent is important to me	Ik vind onafhankelijk zijn belangrijk
	F4	Opportunities for self-expression are important to me	Mogelijkheden voor voor zelf expressie zijn belangrijk voor mij
Achiever	A1	I like overcoming obstacles	Ik vind het leuk obstakels te overwinnen
	A2	I like mastering difficult tasks	Ik hou er van moeilijke taken te beheersen
	A3	It is important to me to continuously improve my skills	Ik vind het belangrijk om continue mijn vaardigheden te verbeteren.
	A4	I enjoy emerging victorious out of difficult circumstances	Ik vind het leuk om als overwinnaar uit moeilijke omstandigheden te komen
Player	R1	I like competitions where a prize can be won	Ik hou van wedstrijden waar een prijs te winnen valt
	R2	Rewards are a great way to motivate me	Beloningen zijn een goede manier om mij te motiveren
	R3	Return of investment is important to me	Ik vind het belangrijk om rendement uit investeringen te krijgen.
	R4	If the reward is sufficient, I will put in the effort	Als de beloning voldoende is, zal ik mij inzetten
Disruptor	D1	I like to provoke	Ik vind het leuk om te provoceren
	D2	I like to question the status quo	Ik stel graag de status quo ter discussie
	D3	I see myself as a rebel	Ik zie mezelf als een rebel

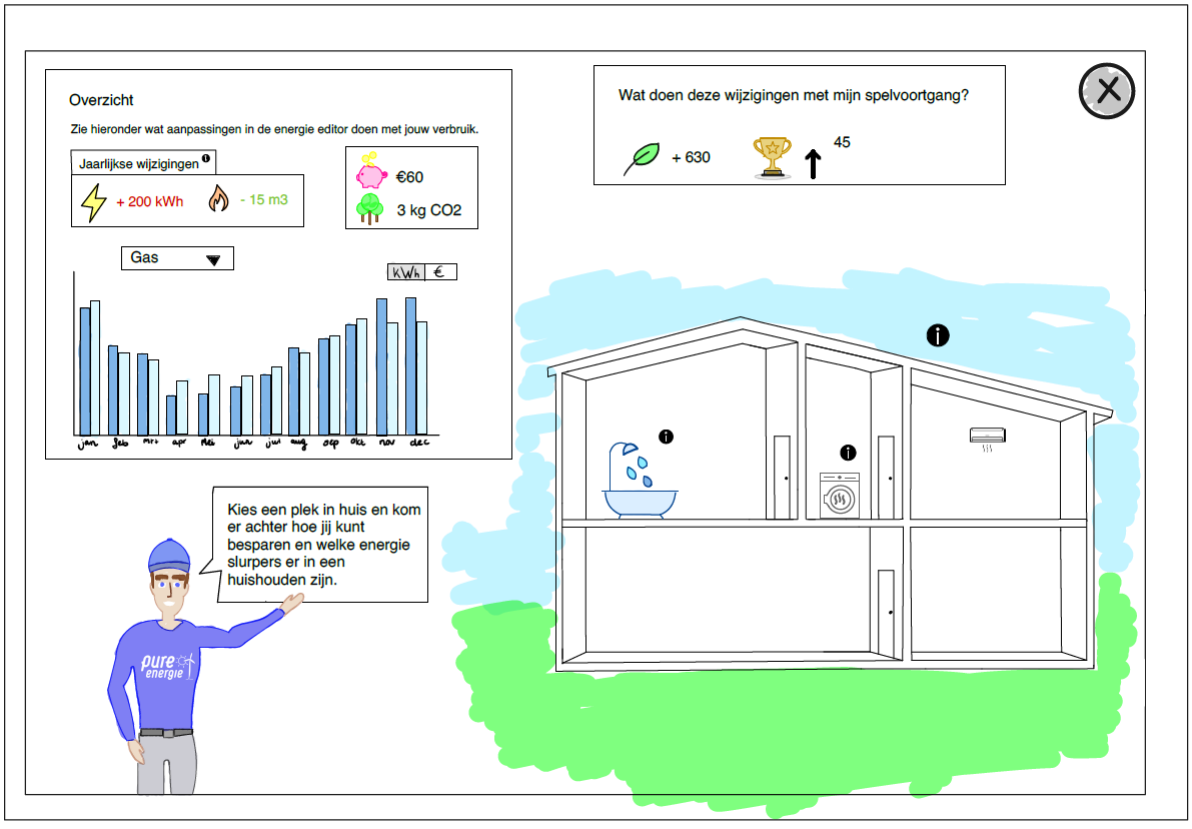
	D4	I dislike following rules	ik hou niet van het volgen van regels

Appendix F: Designs first low-fidelity prototype

Sketch dashboard



Sketch energy editor



Appendix G: Interview template evaluation first low-fidelity prototype

These questions are guiding questions for the interviews applied based on the first low fidelity prototype. As this interview was semi-structured there was also room to discuss other things. However, the four main themes: customer group, sustainability, application suggestions, and questions based on prototype were discussed within this order.

Customer group

- What are you normally looking for within an energy supplier?
    - On basis of which elements/characteristics do you choose your supplier?
- Why are you customer of Pure Energie?
    - How would you describe Pure Energie?
        - What characteristics are typical for Pure Energie?
- What do you think of the services that are offered by Pure Energie?
    - Customer portal etc?
        - Do you miss any functionalities?
- Do you have any requirements for your energy?

Sustainability.

- In which way are you already trying to be sustainable?
- How do you want to become more sustainable?
- Do you think that your personal choices can contribute to a more sustainable effect? And into what level?

Application suggestions

- Suppose you have to develop an application for Pure Energie that stimulates sustainable behaviour, what would you imply?
    - What criteria should this application meet?
    - What would motivate you to become more sustainable?

I would like to show you some ideas for a sustainable application. I am curious what you think about them and how you would apply them. There is no right or wrong so please be honest.

Questions based on prototype

Main page

- What do you think you see?
    - Is there something you do not understand?
    - What is your first impression?
- Would you see yourself using such an application?
- Is there any information missing?
- Would you like to add anything?
- Would you remove anything?
- Would you change anything?
- Does such an application ivites you to become more sustainable?
- Such an application can only be focussed on energy, would you also want to receive hints on other areas also focussed on sustainability?

Comparisons

Would you find it interesting to mirror your energy consumption with other things? Such as:

- Car ride
- Co2 kg

- Amount of trees
- Percentages
- money

➔ can you think of any other things that would be interesting? What is most understandable and attractive for you? Can you put them in an order?

Progression

- Would you like to compare your progress with others?
- Would you like to see your progress weekly or monthly?
- Would you like to see your progress coupled to levels?
    - Or do you want to work with points?
    - Or percentages?

Challenges

- Would you join challenges if presented in such a way?
- How would you like to get challenges offered? What would you like to see?
    - Randomly?
    - Based on behaviour?
    - Based on preference?
- What are challenges that you would like to play?
    - Washing machine
    - Tumble dryer
    - Using less gas
    - Take shorter shower time
    - Make a green investment
    - Use less electricity
- What would you expect to achieve with challenges?
    - Do you need an external reward to perform a challenge?
- How often would you like to be reminded of a challenge?
- Would you like to see how many others would have already joined a challenge
- Would you like to see what you already have achieved?
- Would streaks motivate you?
- Would you also play with others or cooperate with them in teams? For example with friends, family, neighbourhood.

Hints

- Would you like to receive hints to reduce your energy consumption?
    - How often would you like to receive such hints?
    - Would you also want to couple them to for example points or another game element?

Personification

- Does personification appeal to you?
    - What elements would you like to change?
    - Is personification a valuable addition for you?

Energy editor?

- What do you think this does?
    - Is there something you do not understand?
- Is there any information missing?
- Would you add anything?
- Would you remove anything?
- Would you change anything?

- Would you use such an application?
- Does it invite to become more sustainable?
- Is this a valuable addition for you?
- Would you use such an application more often?
- What would you like to add to make such an application more fun/interesting for yourself?
- Are you more interested in the numbers or graph?

Overal

Would you rank the following elements. And explain for each element how motivating it would bef or you and why (not)?

- Profile
- Level
- Progress
- Challenges
- Comparisons
- Progress in numbers (feedback)
- Energy editor

What kind of fun elements would you like to see more in general?

Appendix H: Summarized answers per user type during low-fidelity interview

Points

Achievers: are enthusiastic about points, but mention that there is no clear goal at the moment for what you should earn points. With a clear vision on what you can reach it would improve.

Philanthropists: all three philanthropists were not enthusiastic about the points within the game as it would not motivate them to play. *Phi 3* did mention that when the points had more a meaning in the game she might get motivated to do something with the points. The other two both stated that they would not be motivated by the points as they would like to focus on their impact not on the points. Phi 1 suggests to earn extra points if doing better than your goal.

Free spirits: Fr Sp 3 thinks points are only interesting if an external reward is coupled to them. The other two are both not really enthusiastic about the points as they do not see the extra effect of them except for reaching a higher level.

Hints

Achievers: nice to receive hints. Would be nice if coupled to points and if personal they become more attractive.

Philanthropists: would like to receive hints on how to improve energy usage. All suggest personal hints based on their own energy usage would be more effective than general hints. All suggest that hints must be weekly or monthly and no more often.

Free spirits: nice to receive hints on how to reduce energy consumption. Would be nice if hints were linked to my personal situation. Would want to receive more options and concrete answers that are not hard to interpret.

Progress numbers

Achievers: nice to keep track of progress. However, achievers want it to be clear and want to see how it is reached and what this means.

Philanthropists: find it nice to see their progress back in numbers. They mention that they are mostly interested in the impact of their energy usage and savings. Besides they find it important to see their own progress compared to earlier months/years. However, all mention that the part of feedback and information on their progress might be more comprehensive.

Free spirits: Phi 3 finds it interesting to get feedback on progress and impact. Would be nice to see my own progress through months or years.

Profile

Achievers: nice to make it more personal that would improve it. If you can for example choose avatars.

Philanthropists: would all not be motivated by the profile. Although Phi 3 and 1 mentioned that they would try it out probably but would probably not use it again.

Free spirits: personalisation options are experienced as a positive side effect as it makes the page more interesting for them.

Energy editor

Achievers: Ach 1 thinks it is a nice way to make the page more interactive but is not sure whether she would use it. On the other hand, ach 2 is enthusiastic about the energy editor. Both mention that if it becomes more personal it would be nicer to work with. Besides if you can achieve things within the house it would also be nice.

Philanthropists: Phi 2 thinks the energy editor is a nice addition. He wants to get suggestions for for example more sustainable devices. *"The energy editor must give me a clear image of my energy usage which is nicely visually shown together with the numbers of course*", as said by Phi 2.

Free spirits: nice interactive tool which makes it an interesting and valuable addition. Would be nice if it is reflecting own situation and gives consumption of devices in home. Phi 2 also mentions that it would be nice as if it works as an energy coach in which the impact and hints are shown. She also states that the connection between the house and information overview could be better. She suggest the house could be the lead and that impact must be shown in maybe some sort of calculator. Phi 1 mentions that he would not continuously update his house so for what activities would he come back.

Competitions

Achievers: do want to compete with others and are interested in joining for example the household cup or do competitions with others such as friends and family. Although the competitions should be clear and an equal fight.

Philanthropists: Phi 1 and 2 both would not compete with other households or people in competitions as it would not directly speak to them. They would like to be able to compare with others, but are not interested in direct competition. On the other hand, Phi 3 is interested in competitions with acquaintances such as neighbours, friends or family.

Free spirits: Phi 3 and 1 do not want to compete with others, but mostly focus on their own usage. They want to compare with others in a small overview, but do not want to compete or cooperate with others. Phi 2 was enthusiastic about competitions with others, if they make sense and if its an equal battle. However, Phi 1 is interested in competing only with acquaintances.

Comparisons

Achievers: Ach 1 thinks

Philanthropists: Phi 1 and 2 would like to compare his energy usage with other households and suggest that this could be done in an interactive way. However, phi 2 also mentioned that comparisons must be done 'equally' with other households. Meaning that a smaller house or smaller family on average use less energy than yourself if you live with four in a larger house. Phi 1 also suggest that comparison with region or neighbourhood might also be fun.

> All mention that comparisons of your own energy with kg of CO2 is a vague understanding. However, converted to a car ride or flight it might speak more to the imagination and become interesting.

Free spirits: Phi 3: *"I am missing comparisons with earlier years and months would be nice to compare with yourself as I do not want compare with other people".* Phi 2 suggests that an interactive comparison tool would be nice. On the other hand, Phi 1 does want to compare itself with neighbours or family/.

> Phi 2 would want to something else than the standard comparisons of km and kg of Co2. Phi 1 and 3 wants to see comparisons with money in his overview.

Achievers: do want to compare their own usage with others. Want to see how they perform in comparison with others. They will become more interesting if they become more specific.

Personalisation characters

Achievers: fun elements but do not stimulate motivation.

Philanthropists: do think this functionality might be fun as you can change your own page, however it would not motivate them and they would not use it after one time.

Free spirits: Funny addition that you can tune things within the page to really make it yours.

Challenges

Overall: challenges must not take longer than one month and missing challenges that were already performed. Missing overview of what challenges have been performed.

Achievers: nice to challenge yourself. It would motivate them more if they can compete with others (other customers as well as friends/family). They are missing an overview of achievements and two participants suggested badges to do this.

Philanthropists: were all enthusiastic about the challenges and would make use of it. Phi 2 mentions that a challenges might be hard within a family, because everyone must join to make it an success. However, Phi 2 also states that he likes the part of competition in challenges and that they change over time in other challenges. All three philanthropists mention that they would not be motivated by streaks. What motivates them more would be challenges matching their own energy usage and help increase their impact.

Free spirits: Phi 3 would play the challenges for fun, a challenge linked to his own personal situation would motivate him more. Besides he suggests that the impact of challenges should be shown. Phi 2 agrees on that challenges must address impact and that the concept can be used to create awareness. They all do not want to be obligated to participate in the challenges.

Levels

Philanthropists: Phi 2 states that levels can work as extra stimulus, but at a certain moment when you cannot climb any higher it might demotivate. Phi 3 mentions that she missed a progress bar between the levels, such that it becomes clear what you need to do to reach one level higher. Phi 1 is enthusiastic about the levels and is interested in how far he could get.

Personalisation data

Overall: every participant addressed that if the game was depicting their own situation and tried to improve this it would be experienced as more motivating. Personalisation was suggested in type of challenges, energy editor, and hints.

Corresponding conclusions among all participants

Some notes were made within all the three user types. All of the participants liked to receive hints on how to save more energy and receive information on their progress. However, the way they want to retrieve such information differs per user type. In addition all participants denoted that the more the gamification solution matched with their own energy usage the more attractive the system would become. Some examples that were often mentioned were receiving tips based on your own energy usage, so you get tailored hints for improvements. All the participants mentioned that the energy editor would become more fun if it represents your own household as best as possible. However, it must be close to reality otherwise it would only cause irritations.

Six participants of each user type mentioned that the elements together were in some sense positive although not every element was as appealing to them as others. However, the combination of the elements made the overview complete and more interesting.

Appendix I: Consent form customer research

Titel onderzoek: Gamificatie in het klantenportaal van Pure Energie

Onderzoeker:

Laura van der Neut l.vanderneut@student.utwente.nl

Hierbij verklaar ik goed geïnformeerd te zijn over het doel, de methode en tijdsduur van dit onderzoek. Mijn vragen zijn naar tevredenheid beantwoord en ik heb voldoende tijd gekregen om een besluit te nemen over deelname.

Ik weet dat de data en resultaten van dit onderzoek geanonimiseerd zullen worden en vertrouwelijk zullen worden behandeld. Dit betekent dat de uw gegevens anoniem worden verwerkt en na zes maanden worden vernietigd. De gegevens zijn alleen toegankelijk voor de onderzoeker. Persoonlijke data wordt niet gedeeld met derden. Ik weet dat de resultaten kunnen worden gebruikt voor academische publicaties of wetenschappelijke doeleinden waaronder een master thesis uitgevoerd aan de Universiteit Twente.

Ik ga vrijwillig akkoord met deelname aan dit onderzoek. Ik behoud daarbij het recht om mijn toestemming zonder opgave van reden in te trekken.

Wanneer ik meer informatie wil over dit onderzoek, nu of in de toekomst, kan ik contact opnemen met de onderzoeker:

Laura van der Neut

lauran@pure-energie.nl

06-81610013

Bij klachten over de inhoud of uitvoering van dit onderzoek kan contact worden opgenomen met de ethische commissie van de faculteit EWI aan de Universiteit Twente:

J.A. Rebel de Boer

053-489 3899

ethics-comn-ewi@utwente.nl

Naam deelnemer:

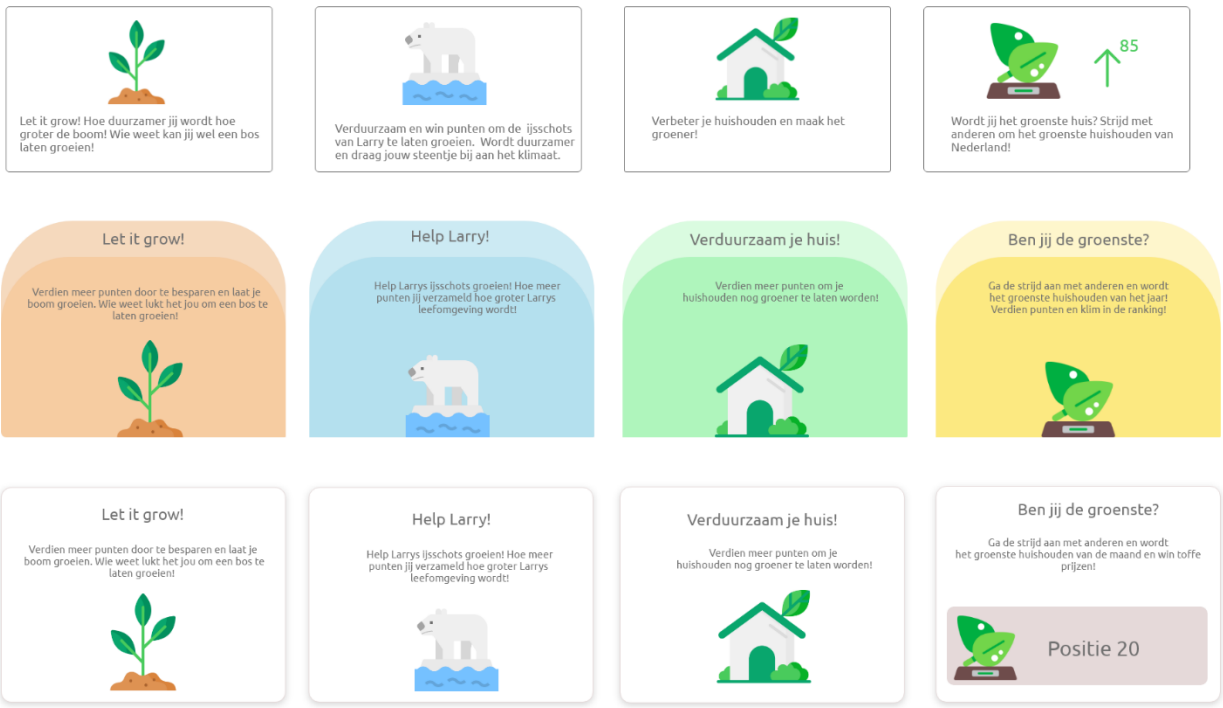
Ik ga ermee akkoord dat mijn spraakopnames tijdens dit onderzoek zullen worden gebruikt Yes / No

Datum: Handtekening deelnemer:

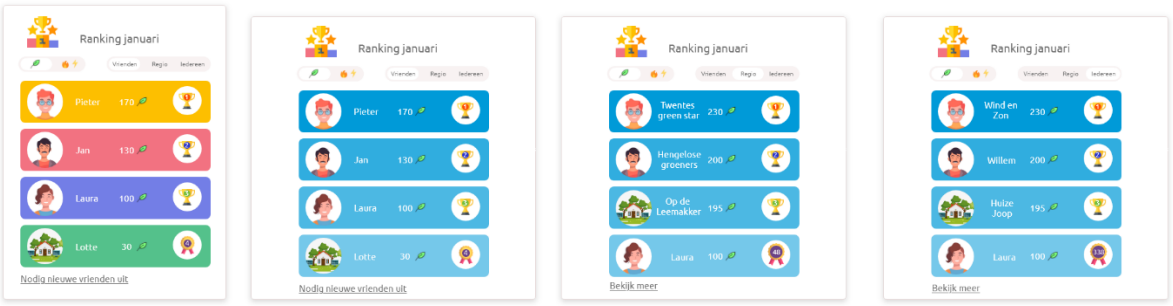
Appendix J: Iterative process of wireframe designs

The iterative process of the wireframes design is shown in this appendix. Each separate element and the improved design steps are shown differently.

Interactive visual challenges



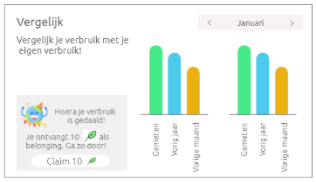
Leader board

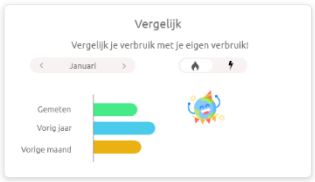


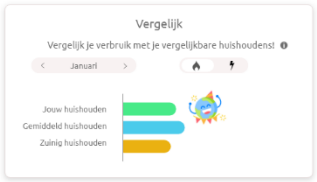
Profile pictures

Metaphors

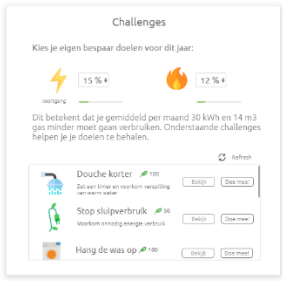
Comparisons

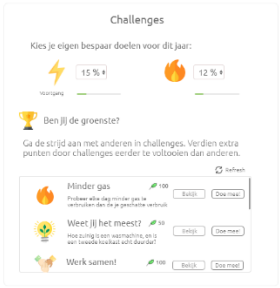


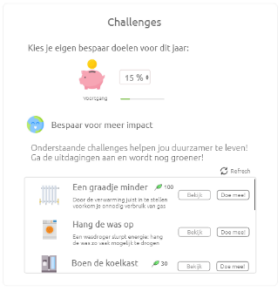


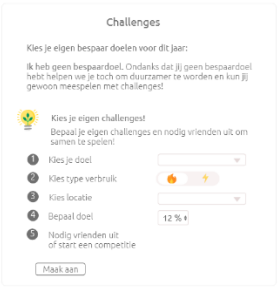


Challenges goal and play

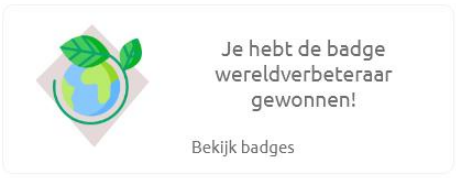




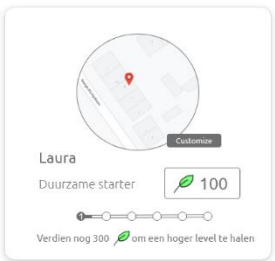




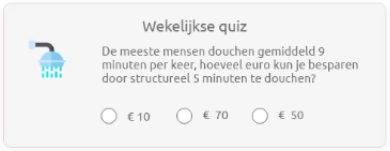
Badges



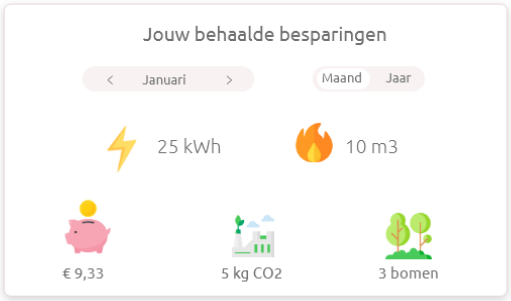
Level and profile block



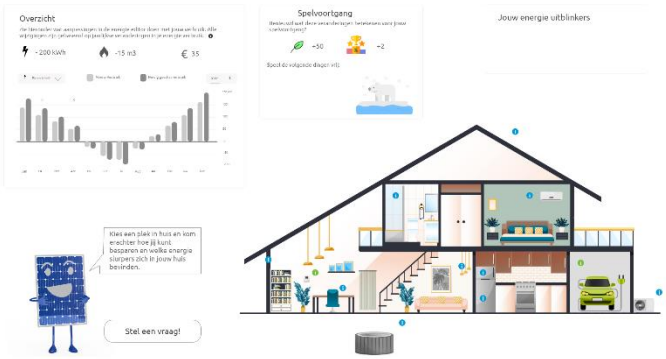
Learn more

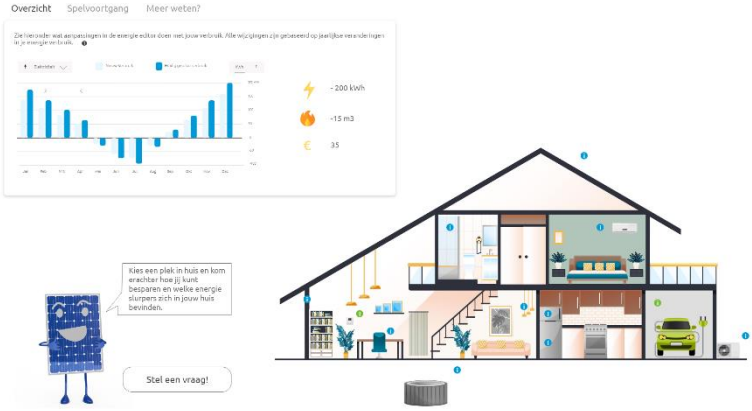


Feedback progress

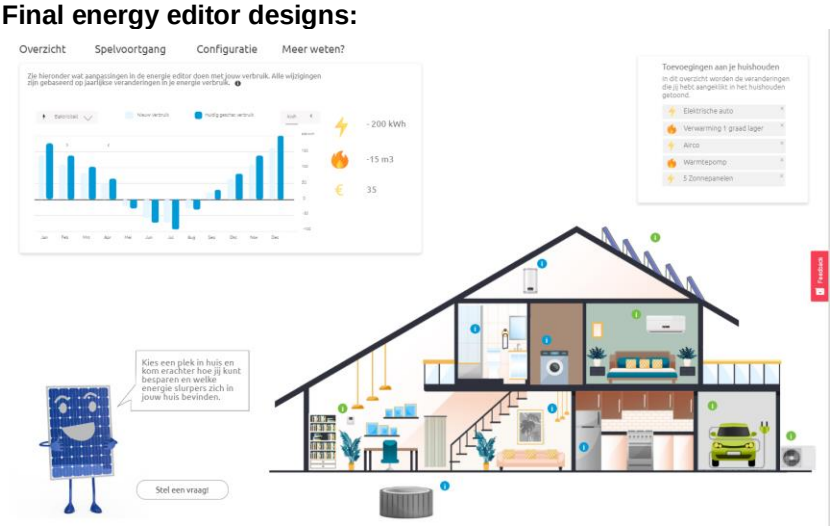


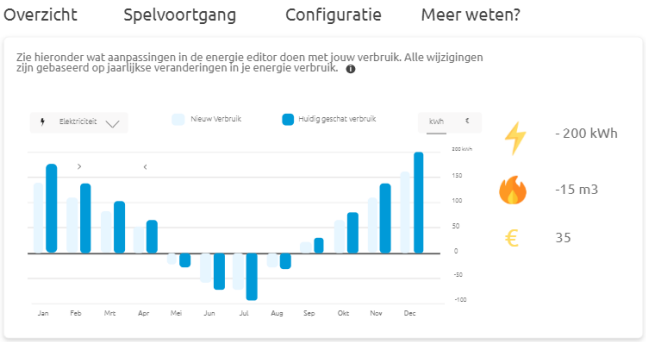
Energy editor

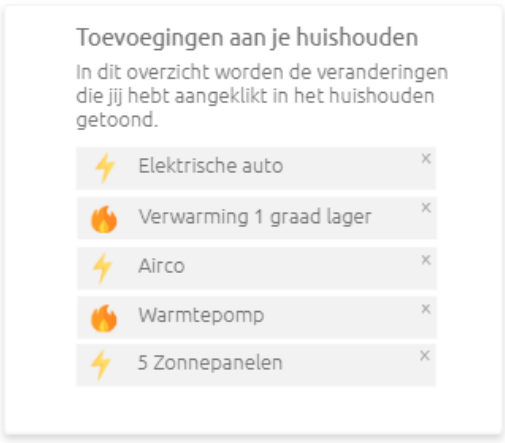




Final energy editor designs:







Appendix K: Interview template final evaluation

Timetable interview, this is a global estimation, small deviations from this time table can be made

Task	**Time**
Introduction	5 minutes
Dashboard configuration	10 minutes
Questions on dashboard configuration	10 minutes
Energy clicking and discussion	10 minutes
Rate designs	3 minute
Wrap up and thank participant	2 minutes

Before start final evaluation: make sure consent form is signed and explain the goal and ask for any questions left.

Step 1: let users talk aloud while configuring their preferred dashboard, help participant where necessary.

Step 2: discuss the choices of participants for personalization, discuss the choices made for each element

- Profile, levels, points, playful challenge, progress, progress metaphors, leader board, learning choice, challenges goal, challenges type, comparisons
    - Why did you choose this design, do you really like it?

Step 3: let participant go to energy editor and allow for exploring while thinking out aloud

Step 4: discuss design of energy editor

Step 5: ask for rating the designs

- Also ask if would trigger sustainable behaviour and an increase of online engagement

Step 6: wrap up and thank participant