Serious gaming as intervention strategy to accelerate the energy transition in households

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Abstract

The energy transition in the built environment in the Netherlands proceeds arduously, partly because of lack of support from homeowners, which is crucial in facilitating the goals set by Dutch climate policies. This insufficiency is characterized by barriers for homeowners regarding lack of relevant knowledge and perceived inability or ignorance of investing in appliances and insulation, both by internal and external factors. This thesis proposes a novel framework that aims to provide a theoretical basis to design serious games as intervention strategies. Three main aspects are considered to be relevant: pro-environmental behaviour, learning theory and a technical model. While pro-environmental behaviour and learning theory are separately explored in theory, a technical model is considered in three sessions with participants, to discover what role they can play in the goals of a serious game. Consequently, the elements are integrated into design elements for the case of the WeEnergy House game. The framework offers insight into how serious gaming might be utilized and shows the potential that this approach might have, which can consequently be validated in further research.

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1 Introduction

In accordance with worldwide efforts to transition to a more climate-friendly lifestyle (IPCC, 2014), the Paris Agreement (Paris Agreement - UNFCCC, 2015) and consequently and more specifically for the Netherlands, the "Klimaatakkoord" set the ambitious goal of reducing CO_2-emissions in the built environment – responsible for ~35% of total energy consumption in the Netherlands (RVO, 2020) – by 3.4 Mton in 2030 (Rijksoverheid, 2019). To reach the 2030 goal, at least 1.5 million houses need to be made more sustainable, via several routes: reducing and eventually eliminating the use of natural gas for heating by improving insulation and electrification of gas-using household appliances; increasing efficiency for electricity use via novel equipment; and investing in local energy production.

This transition is kickstarted and facilitated via so-called 'Proeftuinen Aardgasvrije Wijken' (PAW, platform for experimentation natural gas free neighbourhoods), where municipalities experiment with community energy solutions (e.g. district heat networks) in selected pioneer neighbourhoods (Programma Aardgasvrije Wijken, 2021). However, this strategy is, to say the least, progressing laboriously. Since the start of the PAW project in 2018, only 206 houses have been removed from the natural gas network, while the goal is set at 50.000 houses in 2027 (~ 5.000 per year) (Van den Berg, 2021). Problems arise for example in projects where district heating is the proposed solution, usually because of the lack of support from home owners.

The lack of support is problematic, because while municipalities and government bodies have set high goals for renewable energy integration in their respective regions, the support base of home owners is crucial, since they have to facilitate or at least accommodate to investments in their homes. Success in achieving the goals set by the Klimaatakkoord is very much dependent on the support base and social acceptance of renewable energy as well as behaviours of home-owners (Perlaviciute & Steg, 2014; Van Der Schoor & Scholtens, 2015). These behaviours require at least some form of input from homeowners, be it time, money or allowing inconvenience.

1.1 Barriers

Most people in the Netherlands are aware and concerned about the effects of climate change, and this share is increasing (Centraal Bureau voor Statistiek, 2021). This raises the question of why this does not result in corresponding behaviour in households. Apparently, barriers exist that inhibit behaviours that improve environmental conditions, or **pro-environmental behaviours** (from now on: PEB).

What exactly these barriers are for Dutch households is unclear, but Gifford (2011) recognised 11 psychological barriers that hinder PEB via 'limited cognition'[1]. While they have not been validated for PEB in households, some of them are relevant (Lacroix et al., 2019)

i)   Lack of perceived behavioural control: Someone might feel that they cannot do anything that contributes to mitigation of climate change (Lorenzoni et al., 2007, see also 2.1.1)

ii) Lack of self-efficacy: "my effort is like a drop in the ocean"; someone might know what to do about climate change, but he or she does not feel that their efforts matter (Thøgersen & Grønhøj, 2010a, see also 2.2.1), i.e., they feel that the outcomes are not in their control[2]

iii) Uncertainty: One underlying issue is that the consequences of choices in energy use and investment in energy-using appliances of homeowners are often not clear for them, while they greatly influence the environmental impact of their homes (Ástmarsson et al., 2013; Delmas et al., 2013; Huang & Warnier, 2019). Houses and their energy flows can be very complex and a lack of understanding or uncertainty about their level of knowledge might limit the control that owners can exert on their overall environmental impact via energy use (Van der Schoor, 2021, personal communication), (Ajzen, 2002)

iv) Ignorance: unawareness of climate change as a problem, or no idea what to do about it (Bord et al., 2000)

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[1] Gifford collected a total of 36 barriers from literature which he calls 'the dragons of inaction'. These barriers are meant to explain why most people agree that action should be taken to mitigate climate change, yet much too little action is taken. For more information on this compendium, see http://www.dragonsofinaction.com/

[2] There is some confusion on the specific distinctions between constructs regarding ones belief to perform a behaviour and influence its outcomes, see (Ajzen, 2002) for more info. For this research, I use the two definitions as posed here, as they are used as such by Gifford in his dragons of inaction

1.2 Intervention strategies

To speed up the energy transition within households and overcome these barriers, intervention strategies can be used, which are actions to encourage behaviour of a target group (Abrahamse & Matthies, 2012). These can be structural strategies, which are focused on changing the context in which PEB is engaged with or not, or informational strategies which are focused on psychological barriers in terms of knowledge, attitudes and norms. While both strategies are essential in reducing energy use as they focus on different types of barriers, informational strategies have thus far only resulted in minor behaviour changes (Bird & Legault, 2018; Delmas et al., 2013). This is regrettable, as researchers have noted that psychological barriers as described above are very much relevant in household energy use, and these barriers ask for informational strategies (Guo et al., 2018; Midden et al., 2007). There remains a need for successful informational strategies in the context of household energy use, not only to accelerate the energy transition, but also to discover what characterises successful informational intervention strategies.

There is quite a lot of literature on intervention strategies in energy conservation available, yet it is not yet clear what strategies work best. Delmas et al. (2013) reviewed 59 experimental studies on informational intervention strategies in the context of energy conservation and found that only higher involvement interventions, such as home energy audits and real-time feedback on technological improvements triggered any increase in energy conservation behaviour. These higher involvement interventions are characterised by being tailored directly to the context of stakeholders, which is a requirement for the intervention to effectively induce behavioural changes (Huang & Warnier, 2019; Schultz, 2014). Most effective are intervention strategies where tailored information is combined with immediate feedback, so that efforts to change behaviour are quickly made visible in terms of outcomes. Furthermore, in cases where a lack of knowledge is part of the problem, an intervention strategy should be able to effectively teach stakeholders relevant information (van der Schoor & Scholtens, 2019).

While intervention strategies on the one hand should be tailored specifically to the desired behaviour as well as to the target group, these highly specific strategies often require the most resources per capita (e.g., a home energy audit requires more time, money and effort per capita than a mass-media communication campaign). On the other hand, the desired behaviour must be exhibited by a large number of people to reach the goals set by the Klimaatakkoord. This asks for a highly flexible strategy design where the application can be tailored specifically to the personal situation of the participants, while maintaining the ability to be applied on a large scale.

1.3 Serious gaming

One strategy that has the potential to fit these requirements is serious gaming: playful simulations of real-life scenarios, tailored to the specific conditions in which they are employed. By 'playing out' a situation that resembles one's own to some extent, participants learn and experiment with difficult choices. In this way, the game can raise awareness, develop tailored strategies for individual households and also provide real-time feedback on consequences of those strategies (Gugerell & Zuidema, 2017; Johnson et al., 2017; Mayer et al., 2014; Scarlatos et al., 2014; X. Wu et al., 2020). Johnson et al. (2017) recognized 4 high-quality studies measuring cognitive outcomes in serious games or gamification approaches, all of which reported positive effects in terms of attitudes and awareness towards household energy use. Despite this success, these studies do not include validated methods to pinpoint what aspect of the serious game induced this effect. Similarly, when looking at the effects of serious games to actual behaviour change; only a small number of evaluated studies measure behaviour change, but when they do, observations include significant behaviour change, mostly on short-term measurements. For longer periods, these behavioural changes are not measured and thus not substantiated.

Although there exists a plethora of serious gaming design strategies that show promising results in the case of energy savings and other sustainability goals (Gugerell & Zuidema, 2017; Johnson et al., 2017; Mayer et al., 2014; Ouariachi, Olvera-Lobo, & Gutiérrez-Pérez, 2019; Rizzi, 2019; Rumore et al., 2016; X. Wu et al., 2020), it is still unclear what route is most suitable in the specific context of households. Most serious games considered in literature are not subjected to the requirements posed by Abrahamse (2007) or lack a similar method of guaranteeing a sound theoretical basis or validated evaluation. While reviews acknowledge the potential that serious gaming has in affecting psychological factors and barriers in household energy use, they note that more rigorous validation is needed to establish serious gaming as a proven effective intervention strategy in this context (Johnson et al., 2017; Spagnolli et al., 2016; X. Wu et al., 2020).

1.4 Research questions

In this research, the potential of serious gaming is explored in the context of Dutch households, by examining the type of desired behaviour and their specific barriers, the ability for serious games to overcome those barriers and ultimately, how serious gaming could fulfil the requirements for a successful intervention strategy. In the Netherlands, where social acceptance for sustainable improvements in households is still insufficient in relation to the goals set by the Klimaatakkoord, serious gaming might be a useful tool in creating a more profound support base for the energy transition in the built environment. The main research question is thus proposed as followed:

How can serious gaming elements be used to encourage pro-environmental behaviour in household investments in the Netherlands?

The answer to this question is multifaceted, and as such I hypothesise that the three main goals of a serious game that is able to accelerate the energy transition in households are the following:

1. It should help players to make sustainable choices in their households by enhancing self-efficacy and increasing perceived behavioural control

2. It should effectively educate players so that they understand why sustainable choices are necessary, reducing uncertainty and overcoming ignorance

3. It should be tailored to their specific household situation

1.5 Structure of report

The rest of this report focuses on these three goals by proposing a novel theoretical framework for serious game design elements specifically for the energy transition in households. In Chapter 2, I discuss the anatomy of a serious game, to discover the elements that make up the framework: pro-environmental behaviour, learning theory and a technical model. After that, the methodology is discussed, such as how an online and live sessions on Ameland were used to collect data. Afterwards, in Chapter 3, the case of the WeEnergy House model is discussed, which functions as initial motivation for the study as well as embodiment of the technical model element in the framework, which provides a sandbox in which the framework can be tested and applied.

In Chapter 4 I aim to build the theoretical aspects of the framework, explore the questions on what pro-environmental behaviour is and what theories provide guidance for the design of intervention strategies such as a serious game, in particular using goal-framing theory. Also, the epistemological aspect of the framework is considered via social learning theory, as well as the value and role of the community. I look there for theories regarding learning processes and how well serious gaming fits in these. Finally, I combine all elements and the strategies posed by the theory with the central serious gaming element, and elaborate on where the game utilizes the theory. Also, some evaluation tools are discussed which can be used to evaluate serious games in the context of this framework.

Now that we have explored the theoretical bases for the framework, Chapter 5 is used to discuss proceedings from the Ameland sessions are discussed to discover where the theoretical strategies can complement a technical model and what power it has on its own. To give an example of how the framework may be applied, in Chapter 6 the case of the WeEnergy House game is revisited by proposing a set of design elements.

Concluding, in Chapter 7 I revisit the framework by reviewing its application, and elaborate on where it might still lack and some recommendations for further research.

2 Methodology

To answer the research questions, this thesis aims to construct a framework for serious game design. First, the anatomy of a serious game is explored to discover what elements should build the framework.

2.1 The anatomy of a serious game

As described in the introduction, a serious game is defined by Klimmt (2009) as any form of interactive game for one or multiple players, that has been developed with the intention to be *more* than entertainment. 'More' in this research means that the ultimate goal is to accelerate behavioural change by tackling psychological barriers. Understanding how PEB is characterised is therefore an important element of the framework. It should be built on theoretical principles that are used to explain and predict the targeted behaviour, to recognize psychological factors in these behaviours, and to leverage these factors to encourage behaviour. In the **pro-environmental behaviour element**, it was explored via literature research what theories exist that aim to explain PEB, what strategies they deliver in changing that behaviour and how these can be utilized in designing serious gaming elements.

The barriers posed in the introduction find their common ground in 'limited cognition', according to Gifford (2011). When looking at psychological factors, a lack of perceived behavioural control caused by the belief that one's behaviour makes no impact is likely to be rooted in a lack of knowledge and consequently misperception (Liobikiene & Poškus, 2019; Lorenzoni et al., 2007). Energy use in households is an important part of the total environmental footprint and thus, action can be taken to combat it. The same might be true for lack of self-efficacy, as well as uncertainty and ignorance; their common denominator is that they are (partly) caused by a lack of knowledge.

Consequently, A successful intervention strategy might aim to tackle all these barriers by effectively increasing the level of knowledge regarding these themes, which requires know-how on how a serious game can teach players relevant knowledge. This concerns the information that is displayed, but also the added value of the game elements, in what setting it is played and what role peers and energy communities can have. In the **learning element**, these questions were explored via literature research.

Furthermore, a serious game in the context of households should be easily adaptable to specific household situations, so that it can readily be applied to a diverse group of people. While serious gaming literature gives little recommendations on what elements have the best results, reviews on intervention strategies show that successful strategies combine tailored information with feedback mechanisms (Delmas et al., 2013). To tailor the information, the content of the game should be readily able to display different sets of technical information, according to different household situations of players. This asks for a flexible simulation model, where energy flows and relevant parameters of household characteristics are clearly presented and also accommodates possible changes by immediately providing feedback on possible choices. In the **technical model element**, the *WeEnergy House model* was considered as example. This model was developed as a standalone tool that might aid communities and local cooperations in accelerating the energy transition. It functions as application that stakeholders can use to discuss investments with members of the community that might be interested in accelerating the energy transition in their house, but do not yet know how. As such, the model itself already functions as a tool in an intervention strategy and data can be collected on its effectiveness and consequently, where it might lack.

The WeEnergy House model was developed as part of the ESTRAC-project, where researchers develop methods and tools in order to help stakeholders in creating awareness, increase acceptance and aid in planning of creating sustainable communities. This is accomplished by creating an Energy Transition Roadmap (ETR), where interactive models and serious gaming principles are integrated to fit into the planning and decision-making process towards sustainable communities (Pierie et al., 2020).

In this research, the model functioned as an example of the role of a technical model as an element in the serious gaming framework. In that sense, it was explored what a technical model can already accomplish in terms of the strategies proposed by the other elements, as well as where it still lacks and where it might be complemented by serious gaming elements, in order to function as comprehensive intervention strategy according to strategies and goals posed by the other elements in the framework.

The model allows users to simulate their own household situation in terms of energy flows by specifying the characteristics of their house in terms of heat production and heat loss via exterior walls, electricity use and electricity generation. The model calculates the proposed costs of the yearly electricity and gas bill, which can then be compared with the actual bill to check the accuracy of the model. Any discrepancies are then discussed with a moderator (who also helps in filling in the model since some

information may be too technical) to get an accurate image of heat and other energy flows within the house. The model works via several steps, which are briefly discussed in

To test the application of the technical model and its strength as intervention tool, the model was utilized in two sessions with representatives from the municipality of Ameland. In the rest of this section, first the model is explained and consequently the setup of these sessions is discussed.

These three elements focus on what might elevate a serious game from a regular game. That leaves the game-element itself, which was explored in the **serious gaming element** of the framework. In this element, all three elements were combined with each other and with theory on serious gaming.
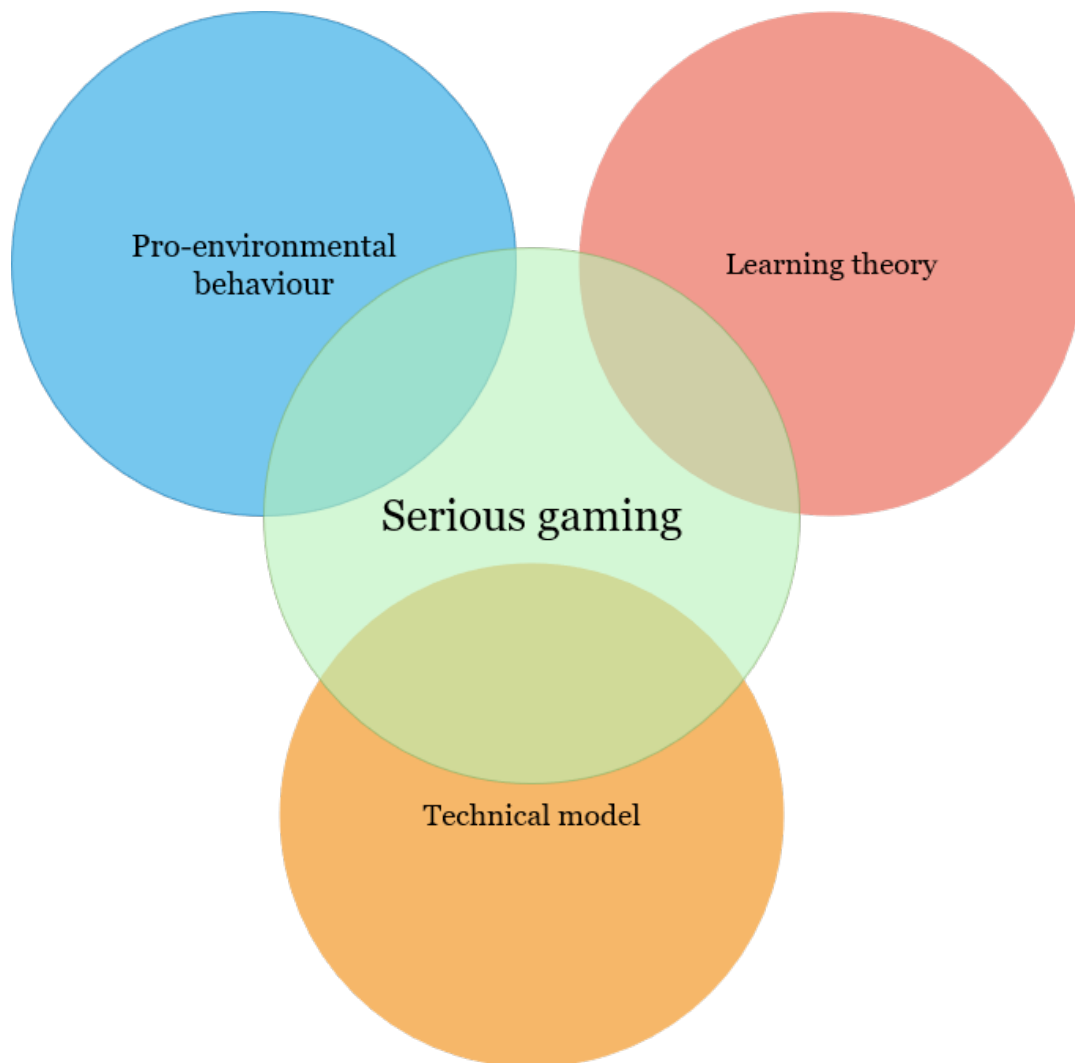
Figure 1: framework for serious gaming for the energy transition in households

Summarizing, the methodology of this research was two-fold. First, the theoretical foundations of the framework were built from exploratory expert interviews (see Appendix A for the reports of these interviews) and literature research, leading to a set of strategies for serious games. Then, the theoretical considerations were explored in three intervention sessions, the Ameland sessions:

2.2 Ameland sessions

To get a first idea of how the technical model can be applied on its own and what role it has in the serious gaming framework, three sessions were held with different stakeholders from the village of Buren, Ameland, who have expressed interest in being an European frontrunner in the energy transition (Villanueva Riesco, 2021) and are actively promoting energy conservation and energy efficiency.

Ameland functions as 'living lab' within the ESTRAC-project and their case is therefore used in testing tools and methods for their usability. In that sense, the overall goals are threefold:

1. For the stakeholders on Ameland: Exploring possibilities for accelerating the energy transition for the municipality of Ameland via application of the model in their community,

2. For ESTRAC: Testing the methods and tools developed in the ESTRAC-project on a real case, exploring impressions and subsequently improving the methods and tools.

3. For this research: exploring the use of the WeEnergy House model as standalone intervention tool, to collect data to get a first idea of how it could function in the proposed framework, and where other elements of the framework need to supplement it as intervention tool. The sessions were not recorded or coded, but each member of the research group took notes, which were later combined in a short report. In these sessions, the WeEnergy House model was used to explore its function as intervention strategy on its own, to discover two things:

   (1) What goals of the serious gaming framework can already be (partly) completed with application of just the technical model

   (2) Which of these goals are less successfully achieved by application of only the technical model. In this way, conclusions can be drawn about where the model still falls short and where serious gaming elements can supplement the model, with regard to the goals of the serious gaming framework.

Three sessions were held:

1. 7th of April: online session

2. 16th of June: live session 1, 1.25 hours

3. 16th of June: live session 2, 2.5 hours

2.2.1 Online session

On the 7th of April, a 1,5 hour online session was held with three members of the ESTRAC research group (moderator, project coordinator and researcher) and four members of the municipality of Ameland, who will be referred to according to their profession and role within the municipality. These abbreviations correspond to the same individual throughout the rest of the report:

   (1) Communication advisor: CA

   (2) Project leader: PL

   (3) Advisor Energy Transition: ET

   (4) Engineering advisor: EA

Within the context of energy conservation in households in Ameland, this online session was meant to present a first draft of the WeEnergy House model to the representatives from Ameland, to get feedback and gauge their impressions. The built environment is for Ameland by far the biggest energy sector, which emphasizes the importance of this specific case. Furthermore, the session was also purposed to discuss other tools within the Energy Transition Roadmap. The full report (by Jelmer Steenbeek) can be found in Appendix E.

After discussion of other tools within the ESTRAC-project, the WeEnergy House tool was discussed and filled in for the house of ET; this was not representative in terms of level of knowledge as they are a professional in the energy sector, but their house was mentioned to be quite representative of average houses on Ameland. The model was explained to be purposed to handle by 'energy coaches' or experts, in the form of an energy audit.

Finally, EA proposed to test the model with representatives of the Dorpsbelang Ameland group, who represent inhabitants of Buren. It was proposed that these representatives are asked to do such a session, to discover if they would be open to participate and also further test the application of the model with a group that is more representative of the average homeowner.

2.2.2 Live session 1

On the 16th of June, a 1-hour session was organised in Buren, Ameland, with two researchers of the ESTRAC research group (moderator and project coordinator), myself, and CA, PL, ET and EA. While at first it seemed that these sessions were not possible due to the COVID-pandemic, fortunately there was still an opportunity for this session to take place, albeit planned on short notice. The full report (in Dutch) can be found in Appendix F.

In this session, first there was some attention for other tools in the proposed Energy Transition Roadmap, which are discussed briefly. Afterwards, the WeEnergy House model was applied to PL's house, which is acknowledged to be not representative for the average house on Ameland, as their energy use was already very low due to the use of high-end equipment. After the discussion on PL's house, the model and its use was discussed.

2.2.3 Live session 2

During the online session, EA and PL proposed to test the model with representatives of the Dorpsbelang Ameland group and thus, live session 2 was organised. In this 2,5 hour session, the same research group as in live session 1 was present (moderator, project coordinator and myself), and three participants from Dorpsbelang Buren (player 1, 2 and 3) were asked to prepare specifications on their household via a question form (see Appendix D: question form house specifications). Two of the three members managed to fill in the form completely, while the third did not measure the dimensions of his house, for unknown reasons. This was not problematic, as their house resembled the house of player 1.

The aim of this session was to experiment with the model and the inhabitants, to see whether the model on itself could help the participants make decisions in their house, or at least provide them with relevant information. EA was also present; he pointed out that the selection of houses from the three members were not completely representative of houses on Ameland, which reportedly has a very diverse inventory of houses, due to Ameland being a popular tourist destination.

In this session, all three houses were considered separately, in the form of a kind of energy audit. The moderator asked questions to the players, they provide answers, which he entered into the model. The players also asked several questions to the moderator, mostly concerning technical options. Most of the time was spent on discussions regarding technical options.

3 The WeEnergy House model

In this section, the workings of the WeEnergy House model are briefly discussed, to get an idea of how the model works. The model is run through via several steps:

Filling in the reference scenario: Heat demand

First, the heat demand is calculated by filling in the total exteriorly walled area plus what type of insulation is present in these walls, as well as the floor and the roof. Windows are filled in separately, both the area and the type (single, double or triple walled). This requires some preparation from the users, as they are asked to go around the house and take these measurements, as well as their yearly energy bill. Furthermore, some relevant specifications of the living situation are asked (number of members of the household, current gas price, water use characteristics and thermostat setting).

Filling in the reference scenario: Electricity demand

Secondly, the electricity demand is filled in via the most recent yearly energy bill. In contrast to the heat demand, calculating electricity demand is not done in the model since this is dependent on usage, rather than specifications. Instead, the yearly electricity demand is filled in together with electricity prices. Furthermore, for some appliances that make up a large part of the electricity demand, the labels[3] are filled in to get an idea where there is most room for improvement. These appliances are the following:

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[3] Note that the labels used in the model are still according to the EU energy label from **before** the first of March 2021, because most people will not have the new labels available for appliances bought before that date. After 1 March 2021, the EU introduced a new scaling, to allow for scores beyond what used to be A+++ (A+++ corresponds to label B in the new system, roughly. See https://ec.europa.eu/commission/presscorner/detail/en/ip_21_818 for more information)

- Laundry machines and dryers or combinations thereof
- Refrigerators and freezers or combinations thereof
- Dishwashers
- Television screens
- Distribution LED-lighting or otherwise

Filling in the reference scenario: Production

Thirdly, any appliance that produces either gas or electricity is specified. For heat, it is important to know what type of installation is used to heat the house and what type of radiators are used to distribute the heating. In Dutch households, this is what makes up most of the heat demand, along with water heating (e.g. for showering) (Milieu Centraal, 2021). Also, separate heaters such as small electrical heaters, IR-panels or wood-burning stoves can be added. Here you can also specify if there are any efforts to recover heat from waste water or air streams, if there is a solar thermal collector present, what type of cooking appliance is used (e.g., induction, ceramic plate or gas-fired stove). In terms of electricity production, solar panels and electrical storage units can be specified in this section as well. Other energy production appliances (such as local windmills for big farming houses) can be entered manually.

Set as reference scenario

At this point, the model provides a heat demand and electricity demand, based on the filled in specifications. When this deviates from the energy bill provided by the user, it can be discussed where this discrepancy comes from.

Start experimenting!

When the demands are accurate, users can go back to step 1 and go through all the steps again in the "new" input fields, choosing either the same appliances as in the reference scenario or maybe trying new appliances. The model immediately calculates the difference in heat demand/production and this is easily visible next to the input fields. In this way, they can see what impact a certain investment will have

Figure 2: selection tool for heat demand. In the grey box, the current situation is filled in while the green box can be used to fill in a future scenario. The difference in gas demand can easily be viewed in the results section; these are displayed next to the planner and can be seen in Figure 3

on their energy usage. On the final result page, some other metrics related to investment costs are displayed. Also, the difference in emissions is showed (in kg CO_2 per year)

A big strength of the model is its flexibility; in the case of rarely seen appliances or when new appliances are introduced on the market, they can easily be added to the model database by any user and with minimal difficulty, using the provided documentation. In this way, the model can be used for any household. For example, if the house has a sauna, this can be added manually as long as some information is available on energy use. Even if that information is not present, it can be assumed that the discrepancy from the calculated heat demand and the heating bill is attributed to those appliances, so that the model can still be used to explore investment options. Also, specifications belonging to certain appliances that might be different in a different location (e.g., the cost of solar panels) can be easily altered to fit the situation it is going to be used in. This is done by the proposed moderator of the game before the game is played with members of the community.

Already the model is able to provide useful insights in the options available to the participant, yet there is still some moderation needed to understand how the model works and to distil relevant information from it. To fully transform the model into a useful intervention strategy, the serious game should be designed to utilize the information from the model as clearly as possible and to allow for a playful experimentation.

The model is a good example of how an intervention strategy can accommodate relevant knowledge applicable to a large group of people, while maintaining

Figure 3: result graphs for the heat demand, as displayed by the model. In the top graph, the old situation is calculated from the grey input fields in Figure 2, the new situation results from the green input fields and the 'selectie'-section can be used to compare with a certain energy label (in this case, label C)

the flexibility and tailored information that is required in a higher-involvement intervention strategy. In theory, each house in the Netherlands can be filled in with the model, allowing for each case to be handled separately.

The major downside to this type of model is that it still might be too technical for participants themselves to fill in and understand, which means a moderator is required to handle it. In the case of household energy, this is inevitable, as the current knowledge level is too low for most people fully understand the energy dynamics of a household which is part of the reason the model exists (van der Schoor, 2021, personal communication).
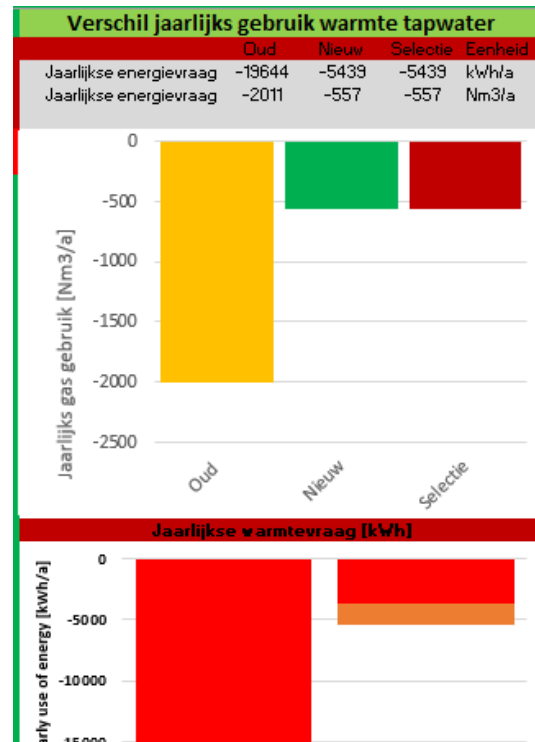
4 Theoretical elements of the framework

In this chapter, the remaining elements of the framework are explored, to build its theoretical foundations and discover strategies for the proposed serious game.

4.1 Pro-environmental behaviour (PEB)

While the technical model functions as the base source of information, the most prominent goal of the proposed serious gaming framework is to discover a strategy to utilize that information to induce a change in behaviour. To reduce energy use in the built environment, homeowners should take action to reduce their energy use, and this is facilitated by a specific type of pro-environmental behaviour: investing in insulation or appliances that either produce energy, use energy more efficiently or in any other way reduce energy use in households.

In principle, any form of action can be said to increase or decrease the magnitude of impact on the environment in some way and can therefore be called either pro-environmental, or damaging to the environment (Stern, 2000). Impacts can be direct: emitting greenhouse gases, depleting scarce materials or energy, land use, decrease of biodiversity or pollution of natural resources; or indirect, which refers to energy that is 'stored' in products, by production, transport and disposal. In European countries in 2003, energy footprints of households were on average 50% direct and 50% indirect energy usage (Kok et al., 2003). More recent studies on this division could not be found.

The second categorization is between *curtailment* and *efficiency* behaviours. The former refers to behaviour that is related to appliances already present in the household (e.g., turning of the lights, lowering the thermostat, lowering shower times) while the latter refers to one-time purchases of appliances that influence energy usage, such as investing in insulation, solar panels and efficient household appliances. Interestingly, both consumers and researchers prefer to focus on curtailment behaviours over efficiency behaviours (Abrahamse, 2007; Lesic et al., 2018), while targeting efficiency behaviours is believed to be more effective in reducing environmental impact (Attari et al., 2010; Gardner & Stern, 2002; Gifford, 2014; Lehman & Geller, 2004), because they do not require consistent engagement with the behaviour. However, these behaviours probably pose higher contextual barriers, e.g., in terms of costs. Also in the field of serious gaming, there exists a wide range of games meant to foster curtailment PEBs, yet very little focus on direct, efficiency PEBs (Morganti et al., 2017; Ouariachi, Olvera-Lobo, & Gutiérrez-Pérez, 2019; X. Wu et al., 2020).

While this research focuses on direct, efficiency behaviours in households, it should be acknowledged that these types of behaviours have effect on other types of pro-environmental behaviours via spillover and rebound effects, and they should be evaluated accordingly. These effects can be either negative (e.g. environmentally inclined persons are more likely to use carbon-intensive transportation such as aviation on their holidays (Barr et al., 2010)) or positive (e.g. people who start recycling tend to avoid products with excess packaging altogether (Thøgersen, 1999)). While there is evidence of both types of spillover effects and also some important drivers are recognized which could be leveraged to minimize negative and maximize positive spillover effects (see Truelove (2014) for a review), it is not yet clear how these effects can be utilized. The evidence of these effects does suggest that it is a good idea to measure spillover effects in intervention strategies, to get a better view of which moderator variables are most influential in specific types of behaviour.

4.1.1 Theory of Planned Behaviour

Since the establishment of environmental psychology as a separate field within social psychology, several theories concerning behaviour and behavioural change have been used to explain PEB. One important theory is the *theory of planned behaviour* (TPB, Ajzen, 1991), because of its wide application in explaining behaviour and its changes. According to TPB, behaviour is simply a balance of pros and cons, mostly predicted by someone's intention to perform that behaviour. When the pros outweigh the cons in someone's personal perspective, it is highly likely that the behaviour is engaged with. These pros and cons are evaluated via three constructs:

1. Attitudes towards that behaviour: whether one evaluates the behaviour in question as good for them or not good for them. For example, lowering the thermostat during wintertime might be evaluated as 'not good', because it will cause one to feel cold, thus the thermostat will not be lowered.
2. Subjective norm: the extent to which one believes that others that are important to them will evaluate that behaviour and consequently how they feel that behaviour would be evaluated.

For example, one might decide not to lower the thermostat because one feels that visitors or other members of the household might not like the colder temperature.

3. Perceived behavioural control: the extent to which one perceives the behaviour to be difficult or easy and therefore has control over the performance. For example, one might feel that he or she is physically unable to lower the thermostat (because it is situated in an unreachable place) or that lowering the thermostat might not have the desired effect of lowering the temperature, saving money or saving energy.

According to TPB, these three constructs are the best predictors of whether one will engage in behaviour. When specifically looking at PEB, perceived behavioural control (point 3) and to a lesser extent attitudes (point 1), are quite good predictors of intentions to reduce energy usage (Abrahamse & Steg, 2011; Arya & Chaturvedi, 2020).

4.1.2   Value-belief-norm theory of environmentalism

Another theory specifically formulated for PEB is Sterns *value-belief-norm theory* (VBN, Stern et al., 1999). In short, this theory proposes a sort of causal chain of constructs; actions or behaviour are preceded by not only the intention to do it but also by personal norm, while TPB only considers subjective (social) norms. The construct consists of the order and priority that one grants to certain values, making up their personal 'value system'. Values are defined by Schwartz as 'desirable goals, varying in importance, that serve as guiding principles in people's lives' (Schwartz, 1992). Four types in two categories of values have been recognised to be relevant when looking at PEB: *self-enhancement values* (*egoistic* and *hedonic* values; concern for yourself) and *self-transcendence values* (*biospheric* and *altruistic* values; concern for environment and others, both current and future generations) (G. Perlaviciute, personal communication, 2021).

Values are believed to remain quite constant after adolescence (Steg et al., 2014), which would suggest that efforts to leverage someone's biospheric values to induce behaviour are futile when those values are not already prioritized significantly. Furthermore, while the variables used in the VBN-model have been shown to have certain predictive power for curtailment behaviours, where barriers in terms of self-enhancement values are low; it has less explanatory power for efficiency behaviours where these barriers are higher in terms of cost, effort, inconvenience and time (Abrahamse & Steg, 2011).

Not only the VBN theory but also TPB runs into problems when applied to predict or explain pro-environmental behaviour (Hynes & Wilson, 2016). First of all, both models assume a deterministic decision-making process that is always based on attitudes and norms, so that the decision is always rational and well-thought through, and the outcome is completely clear. For certain investments this is not the case, since the information that is needed to make these rational decisions often lacks, both the range of options and what environmental impact their investments have. Furthermore, the moment where a decision needs to be made is often unexpected – e.g., when the old one breaks. Secondly, there is uncertainty about which particular values, norms and attitudes influence the process between attitude and its potentially resulting behaviour, especially in the case of pro-environmental behaviour. Both VBN and TPB therefore have limited explanatory power in PEB, which is also showed experimentally by Abrahamse & Steg (2011).

4.1.3   Goal-framing theory

The question remains: How can someone's biospheric values be leveraged in order to induce a change in behaviour? The goal-framing theory offers a useful description on how PEB changes and what kind of moderation is most useful, by adding a form of versatility in someone's motivations and resulting behaviour by proposing a 'goal-frame' (Lindenberg & Steg, 2007). Behaviour often follows from multiple motives and is also not always consistent within individuals (Stern, 2000), and the goal-frame theory is able to accommodate this.

In short, goal-framing theory assumes that behaviour results from not only someone's personal norms, attitudes and values, but also a certain mindset plus the definition of the situation. When a situation poses multiple choices, the selected choice is dependent on what goal one has with that choice, and that goal (or those goals) can vary, depending on what the frame of the situation is. This is also where goals differ from values, as goals can change relative to the situation and provide a short-term motivation, while values are more concerned with someone's 'life-goals' over a longer period of time. For example, if someone has just watched David Attenborough's A Life on Our Planet, he or she might be more inclined to engage in pro-environmental behaviour, because the message of that particular documentary puts the person in a goal-frame that favours environmental protection ("We should save the planet by

acting on climate change"). The same goes the other way around; when that same person checks their bank account and discovers that the streaming service that he or she used to watch the documentary is getting more expensive, the goal-frame might shift from engaging in PEB to saving money – two behaviours which, in the case of expensive investments, are often not compatible and thus, give rise to the barriers posed in 1.1.

The theory proposes three separate goal-frames that are most relevant for PEB: the *hedonic,* the *gain* and the *normative* goal.

First, a **hedonic goal-frame** makes one mostly concerned with how one feels at that particular moment, a kind of well-being via pleasure, comfort, self-esteem, excitement, freedom, lack of inconvenience, uncertainty and effort. When looking at the thermostat example, someone in a hedonic goal-frame might increase the temperature when they feel cold, to increase comfort. There is some effort in having to walk towards the thermostat, which might be a barrier, yet with current smart home technology, the thermostat can be controlled via a smartphone, removing that barrier. The thermostat is increased, the temperature quickly rises, and the goal is achieved.

Secondly, a **gain goal-frame** makes one concerned with personal resources and changes thereof. The check of the bank account is an example of something that might put someone in a gain goal-frame. This concerns not only money, but status. It is comparable with egoistic values; someone in a gain goal-frame will always pick the cheapest option, or an option which is perceived to increase status significantly. Here the thermostat example becomes interesting, because now the gain goal-frame is compatible with PEB. Lowering the thermostat will decrease energy costs (albeit not directly visible on the back account), which might incline someone in a gain goal-frame to use less energy.

Lastly, the **normative goal-frame** is focused on appropriateness in many forms; it concerns what one 'ought' to do, regardless of the impact on comfort or status. In PEB this can be feeling that one should save energy to decrease impact on the natural environment. When considering the thermostat, one might lower the temperature but not because of financial incentives, so the thermostat would be lowered even if one does not pay for the energy bill of the house. It should be noted that normative goals are not limited to biospheric norms, but may also be related to social norms (Cialdini et al., 1990). For example, one might invest in solar panels because others value their contribution to the collective goal of energy reduction, rather than investing in something that might have more effect but is invisible to others. This is also exemplary to how goal-frames can coexist and reconcile certain goals – displaying solar panels on your roof might be perceived as status-enhancing, which is also a gain goal.

While the normative goal-frame is distinguished as separate, this does not mean that the gain and hedonic goal-frame are not guided by norms at all. Lindenberg and Steg (2007) note that norms can still influence gain and hedonic goals, albeit in a more personal way, by considering positive and negative sanctions in terms of gain goals. This is where the terminology of what norms mean might differ from how for example TPB explains how norms affect behaviour; ultimately, TPB poses that behaviour is always a rational decision between costs and benefits, and when benefits outweigh costs, something is to be 'gained': a gain goal-frame. Subjective or social norms weigh as either cost, when negative sanctions are expected, or benefits, when positive sanctions are expected. The same goes for hedonic goals; someone might not feel comfortable with behaviours where negative sanctions are expected from either peers (i.e., social norm) or self (guilt, shame, etc.), and feeling comfortable is a hedonic goal.

In a normative goal-frame, norms affect behaviour in a different way. The main and only goal in a normative goal-frame is 'to act appropriately', regardless of whether sanctions in terms of resources (gain goals) or whether it feels good (hedonic goals) are expected after performing the behaviour (see (Lindenberg, 2005) for more information on how this theory treats norms). This means also that the way in which a normative goal-frame results in behaviour goes via two steps. First, when a normative goal-frame is activated, one is motivated 'to act appropriately', regardless of barriers in other goals. Then, one searches in memory or in situational aspects what acting appropriately means in that situation, what exactly is the behaviour that is considered the most appropriate. When that behaviour is found, it is performed.

Goal-framing theory suggests that PEB in households is usually compatible with a normative goal-frame, while gain goal-frames and hedonic goal-frames pose barriers. It is especially relevant for direct, efficiency-related PEB because it highlights important cognitive barriers. Very often, these barriers arise from a conflict in goals between all three types. These barriers are most apparent with normative goals, which are often long-term goals, versus either gain goals or hedonic goals. Showering five minutes instead of ten might be perceived as less comfortable, showering with cold water might be even more uncomfortable, and there is no form of feedback that ensures that the behaviour has the desired effect

of saving energy; allowing a contractor to increase insulation or install a heat pump is likely to bring discomfort in terms of subjecting your house to workers and noise; installing solar panels might be perceived as expensive. The theory suggests that the relative displacement strength of the gain goal is much higher than normative goals in high-cost situations, such as most one-time purchases and investments in households (Lindenberg & Steg, 2007). The higher the cost of the behaviour, the more difficulties a normative goal-frame will pose. Furthermore, the impact of energy saving on climate is often not directly visible (Abrahamse & Steg, 2011; Gifford, 2014; Thøgersen & Grønhøj, 2010). There is in particular a difference between self-enhancement values and self-transcendence values - the impact of certain behaviours is much clearer in terms of costs and comfort than it is in terms of environmental impact, which gives rise to uncertainty.

One issue with the goal-framing theory is that its validity has not been extensively tested in the environmental domain. Nevertheless, the line of thinking is useful for the design of an intervention strategy that aims to overcome the barriers that people experience while considering PEB, since it coincides with major theoretical approaches to environmental behaviour (Steg & Vlek, 2009): the assumption that choices in behaviour are always reasoned and based on highest benefits vs. lowest costs (e.g., TPB, and a gain goal-frame), the examination of value-basis beliefs and environmental concerns and moral obligations (e.g., VBN, and a normative goal-frame), and focus on affective and symbolic factors which is mostly focused on car use (hedonic goal-frames). Steg & Vlek denote that it is not clear which line of thinking is most successful in explaining high-cost behaviour, so combining them might be a better option.

To discover how goal-frames can be leveraged to induce PEB, it is important to know what goal-frames are a priori most prominent in the target group. Ebrahimigharehbaghi et al. (2019) discovered that for Dutch homeowners, 'enhancing the quality of life' (a hedonic goal) is the most important driver when considering renovations in their house, while 'gaining financial benefits' (a gain goal) is a second important driver. This is also reinforced by goal-framing theory, which suggests that hedonic goal-frames are strongest because they operate on the shortest time-frame – to feel better right now. However, the dataset used by Ebrahimigharehbaghi is from 2012, which is quite old already considering the increased interest in environmental issues over the last 10 years (Centraal Bureau voor Statistiek, 2021). Also, the dataset is not very comprehensive in terms of both timeline (it follows potential renovators in quite a late stage of renovation, after they have made the decision to renovate) and differences between investments (i.e., there is no difference made between buying a LED-lights or improving insulation). It is therefore not completely clear what currently the most prominent goal-frames are for Dutch homeowners, although it can be assumed that gain goal-frames and hedonic goal-frames are more prominent than normative goal-frames.

4.1.4 Strategies to encourage pro-environmental behaviour

Goal-framing theory leaves two routes for an intervention strategy to encourage pro-environmental behaviour, which are both concerned with the relative strength of a normative goal-frame:

  i)   Strategy 1: Reconciling gain and hedonic goals with normative goals

  ii) Strategy 2: Strengthening a normative goal-frame

4.1.4.1   Strategy 1: Reconciling gain and hedonic goals with normative goals
When costs are at a certain level, either in the form of money/time and comfort, normative goal-frames will not be able to 'compete'. Thus, reducing or removing perceived conflict by harmonizing investments with hedonic/gain goals is essential with direct, efficiency-related PEBs, since costs are often high. Although some literature suggests that is it not a good idea to focus on hedonic/gain goals because incentives that reconcile these goals are often for a limited time (e.g., subsidies) this will probably be less true in one-time, high-cost behaviours, as they are not required to be maintained over a longer period (removing insulation from your house is a bad idea, regardless of the goal-frame) (Bolderdijk & Steg, 2014).

However, besides the effect of incentives, there are other risks. First, when PEB is engaged with because of hedonic/gain goals, this might be more prone to rebound effects/negative spillover ("I've got a more efficient heating system so now I can increase the temperature to be more comfortable"). Secondly, it might result in a form of moral hypocrisy, where one wants to appear moral and appear to show PEB, yet will refrain from doing so because of costs. This behaviour is mostly seen in strategies where hedonic and gain goal-frames are targeted, and to a much lesser extent in strategies focused on normative goal-frames (Batson et al., 1999; Lindenberg & Steg, 2014). There lacks a consensus in literature whether

these negative effects (spillover, rebound effect, hypocrisy) actually occur when looking at the type of behaviour considered in this research.

Making the gain and hedonic goals compatible with a normative goals can be done by showing benefits in terms of gain and hedonic goals, such as focusing on the timescale at which a certain investment delivers a return on costs, or by showing that a more modern household with insulation and heat pumps delivers a more constant temperature in house, as well as maintain heat longer when the thermostat is turned off (Perlaviciute, 2021, personal communication). Providing information often focuses on long-term benefits versus short-term costs but also has potential to correct possible misperceptions (Abrahamse & Matthies, 2012).

An informational intervention strategy can only aim to harmonise all three goal types by changing perceptions rather than actually making investments cheaper or more comfortable. Truly making gain and hedonic goals compatible would be most effective by actually lowering costs and increasing hedonic benefits, via structural intervention strategies such as subsidies or rewards, rather than psychological, informative strategies (Abrahamse & Matthies, 2012), but this power remains with policy makers, energy companies and other stakeholders. Thus, for the serious game design elements, it might be more suitable to focus on strategy 2:

4.1.4.2   Strategy 2: Strengthening a normative goal-frame
That leaves strategy 2, as also portrayed in Stegs Integrated Framework for Encouraging Pro-Environmental Behaviour (Steg et al., 2014): strengthening normative goals. Ultimately, motivations for performing direct, efficiency PEB are most compatible with a normative goal-frame and this frame will always be the strongest base for this (Lindenberg & Steg, 2007) - a strong normative goal-frame will thus usually result in PEB. It also ensures that PEB is engaged upon from a motive that keeps rebound effect and negative spillover to a minimum and allows plenty of room for positive spillover effects (Lacasse, 2016; Namazkhan et al., 2020).

Positive spillover effects can be utilized by focusing on behaviours where the conflict with other goal-frames is lower, thus establishing a more pro-environmental social identity as well as provide a basis for the desire to be consistent in PEB (Truelove et al., 2014). Providing a normative goal-frame might also cause a spillover effect outside of the domestic situation, such as in office buildings or other public spaces, where there is no direct financial responsibility and the gain goal is therefore less favourable towards pro-environmental behaviour.

As explained earlier, behaviour from a normative goal-frame follows two steps only: the goal is to act appropriately, appropriate behaviour is selected from memory, and it is performed. This does mean that the strength of a normative goal-frame is lower when active norms are complicated or abstract, also called 'smart norms' (Gardner & Stern, 2002; Lindenberg & Steg, 2007); these are norms where the corresponding behaviour is not immediately clear (e.g. "do good for the planet"). When it is unknown what is "appropriate" at that time or if one feels that he or she is not able to engage in that behaviour (lack of self-efficacy), uncertainty about the situation will cause one being unable to act upon biospheric values ("I do not know how to 'be appropriate'"), and thus the normative goal-frame will quickly make place for a hedonic or gain goal-frame.

In Stegs framework, the strength of a normative goal-frame is also dependent on values and situational cues. Biospheric values are most important when behaviour is shown because one feels it is appropriate to live environmentally friendly, i.e., it activates a personal norm and allows people to reflect on their environmental self-identity. Also, when biospheric values are endorsed more strongly than egoistic values, one particularly focuses on outcomes in terms of environmental aspects rather than monetary aspects. As such, a reinforcement of normative goal-frames also affects evaluation of outcomes of their behaviours.

Since the order and priority in which values are endorsed and thus the strength of biospheric values is not variable in short-term, normative goal-frames can only be strengthened further by leveraging situational cues (provided that it is clear what the appropriate behaviour is). These are factors that might either activate or inhibit biospheric values, by framing a certain situation. Steg describes three relevant situational cues.

(1)   Cues that show whether others respect or violate biospheric norms: when situational cues signal that others violate these norms, the normative goal-frame is weakened ("they don't care, why should I care?"), but when situational cues show that others also try to act appropriate, the goal-frame is strengthened.

(2) Cues that show that behaviours are costly: these are cues that highlight conflicts between gain and hedonic goals versus normative goals; this is covered in strategy 1, but in terms of normative goals this means that actions that aim to lower behavioural costs should be explicitly linked to normative goals rather than hedonic or gain goals, to maintain a normative goal-frame

(3) Cues that require quick prioritisation of multiple goals, which quickly cause goals with shorter timespans to become more focal, weakening the normative (long term) goal-frame.

While these cues are not especially relevant for the behaviour considered here, they do provide some extra handles to keep in mind when designing a serious game aimed at promoting pro-environmental behaviour in households, such as showing that others also adhere to normative goals, or linking also mechanics that focus on reconciling gain and hedonic goal frames to normative goals, in order to maintain a normative goal frame.

4.1.5   Summary

In Figure 4, an overview of discussed parameters can be seen and how they influence other parameters (red arrow = inhibition, green arrow = promotion). Also the barriers posed in the introduction are mentioned here, to show how the parameters relate to these. Summarizing, the pro-environmental behaviour element poses several ways in which the serious game can encourage pro-environmental behaviour. The ultimate goal is to increase the relative strength of the normative goal-frame, by either reconciling gain and hedonic goals with normative goals (while maintaining a focus on normative goals) and thereby lowering perceived barriers in terms of self-enhancement values, or by strengthening the normative goal-frame by appealing to appropriateness and showing what this means, by explaining how exactly appropriate behaviour decreases energy use, and what power one has in terms of environmental impact, with these behaviours.

This poses two important questions to be answered by other elements in the framework:

a) How can participants be aided in translating smart norms into behaviour?

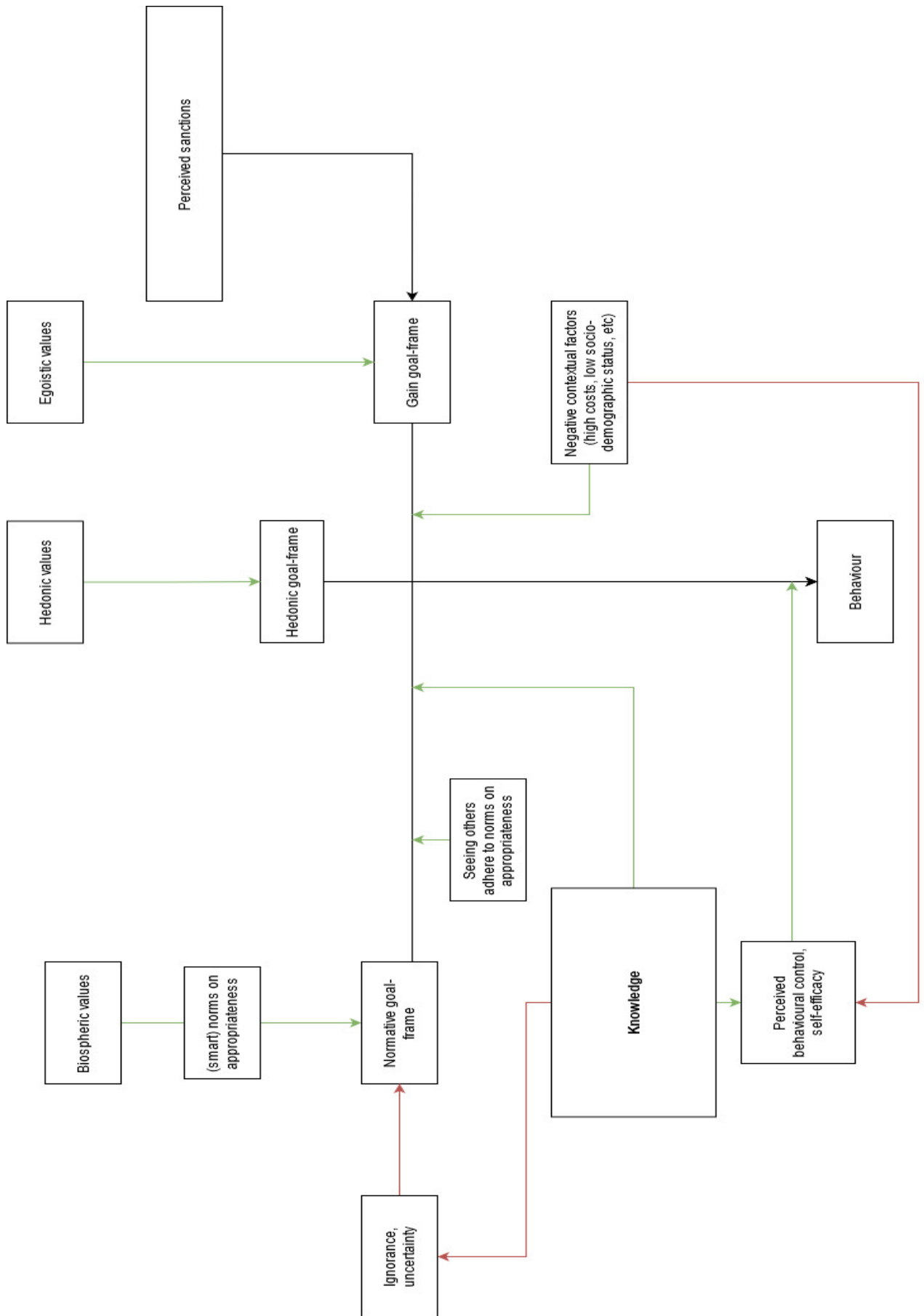b) How can cues concerning adherence of norms by others be leveraged?

Figure 4: overview of pro-environmental behaviour elements

4.2 Learning theory

In this paragraph, the aim is to discover how the information in the technical model can best be transferred to players, to increase their knowledge. The previous section showed that the strength of a normative goal-frame is partly dependant on the players ability to translate norms into behaviour. When a serious game can successfully clear up norms that were unclear before playing the game, it might have the desired effect of inducing PEB.

An intervention strategy might aim to learn players about impact of their behaviour, about what options are available for them and about what at this moment in time is the most useful for them to do. In this context, 'learning' thus refers to an increase in knowledge (rather than an attitude shift), which can occur via several routes (e.g., teaching, experiences in life, etc.), thereby promoting behavioural changes by reframing the perception of a certain familiar situation, such as energy-use in someone's personal household.

While there is a limited offer of research where intervention strategies are designed and evaluated within the context of learning theory, there exists a plethora of theories that explain how learning is facilitated, each related to a specific perspective of psychology or sociology (behavioural, cognitive, social, etc.). Each perspective offers their own unique point of view regarding how someone learns, yet there seem to be two relevant ideas that form the consensus of how learning works in the context of this research:

1. **Learning is specific to the individual:** From a constructivist point of view, the learner itself is a 'active constructor of meaning' (Bang et al., 2007; Merriam & Bierema, 2013). In other words, learning occurs when the learner is actively looking to make sense of things they see, experience or hear about. This occurs in a specific route to the individual, so it emphasizes the relevance of the current knowledge of the learner, as everything that is learned is built upon their current level of knowledge. This also emphasizes the active component, as only the learner itself can actively construct their own 'building' of knowledge.
2. **Social learning:** Although learning remains individually specific, multiple learning theories emphasize the importance of a social context. The things that learners have in common are the things that allow them to learn from each other by sharing ideas and modelling to peers with a perceived authority. In this way, learning is mediated by doing it together.

4.2.1 Social Learning Theory

One theory that can be used to add a theoretical basis for serious game design is Bandura's Social Learning Theory (Bandura, 1986) (from now on: SLT)[4]. SLT has already been used in the design for serious games, such as by Fuchslocher (2011), who used a serious game to enhance self-efficacy in diabetes patients, increasing confidence that they can manage their own insulin levels. Broadly speaking, SLT focuses on social learning - behaviour can be explained by looking at how someone learns from others. Two ways of learning are described:

1. By direct experience: turning off the thermostat and experiencing how cold your house can be might learn you that turning off the thermostat is not a good idea if you want to be comfortable
2. By observing (observational learning): one might learn that buying solar panels is a good idea by seeing how it influences both the looks of your neighbour's house, as well as the effect on his or her energy bill.

Learning by direct experience is less interesting for direct, efficiency PEBs, as it is hard to 'experiment' with the behaviour considered, since the specific action of investing in energy-saving equipment is performed once on a timescale of multiple years. Therefore, observational learning might be more interesting to focus on.

Observational learning occurs when the learner observes a behaviour and its outcomes, also called vicarious experiences. By observing someone or something exhibiting some kind of behaviour, succeeding in that behaviour and having a positive opinion on that behaviour, the behaviour might become more attractive. Modelling works via two pathways:

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[4] Social Learning Theory was later in 2001 renamed by Albert Bandura to Social Cognitive Theory, to emphasize the importance of cognitive aspects in learning with the goal of changing behaviour (Bang et al., 2007). In this research, the original name is used to emphasize its relation to learning theory.

1. **Modelling to peers:** If the game is played with multiple people in similar household situations (i.e., neighbours, inhabitants of the same neighbourhood), it will be easier for someone to learn by observation. The situation that is observed should resemble someone's personal situation as closely as possible, to make the step from the observed situation to someone's own situation as small as possible, thereby decreasing the required effort to exhibit the behaviour themselves. Also, goal-framing theory poses that playing with peers might leverage situational cues regarding adherence to norms by peers, strengthening the normative goal frame. This point is further elaborated on in 4.2.2.
2. **Virtual modelling:** A digital simulation tool such as the WeEnergy House model allows players to experiment, thereby 'observing' the behaviour of a simulated version of their own household. By experimenting with investments, the results of the behaviour can become clearer. While it seems that this is not 'observing' per se, as you control the actions in the simulation, it might still be useful to observe what the effects of certain behaviours are in the simulated version. This mechanism is also observed in serious games concerning diabetes (Fuchslocher et al., 2011) and exercise (Fox & Bailenson, 2009).

4.2.2 The community

Social learning theory emphasizes the added value of learning with peers in similar situations, such as fellow members of a community, which can be regarded as a collection of peers in similar household situations, i.e., in a neighbourhood. One potential benefit is to contribute to social cohesion within the community, which is theorized as an important driver for the rapid growth of 'community energy' (local production of renewable energy, governed by citizens, see van der Schoor & Scholtens (2019) for a review). The effectiveness of local community energy initiatives in the Netherlands (such as GrEK) is dependent on the level of activities (Van Der Schoor & Scholtens, 2015), such as game playing sessions.

While literature surrounding community energy grows rapidly, it rarely goes beyond the front door of individual households. This is remarkable, as the role of households in community energy is at least as important as decentralized energy production and the barriers for households might even be larger. Van Der Schoor (2021, personal communication) claims this might have to do with the complex nature of a house, which is often not directly understandable for homeowners.

Furthermore, one of the strengths of the community might lie within providing members of that community with a sense of urgency regarding PEB. The lack of urgency for homeowners is rooted partly in the feeling that their efforts do not contribute significantly to the global goal of reaching energy neutrality (lack of controllability), which could be targeted if the goal is reframed to the community level (instead of a global level) (Van der Schoor, personal communication, 2021). When the goal is to be completely self-sufficient in terms of energy on community level by producing electricity locally (e.g., a windmill that provides energy for the whole neighbourhood), households must also be ready for this by getting rid of any application that requires a gas connection, such as traditional central heating boilers.

4.2.3 Summary

Consensus of different approaches to learning emphasize the need for knowledge to build on what is already present, further establishing the idea that the information in the game should be tailored exactly to the situation of the player, both in terms of what household they live in and also their current knowledge level. In terms of social learning, SLT emphasizes the potential for learning via social experiences, by observing peers in similar situations. To effectively learn knowledge that is required to translate smart norms into behaviour and to strengthen normative goals by learning what norms peers adhere to, intervention sessions thus should be social occasions. As an additional benefit, social learning contributes to social cohesion and has the potential to reframe sustainability goals to a scope that is more relevant.

4.3 Serious gaming
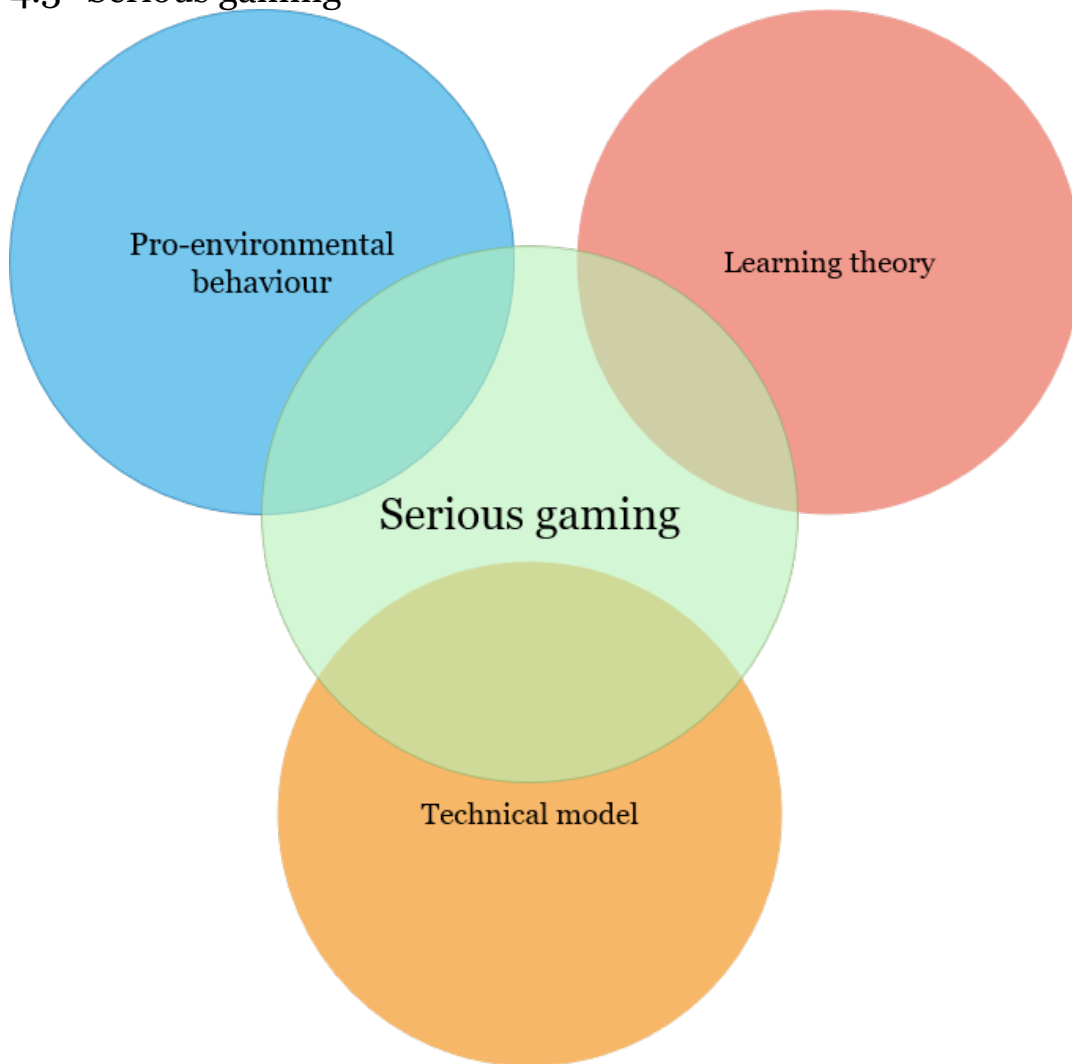
Figure 5: reminder of the framework

So far, the elements have proposed useful pathways for intervention strategies to promote pro-environmental behaviour in households. In 4.1, the characteristics of the targeted behaviour were explored to discover strategies to encourage them, while 4.2 provides theoretical basis for the way intervention strategies can effectively teach players relevant knowledge, as well as what factors might enhance this, such as playing in communities of peers. What remains is to combine these strategies and link them in a framework for serious games, where all pieces of the puzzle come together.

To do that, this paragraph is aimed at first exploring what guidelines exist in literature for the design of serious games, and also how the strategies posed by the other elements can be integrated into serious gaming design.

Aside from approaching serious gaming via behavioural sciences or social sciences, it can be considered a field of research on itself and therefore deserves a separate focus. While it is a very young field of research, there exists already a wide plethora of climate and/or energy-oriented serious games with diverse approaches and goals, which have shown that serious games can indeed encourage PEBs (see Morganti et al., 2017; Ouariachi, Olvera-Lobo, & Gutiérrez-Pérez, 2019; X. Wu et al., 2020; for reviews).

The added value of a game over other intervention strategies is hard to pinpoint, but some scholars attribute it to the form of immersion that one might reach when invested in a game. This 'state of flow' causes players to increase their awareness and understanding of certain messages that the game delivers, such as the goal or the narrative (Csikszentmihalyi, 1998; Soekarjo & Oostendorp, 2015). Also, playing

a game that functions as a real-life simulation allows for experiential learning, as players are allowed to experiment with choices that they might also have to make outside of the game.

While there lacks a validated method to design serious board game elements in this context, Ouariachi, Olvera-Lobo, Gutiérrez-Perez & Maibach propose a framework to increase climate change engagement through video games (2019, Ouariachi, personal communication, 2021). This framework was developed in close cooperation with 12 experts to provide a set of game attributes that should be taken into account in serious game design.

The framework attains a focus on digital games, which have added value over non-digital games via multiple ways, such as the use of digital tools to enhance the quality of the simulation or allowing players to be part of a larger social community of players (e.g., via social media). This suggests that combining a physical serious board game with the digital technical model, some of these benefits might still apply. In terms of differences between youth and adults, McDonough (2013) argues that the way that the two different groups go through the natural learning process is not that different from one another. The most important differences are related to the point made on individual learning in the section on learning theories; the use of prior knowledge and the learner as an 'active constructor of meaning'. Whereas children make unconscious choices in which direction they take while processing new knowledge and are less 'involved' in choosing what to learn, adults take more responsibility in their own learning by choosing more consciously to participate in a learning session. This means that for serious games for adults, more focus should be put on recognizing what prior knowledge is available for the players, what motivates the player to build upon that knowledge and aid them in making the decision to participate in these types of learning. This suggest that for adults, it is harder to reach the state of flow as described above, which underlines the fact that the game should be immersive, interesting and allow adults to be motivated to play it.

In the rest of this section, the parameters proposed by Ouariachi et al., (2019) are first discussed in terms of how they relate to the strategies posed by the other elements. After that, the remaining parameters are discussed, as serious gaming also has unique elements that are not explicitly linked to the serious component, but rather to the game-component. Finally, in Figure 5, the separate elements surrounding the increase in knowledge as aimed by the serious game are displayed, with serious gaming elements in yellow.

I. Achievable

When the game presents players with challenges, they should have the feeling that they can complete these challenges and receive positive feedback. Encountering challenges that feel achievable in the game and are similar to challenges in the real world is supposed to make players feel good about completing them in-game, giving them a sense of confidence that they can complete them in the real world as well, thereby tackling internal factors in self-efficacy and perceived behavioural control.

II. Challenging

While challenges should be achievable, they also should not be simple. Players should be encouraged to solve a problem that requires them to really use new skills and knowledge, which can excite curiosity and by that, increasing self-efficacy. Working towards a goal that seems challenging is also a requirement to reach a state of flow, allowing for enhanced engagement and immersion in the game (Csikszentmihalyi, 1998). In other words, to make sure that the goals of the game are both achievable and challenging, the game should be 'not too hard and not too easy'. This asks for the game to be able to accommodate to different levels of difficulty, depending on the level of knowledge of the players, which also asks for flexible difficulty settings, tailored to the players.

Setting challenging yet achievable goals is used often in successful intervention strategies (Delmas et al., 2013), by giving a reference point, something to work towards. This makes the behaviour more likely to change, especially when combined with feedback and reward-systems (Abrahamse et al., 2007).

III. Concrete

The game should not communicate information by delivering big pieces of text for players to read, but by integrating the information into the game mechanics in a simplified way. The attention of the players should be focused on the gameplay. This is also underlined by Van der Schoor (personal communication, 2021), who explains that people often lose interest when information becomes too technical or too complicated, which further emphasizes the need for tailored information.

IV. Credible

The game should show that the information that it delivers comes from reliable and trustworthy sources. This allows players to believe the ideas presented to them and thereby support the adoption of new knowledge upon their present level of knowledge.

V. Efficacy-enhancing

The game should allow players to experiment in a sandbox type environment, to control their own actions and to see consequences of certain behaviours and thereby empowering them to exhibit those behaviours in real-life. The framework notes that this can be reinforced at the end of the game, showing more explicitly how the actions in the game can be translated to real-life behaviour.

VI. Experiential learning

In practice, experiential learning is prioritised over analytic learning. Climate change is a problem that is often difficult to recognize, which emphasizes the need for experiences to learn. Games are very suitable for this by allowing players to experiment in a sand-box environment.

VII. Feedback-oriented

In order to facilitate engagement with the content of the game, effective feedback is thought to be essential. Especially when given at the right moment, effective feedback may give the extra push for players to increase their knowledge. In games, feedback is materialized via the experience itself, seeing what consequences certain actions in the game have and effectively translating those consequences to similar actions in real life.

When combined with a reachable yet challenging goal, feedback can influence behaviours because the outcome expectations of certain behaviours become more tightly linked to the behaviour. Feedback mostly consists of displaying energy consumption behaviour or energy savings, either continuous (e.g., via a smart meter) or periodically (similar to the energy bill most households receive every month). Most feedback strategies that are currently employed focus on gain goals, but similar strategies can be employed regarding the lowering of emissions or other normative goals.

VIII. Identity-driven

In order to make the transition from the game to real life easier, a game should appeal to the players' identity. In the proposed framework, players can use their own homes as playing field, which already establishes a connection between players and the game. Furthermore, the game allows players to identify not only with their current living situation but also with a desired living situation in the future, which reinforces the emotional connection (Heath & Heath, 2010).

IX. Levelling-up

In order to keep the game challenging even after they learn how the game works, the goals should also become more difficult. This can be done via levelling-up, challenging players with new (maybe unforeseen) challenges as they play. This can also provide a feeling of progression for the players, reinforcing the idea that they are learning something and getting ahead, strengthening the effect of goal-setting further.

X. Simulating

Also underlined in experiential learning and efficacy-enhancing, simulations allow a model of real life with less direct negative consequences, allowing players to identify what those consequences might be in real life. This also reinforces the idea that the game should not be a linear story, but that the game might have multiple outcomes and goals.

By simulating a real-life situation which resembles their own, SLT poses that players can consequently model after their own in-game actions, because they now know more about outcomes and what options are available.

XI. Social

Games are rarely played individually, and playing games with a group adds to the experience of identification and meaning. It is also useful to see how others deal with certain situations, to learn new strategies of approaching problems as well as validate your own actions (van der Linden et al., 2015).

Social playing and learning is identified as key strategy in this serious gaming framework, as it works towards many important goals of the intervention strategy. SLT poses that social learning via observation of others is an effective way to teach new information. Furthermore, playing a game socially

with peers from the same community allows players to view other players adhere to normative behaviour, which reinforces the situational cue that strengthens the normative goal-frame.

Also, it might promote social cohesion within a community and allows for collective goal-setting, which might make the quest to energy neutrality less daunting, as ones individual impact is relatively bigger, thus enhancing self-efficacy. Furthermore, playing serious games together with the community not only functions as beneficial for the community, but also helps on an individual level. SLT shows that observing others and consequently modelling to them is an important learning pathway for empowerment. The structure of a community (where houses are bound to be more similar to each other than to houses outside those communities) provides an opportunity to model to peers that one identifies with, thus increasing the learning potential while also enhancing self-efficacy and perceived behavioural control (Cojuharenco et al., 2016)

Aside from parameters that overlap with parameters and strategies posed by the other elements of the framework, serious gaming as a separate discipline poses four more parameters that can be used to design successful serious games.

XII.   Fun

Games should be fun. Even though the main goal of serious gaming in this research is to educate and persuade (hence the 'serious'-tag), the amount of fun a player has is directly influential on the engagement that a player has with its content. Some researchers even theorize that fun is a requirement for engagement and immersion (Klimmt, 2009; Prensky, 2002). A fun game is naturally motivating, engaging and provides a memorable experience, which also means that the lessons from the game are more easily remembered (J. S. Wu & Lee, 2015).

XIII.   Meaningful

This goal is more specific to the topic of climate change; to really feel its impact, players should be confronted with the worrisome consequences of it, while reinforcing the message that there are possible remedies and solutions.

XIV.   Narrative-driven

The narrative, or story-telling aspect of the game is what is used often to increase engagement. It is unclear whether this is the case with adults as is it with teenagers, but it is assumed that also for adults, the creation of a situation that is meaningful to players beyond something that is familiar (identity-driven) can also increase engagement.

XV.   Reward-driven

Games that function as apps often use rewards to encourage players to come back to the game (e.g., in form of digital "coins", points, unlockables, more game content, etc.). Rewards are mentioned by many researchers as a key component in encouraging behaviour (Abrahamse et al., 2005; Fox & Bailenson, 2009; Spandagos et al., 2021), so a game that contains rewards for desirable behaviour might be more effective.

4.4 Evaluation tools

An intervention strategy can only said to be persuasive until effective behaviour change following the intervention is measured (Spagnolli et al., 2016). So far, there are no evaluations on intervention strategies regarding direct, efficiency PEB in literature known to the researcher, but only on intervention strategies targeted on curtailment behaviours. This is regrettable, because they could provide insight in how to accurately measure potential changes in direct efficiency behaviour, which are less obviously measurable than curtailment behaviours. Nevertheless, I propose here a set of evaluation possibilities for the case of the WeEnergy House game as intervention strategy, as learning method and as serious game, to measure its effectiveness but also to evaluate whether the game should be altered to achieve a bigger impact. Since separate aspects of the game are designed with separate theoretical bases in mind, they should be evaluated accordingly. Not all used parameters should be evaluated individually for their contribution to the desired goal, as this has been extensively done in other literature. Rather, the game should be evaluated on its core goals; inducing direct, efficiency behaviour, increasing knowledge, promoting social cohesion and ultimately, accelerating the energy transition in the built environment.

Generally, evaluations of intervention strategies can be costly and time consuming, especially when the targeted behaviour is only visible on a time span of multiple years (Steg & Vlek, 2009). Also, comparisons are difficult because while intentions to save energy are not related to socio-economic status, actual

energy usage is. This makes comparisons between a control group difficult, as it might be cumbersome to find a household in a situation that is comparable to the households of the players.

Because of these restrictions, evaluations for these serious games should be aimed at differences on individual levels, not only on environmental behaviours but on multiple aspects (Abrahamse, 2007; Steg & Vlek, 2009):

1) Changes in behavioural determinants (self-efficacy, perceived behavioural control; especially these are useful to measure since they can be predictors of actual behaviour change (Spagnolli et al., 2016))

2) Environmental behaviours (efficiency behaviours, but also curtailment behaviours, to check for positive spillover effects)

3) Actual energy usage, to see whether a potential change in behaviour actually results in energy saving or whether the effects are nullified by negative spillover and rebound effects

4) Changes in quality of life, as it is an important component of sustainable development

In terms of goal-frames, the WeEnergy House game poses an excellent opportunity to include an evaluation before and after the game (both short-term and long-term) to see what goal-frames are most active and if the game has any power to realign these goal-frames. Including evaluation regarding goal-frames can also provide extra validation for goal-frame theory as a useful theory to explain and predict pro-environmental behaviour in households.

As an educational tool, evaluations on potential increases in knowledge regarding sustainable investments around the household can be measured, both on short-term and long-term. This can be related to environmental behaviours, i.e., whether an increase in knowledge leads to people being more readily being able to translate certain smart norms into behaviour. This should be done on two orders (Mayer et al., 2014):

1) First-order learning: short-term, measured changes in knowledge, attitudes, skills and behaviours; but player learning satisfaction and self-perceived learning as well.

2) Second-order learning: medium- to long-term, collective, both participants and other non-participant community members, whether results are implemented, organizational changes in the community.

For all aspects discussed here, validation should be done in collaboration with experts from those respective fields, to ensure reliable data collection and validated results.

4.5 Summary

In this chapter, the framework was built up by looking at theory regarding pro-environmental behaviour. To leverage a normative goal-frame and by that encourage pro-environmental behaviour, increasing knowledge is expected to be key, by putting hedonic and gain goals in perspective and by that lowering perceived barriers, or by leveraging factors that strengthen the normative goal-frame, such as situational cues or increasing knowledge. This framework focuses on increasing knowledge via social learning within communities, as well as allowing individual, experiential learning via simulation in a technical model.

When applying the framework to serious game design, first it should be discovered what a technical model can already accomplish and where serious gaming elements should supplement this. Furthermore, it is still unclear whether contextual factors pose such great barriers that the displacement power of hedonic and gain goals is too high in order for normative goal-frames to become prominent.
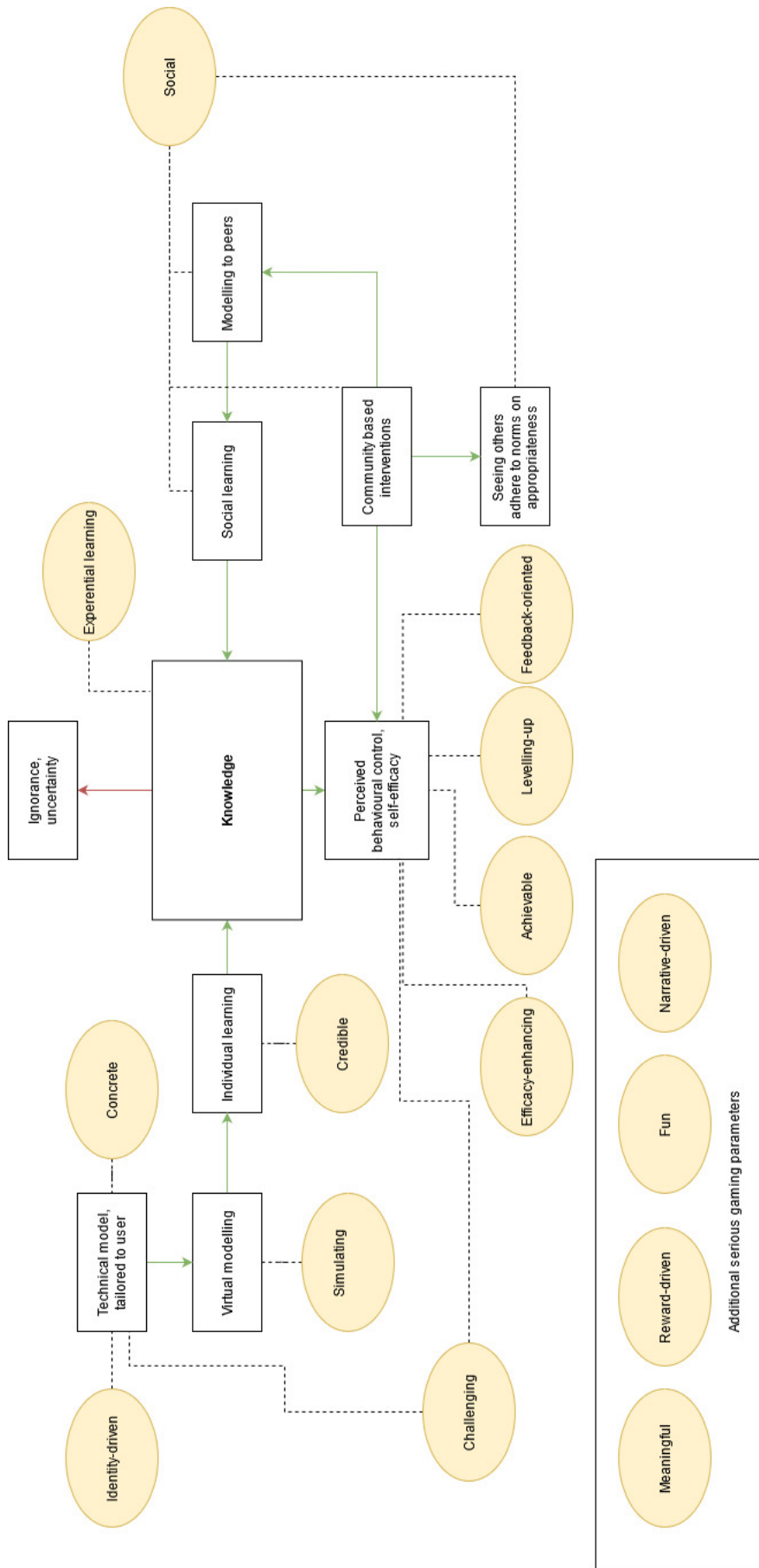
Figure 6: relation between important elements in the serious gaming framework

5 Results: Ameland sessions

In the online session and in the two live sessions, the WeEnergy House model was discussed with several participants. Here, the proceedings of the sessions are discussed with the theoretical elements of the framework in mind, to explore what goals and strategies from the framework the technical model already might accomplish, and where serious gaming elements could supplement the model. The second live sessions were purposed to get a first idea of how potential participants might handle the model and what their first reactions were after such a session. As such, first it is shortly discussed what the impressions from the participants were, and consequently the proceedings are explored in the light of parameters posed by the theoretical elements in the framework.

During live session 1 and the online session, all representatives from Gemeente Ameland said that they were eager to continue using the tool in their community, as they believe in its usefulness. Most of the doubts were concerning whether homeowners are stimulated to take part in using the tool, or if some extra form of incentive is needed. One important related point from the discussion was that it might be problematic already for potential players to discover the specifics of their houses, as this was also problematic in surveys done by the municipality. Especially for houses in Ameland this was problematic, since the number of inhabitants at any given time is variable since many houses are also purposed as holiday homes. While this might be problematic at first, it is acknowledged that having these conversations with homeowners to discover what influence that has on energy use might already prove educational for them.

One representative from Ameland argued that the most added value from the tool was found in its power as independent overview of choices on many fronts, rather than just advice from contractors who focus on one important aspect. He proclaimed that the value as independent overview should be focused on more to attract homeowners who are uncertain about options and have trouble finding authoritative sources to help them with this.

5.1 Goal-frames

While the Ameland-sessions did not include any validated method to study goal-frames, they provide some insight in what goal-frame was most prominent. The most interesting observation in both the live sessions and the online session was that there was very little attention to normative goals. When norms were considered, these did not represent norms regarding climate or energy, but rather social or personal norms. For example, player 3 in live session 2 explained they were considering investments in their house because they had a personal connection with the house (their grandparents used to own it), and therefore wanted to make sure it was future-proof, even though they were considering moving from the house. Considering not investing in their home caused a feeling of neglect, which induces a sense of guilt, inducing a hedonic goal-frame.

Normative goals in terms of biospheric values were very seldomly discussed. Even in the first session, when PL was asked what the role of reducing emissions was in his investments (their house already had a very low gas demand due to insulation, a hybrid heat pump and more), they said that 'reducing emissions' was not something they considered. Rather, they thought about investing to reduce their gas bill (a gain goal), as well as increase comfort in their house (a hedonic goal).

According to PL, perception of costs is the most important barrier. They are only concerned in energy use in terms of how much it costs, rather than its contribution to climate change. PL also acknowledges that it is difficult to promote interaction in such a session, as a household is very personal. One interesting remark was that ET and PL both had the expectation that eliminating gas use would have the greatest effect on costs and emissions, but the model did not support this expectation, due to high investment costs of complete electrification.

Concluding, a gain goal-frame seemed thus to be dominant for the entirety of both sessions. Already in the introduction of the first live session, both the moderator and the attendees explained that they felt that financial barriers were most important. After filling in dimensions and specifications for the respective houses, attendees were asked if they already considered some investments, and all players in live session 2 claimed that they were worried about the investment costs. Furthermore, when the moderator proposed investments, their first action was to look at the results in terms of investment costs and payback period, which were also central in the results overview. In the second live session, the conversation was steered more towards normative goals such as reaching "nul op de meter" or having a small ecological footprint, but this proved difficult. Player 3 explained that they felt it was not clear what benefits a new refrigerator would have in terms of energy use. The answer was given in kWh by the model, which was still unclear for her.

In terms of hedonic goal-frames, the model does not include any metrics about comfort, convenience or effort. However, the players in live session 2 did acknowledge hedonic goals in the discussion to whether they would like to invest in something. For example, player 1 mentioned that they might want to upgrade from double-glazing (HR++) to triple-glazing (HR+++) glass windows, to lose less heat when the temperature outside is lower. This suggests that hedonic goal-frames are still more present than normative goal-frames.

5.2   Self-efficacy and perceived behavioural control

While it was not extensively discussed, all attendees showed that they agreed with the importance of energy conservation. Because of their intention to invest even though they acknowledge the high costs, it can be assumed that they are motivated to reduce their individual environmental impact and also feel that they are able to make these decisions for their households. As such, they a high level of perceived behavioural control, i.e., they believe that they can perform this behaviour.

In terms of self-efficacy, none of the attendees expressed that they had the feeling that they do not influence outcomes in terms of global climate goals. As such, when they were asked what barriers they experience, they were all internal factors (lack of personal resources or necessary knowledge) rather than lack of control over outcomes and goals.

5.3   Social learning

During the live session, there was a clear difference between interaction in the first session and the second session. In the first session, both the moderator and the energy advisor had a lively discussion with the homeowner concerning technology of heating appliances and insulation. In terms of learning via virtual modelling, the first session proved fruitful, as the homeowner noticed a discrepancy between the model and his gas bill. This was later explained by the energy advisor as probably having to do something with the optimization of his hybrid heat pump, which was considered useful information by the homeowner.

At the second session, there was a remarkable lack of social interaction. Every house was considered individually, and during the consideration of a house, other attendees had no input. This resulted in a rather one-sided conversation between the moderator and the individual attendees, much like a personal energy audit. However, filling in the model for the last house went considerably more quickly than the first two, and the last attendee was able to go through the options more quickly. This suggests that the last attendee did learn from observing others.

5.4   The role of the moderator

In both sessions, the moderator had the role of controlling the model as well as guiding the conversation. Filling in the model took quite some time (around 30 minutes per house), mostly because a lot of time was spent explaining what options there are and diving quite deep into technical information about the options. There was little interaction between players, only between the moderator and the player, which resulted in a kind of personal energy-audit.

While the model is deemed too complex to fill in by participants themselves and fully understand its capabilities, a moderator with relevant technical knowledge in the field is probably able to understand the model quite easily, as was the case with these sessions.

5.5   Timing

One interesting notion that was discussed and is not yet very broadly discussed in the theoretical framework is timing. For curtailment behaviours, timing is less of an issue since these behaviours are things that need to be done either continuously or on a very short time scale (e.g., every day). However, efficiency behaviours require planning and are often done only every few years (e.g., buying a new central heating boiler), or sometimes only once in the lifetime of a house (e.g., insulation). Attendees mentioned that they were not thinking about upgrading their central heating boilers to heat pumps, because the one they are currently using has not yet met the end of its lifetime. For these products, the type of behaviour that the game aims for is significantly different in terms of timing than insulation, because of the relation to product life-cycles, even though older products tend to be less efficient.

Both EA and PL remarked that the model should not aim to urge players to invest at that very moment, but rather 'plant a seed', so that players make a sustainable decision when the time comes.

5.6   Concluding

From the Ameland sessions, it seems that the model already shows potential in providing tailored information to players, and thereby aiding them in making investments in their homes. The model was

readily able to accommodate different household types and where information seemed inaccurate, this was not deemed problematic but rather helpful, as it provided a learning experience.

It was clear that all participants in both live sessions were mainly gain goal oriented, which emphasizes the requirement for reconciliation of gain goals with PEB. Hedonic goals were recognized with players, but the model was unable to accommodate this and the moderator answered questions regarding hedonic goals using their own knowledge. Since elements that enhance normative goal-frames were positive, this suggests that the relative displacement power of contextual factors enhancing gain goals are indeed high.

Furthermore, the model and its use should radiate authority, which asks for knowledgeable moderators – not many of them are available. This asks for sufficient supplementary material, such as instruction video's and user manuals.

6 Serious game design case: the WeEnergy House game

The Ameland sessions provided a first idea of what role the technical model can play in achieving the goals of the serious gaming framework, as well as explore where barriers might lie for players. This leaves room for serious gaming elements to complement the technical model and by that provide the extra mechanics that are needed to accomplish the goals.

To provide validation of the use of the proposed framework, this section proposes an example set of design elements for a potential WeEnergy House game as an extension of the WeEnergy House model, which was used in the Ameland-sessions. With these elements, an example of the use of the framework is posed to provide clarity in what kind of elements can fill the gaps left by the technical model.

These are categorized in four major game design categories: gameplay, winning condition, narrative and content (Ouariachi et al., 2017).

6.1 Gameplay

The way the game is played can play a very important part in the effectivity. It often has a large role in how fun the game is, how participants stay engaged and how they interact with the material. If we look at the impressions from Ameland, it was clear that interaction between players was lacking with the model, and the gameplay is an excellent opportunity to fill that gap.

6.1.1 Everybody plays with their own house

One example is by looking at how multiple participants can be engaged at the same time, instead of treating participants one by one. By letting all participants play with their own house while working towards a collective goal, they can experiment truly with a simulation of their own specific situation. This means that every player is provided with maximally tailored information, while they can observe how other participants treat their own house and model to their virtual selves as well as the collective of participants. Playing with your own house might also be more meaningful to the participants, which contributes to the goal of the game to enhance self-efficacy in these behaviours.

To play with your own house, everybody has in front of him a depiction of the model with all metrics displayed during the game. This might be possible by providing each player with a version of the model (e.g., on a small screen), where they can see in real-time what the status of the house is. The moderator (see 6.1.3) controls all models via its hub, so that participants can follow in real-time what impact certain decisions have on the household.

While playing with your own situation adds to the personal goals, the social component should not be neglected. To enhance social cohesion in the player group, the game should include game mechanics that allow for participants to work together in some way and help each other make improvements in their house. This aids n the learning process via modelling and can also be fun.

6.1.2 Classification of investments

To classify each investment in a concrete, credible and understandable way, several metrics can be used that can readily be translated in game mechanics. For instance, the following three metrics can be used:

- Associated emissions

- Costs

- Comfort

The game should include these metrics in the game mechanics as well. In terms of environmental impact specifically, the term *associated emissions* might not appeal to the imagination of most people, so some translation or metaphor that corresponds with the situation might be more suitable. An obvious option would be **energy labels**, which have proved to be successful in nudging consumers towards sustainable options and providing clarity in climate communication (see (Ölander & Thøgersen, 2014) for a review).

The energy label of a household is also already used in the WeEnergy House model, as well as in other tools in the roadmap proposed by ESTRAC, which makes it easier to work with for stakeholders that use multiple tools in their respective communities.

Including costs in the game is straightforward, as currency can be easily implemented (i.e., like in Monopoly), but for the hedonic aspects, this is not so straightforward. One option is to work with a simple 'comfort score', which goes up or down depending on the investments made. For example, by adding a positive comfort score to insulation improvements, participants learn about the positive impact that insulation has on the temperature inside the house. On the other hand, large investments might bring a little bit of discomfort for a short amount of time because it needs to be installed by a third party. The comfort score might have impact in random events (see 6.1.7), or a minimum might be agreed upon when setting the winning condition. The exact amount of comfort points a certain appliance might have would need to be determined in accordance with stakeholders

6.1.3   The moderator

One of the key impressions from the Ameland session was that the role of moderator can be very useful in providing tailored information beyond what a model of game can bring. During the game, participants will have questions about certain applications or options and a credible moderator can provide answers while also helping in decision-making. The moderator also functions as a source of credibility for participants, so that they truly believe that the simulation is accurate and that they gain accurate knowledge. Of course, this does require the moderator to be knowledgeable on a certain level. This might be problematic, since theory on community energy and social learning also underlines that the moderator should be someone who is known to the participants, to increase credibility build trust so that participants feel free to ask questions and play however they want. It remains to be seen whether all communities have at least one member (preferably more if the game is to played multiple times) that might function as moderator.

Figure 7: example of a European energy label for a refrigerator. source: https://en.wikipedia.org/wiki/European_Union_energy_label#/media/File:Energy_label_2010.svg

The role of the moderator can also be added to the game via a specific game mechanic, e.g., the possibility for participants to do an energy audit. When participants use this option, they can have a short conversation with the moderator where they use the model to explore some options, or to look at results from investments that are made.

6.1.4   Investment tiers

The model proposes investments on several different aspects of the house, but how can these be implemented in the game? One important recommendation in this aspect is to let participants start with smaller investments that might be easier to make and are less expensive, to induce a positive spillover effect. This strategy ensures that the participants do not immediately encounter a large barrier in terms of gain benefits, and are more easily tempted to get momentum in investments. Because this is a behaviour that is desired outside of the game, simulating that order might be a good idea in the game, especially when combined with goal-setting.

For example, the investments might be divided into different tiers that are available to the player at different moments in the game. First, players get the opportunity to invest in new LED-bulbs (if their house does not yet have these) and cooking via induction, which have much lower investment costs than higher-tier investments. Later in the game, players can advance to investments of higher tiers, that require larger investments but might also yield more impact on the energy label of the house. One proposal for the tiers is the following, but they should be selected based on costs.

Tier 1

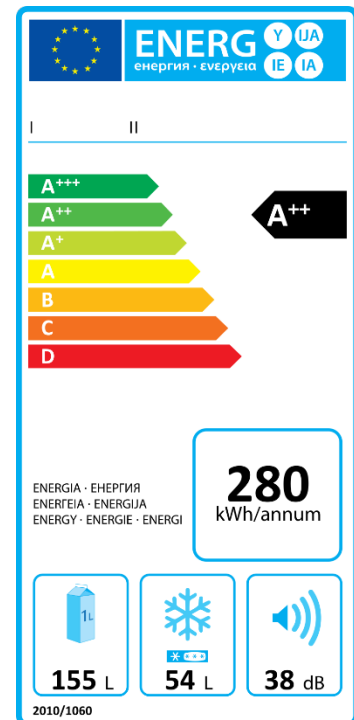- Refrigerator/Freezer
- LED Light bulbs

- Induction cooking
- Douche alarms (to reduce the water demand in the model)

Tier 2

- Major appliances (washer, dryer, etc.)
- Solar panels
- Heat recovery systems (shower and ventilation)
- Solar water heaters

Tier 3

- Heat production in house
- Heat release (floor warming, etc.)
- Insulation improvements

The progression through tiers provides some storyline already to the game, but also functions as an opportunity for players to 'level up'. This is also mentioned by Ouariachi's framework (2019), which proposes that a game should have multiple levels to provide a constant skill gap, even as players progress and become more knowledgeable in the game. This also adds to the perceived achievability of the challenges, as well as providing a challenging goal throughout the whole game. Going from one tier to the next could also be rewarded with the opportunity to do something fun, such as a random event (see 6.1.7)

The possibility to choose a certain investment might also be dependent on the presence of another investment. For example, to use a hybrid heat pump, a minimal insulation level is required, since the hybrid heat pump heats via lower temperatures. In this way, another level of storyline is added via this 'tech-tree'-construction. Furthermore, some investments might work better if they are both coupled; for example, if a heat pump is present, more of the electricity production from solar panels is utilized in the house rather than delivered back to the grid. Since the former is more efficient, it will influence the electricity demand and costs.

6.1.5 Time

One game mechanic that is important for certain investments is Time. The game could span over a given set of years, or time could not be a mechanic at all. However, since the timing of investments might be important to some players (e.g., in terms of when they want to upgrade their central heating boiler), it might be a good idea to include some form of time scale. Also, since the Klimaatakkoord has set 2030 as a year where a certain goal is acquired, this might be used in the narrative as well. For example, if the game is set to play out over a timescale of ten years, this can be functional in providing a timeline for the game as well (e.g., every 'turn' is one year).

In terms of tiers, improvements that are made in later tiers are mostly investments that are only made every 10+ years (e.g., central heating boilers/heat pumps), or where investment is not dependant on lifetime of products that are already present (e.g., solar panels, insulation upgrades). This asks for another game mechanic in which these investments can be made. It might be a good idea to let players experiment at least with every tier, to make sure that every player 'completes' the game. Most people will probably only play the game once, which asks for the game to make sure that every player experiences the entirety of content that the game has to offer.

6.1.6 Subsidies

One possible game mechanic that allows for players to invest in a certain high-tier investment is the inclusion of subsidies. Often, subsidies are installed by policy makers to promote certain high-cost investments, such as solar panels or insulation upgrades. These can be added to the game as a varying list, which can be added via random events. The subsidies have effect on the costs of investments, making them more attractive for players to do at that time. This resembles a real-life situation, where subsidies are often present but homeowners do not know how to apply for them (de Vries, 2020).

6.1.7 Randomness

Many games in digital and physical context employ random events in order to add some arbitrariness to the game, which might add some new level of fun and of challenge to the balance. A game could be largely based on randomness (e.g., a game that requires every turn to roll dice), or have almost no randomness at all (e.g., chess). It also adds credibility by resembling a real-life situation, since unexpected events can occur which asks for people to rethink their plans. For example, subsidies and when they are implemented might be thoroughly planned by policy makers, but for ordinary citizens these might come as completely random, since they have very little influence over them. Other possible random events that might influence household energy usage are the weather, natural disasters, or pandemics.

6.2 Winning condition

When a game is trying to convey a certain message, the winning condition is paramount in the framing of this message. What requires the players to do to win the game is what the game tries to tell you what 'winning' is, or what behaviours and actions should be done to be successful. This depends on the narrative as well – when a game asks you to be the villain (e.g., murdering civilians in The Werewolves of Millers Hollow), modelling is less prominent because players might not identify with the character they represent. In a game like the WeEnergy House game, where the game is designed to be an accurate simulation of the players real-life situation, the winning condition can be more readily translated into a goal in real life. Thus, the winning condition employs a goal-setting strategy to aid in behavioural change, by providing an attractive goal that is both challenging and achievable, as well as concrete and meaningful. This asks for the goal to be supported by the narrative as well.

Setting a specific winning condition might be a way to put players in a goal-frame, to underline the most important goal of the game. Since the model already includes some focus on gain goals, the main goal of the game should be related to a normative goal-frame, or a hedonic goal-frame that is compatible with a normative goal-frame. In terms of normative goals, a goal of emissions, or rather emission reduction can be set in the form of a desired energy label for the house. In terms of hedonic goals, a minimal comfort score as described in 6.1.2 can be set as goal as well.

Every house is different, and such every house has different potential goals. The winning conditions should thus be flexible and agreed upon by the players at the beginning of the game. This also ensures that the game remains relevant over the years, since new appliances can be added and the average energy label for players increases. For example, achieving an energy label that is two levels higher than the starting point might be considered easy, three levels higher might be medium and four labels means a hard game. For houses that already have an energy label of B or higher, the winning condition might be more related to comfort, or by aiding other players.

In addition to the goals for personal houses, a collective goal can be set to include a social winning condition as well. For example, a collective energy label could be set, so that when one individual player does not reach his goal, the game can still be won via compensation of other players. This adds to the social cohesion as well as the achievability of the winning condition.

To achieve the winning condition, feedback should be given periodically throughout the game, since goal-setting is often most fruitful when combined with feedback (Abrahamse & Matthies, 2012). This feedback should be positive and supportive, for example by connecting random events that aid the player or by giving rewards (Ouariachi et al., 2017)

6.3 Narrative

Narratives in games have a unique role: they provide the opportunity to add an element of fantasy in the game, by including storylines, characters and more. Ouariachi et al. (2017) discovered that the narrative of serious games is in many case a requirement to effectively communicate about the climate. It is also what makes the game engaging and providing reason for players to pay attention by pulling them into the story and an opportunity for players themselves to tell a story or to shift the narrative, since they influence decisions made in the storyline. In that way, the narrative is what distinguishes a game from a model and also what makes it fun.

In terms of goal-frames, the narrative is very suitable to provide basis for the winning condition, by providing a storyline in which the winning condition makes sense. By that, the winning condition becomes more than just something that the game imposes on you – it substantiates that the winning condition is just and appropriate. This suggests that the narrative should accommodate the winning condition by explaining why aiming for a normative goal is the way to win the game. This is also an

opportunity to make climate change visible to the players and connecting climate goals to household energy usage, reducing uncertainty and combating ignorance.

For example, one possible storyline is that the municipality has asked the player group to make some investments in their house, because otherwise the goals set by the Klimaatakkoord cannot be achieved. The purpose of the Klimaatakkoord should not be neglected to ensure that players do not feel coerced in achieving some abstract goal that somebody else has set for them, so the narrative should include solid reasoning as to why the Klimaatakkoord is important. Furthermore, as the game provides a concrete challenge to comply with a rather abstract norm, this might help in enhancing self-efficacy as well as providing a sense of urgency and allowing them to more easily translate their norms in behaviour. To make it more personal for the players, they could be 'the chosen someone's', since they can give a good example to the rest of the community by reaching the goal and showing how it is done. This also provides a social aspect to the game, since the players are chosen as a group that represents a community.

Another way to provide narrative to the game apart from the winning condition is via the random events that are explained in 6.1.7. For example, in games like Monopoly, random events tell the story of actually being the character that you are supposed to play in the game, via events that might happen to people in similar roles in real life. This is an opportunity to provide a sense of urgency by showing the effects of climate change in households, for example:

- "There is a heat wave going on! If you have insulation label G, your comfort score decreases by x because your house is very hot. If you have insulation label A, your comfort score increases by x, all the members of your household are happy with the temperature inside the house. You can also buy a mobile air-conditioning unit to increase comfort score by x, but this adds x to your emission score and costs x."

- "The Netherlands has decided to stop producing gas because of the earthquakes in Groningen. Also, Russia has increased its gas price since they own a bigger share of the market. Increase your gas price by x"

6.4 Content

Content entails the text displayed on cards, the balance between information given on the playing material and provided by the moderator, game design elements, the number of possibilities in choosing investments, etcetera. Many purposes of the game rely on the quality of the content and the message that it delivers – it can provide credibility to claims, add meaningful narrative to the game and it can also be fun. If the information displayed on cards is too comprehensive or too difficult, players might lose interest because they feel they do not understand. The same goes for information that is too sparse or too simple – players might not take the game seriously. The right balance in the length and complexity is not something that can be determined upfront, but should be determined in accordance with the target audience, via playing sessions, and should therefore be taken into account in the evaluation process.
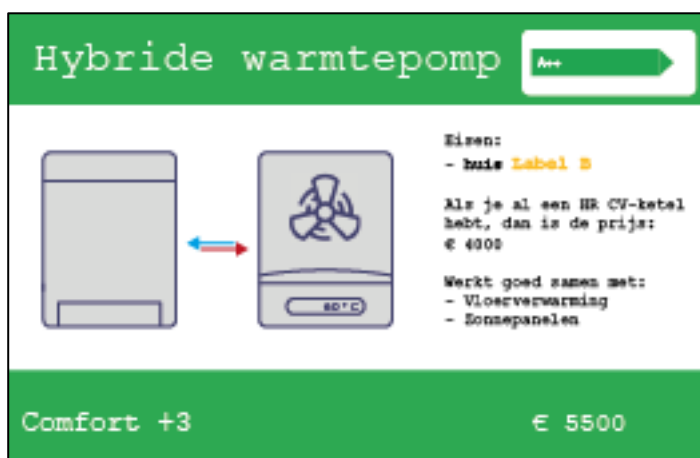
Figure 9: example of the front of a playing card
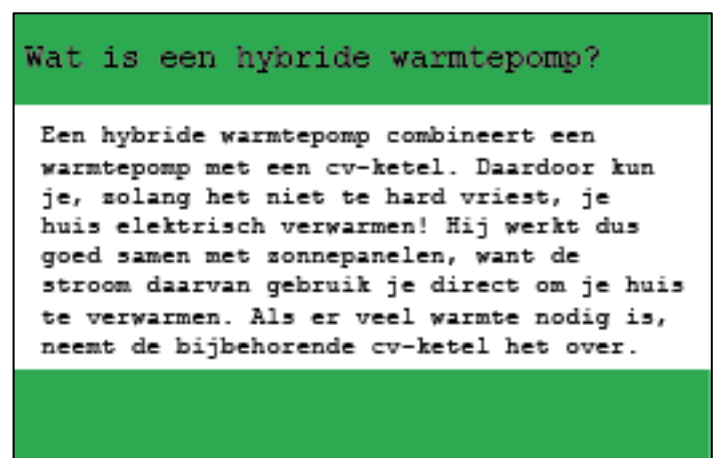
Figure 8: example of the backside of a playing card containing extra information about the appliance

Game characteristics	Goal-frames	Intervention parameters	Social learning and community building	Serious gaming parameters
Gameplay				
Everybody plays with their own house	-	Tailored information Feedback	Direct experience Virtual modelling Enhancing self-efficacy	Efficacy-enhancing Experiential learning Identity driven Meaningful Simulating
Classification of investments	Strengthening a normative goal-frame Reconciling gain and hedonic goals with normative goals	-	-	Concrete Credible Efficacy-enhancing
The moderator	Strengthening a normative goal-frame	Tailored information Feedback	Social cohesion Vicarious experience	Credible Feedback-oriented Fun Meaningful Narrative-driven Social
Investment tiers	Inducing positive spillover effects	Goal-setting	-	Achievable Challenging Levelling-up Reward-driven Simulating
Time	Reconciling gain and hedonic goals with normative goals	Goal-setting	Enhancing self-efficacy	Achievable Concrete Credible Efficacy-enhancing Feedback-oriented Narrative-driven
Subsidies	Reconciling gain and hedonic goals with normative goals	-	-	Credible Reward-driven
Randomness	-	-	-	Credible Fun Challenging
Winning condition	Strengthening a normative goal-frame Reconciling gain and hedonic goals with normative goals	Goal-setting	Enhancing self-efficacy Direct experience Social cohesion (for the collective winning condition)	Achievable Challenging Efficacy-enhancing Experiential learning Feedback-oriented Fun Levelling-up Narrative-driven Reward-driven Simulating Social

Narrative	Providing a normative goal-frame Translating abstract norms into behaviour	-	Increasing perceived behavioural control Social cohesion	Credible Fun Identity-driven Meaningful Narrative-driven Simulating Social
Content	Providing a normative goal-frame	Tailored information	-	Concrete Credible Fun Narrative-driven Simulating

6.5 Concluding

These design elements are by no means 'the perfect answer' to the gaps left by the technical model. They should be viewed as an example of how the framework can be applied. Whether they prove to be useful, remains to be seen by implementation, followed by evaluation via playing of the game. They are also not meant as conclusive game design, as a game consists of more elements that are not covered in this research, such as design, rules, etcetera.

7 Conclusions & Discussion

In this thesis, I propose a novel framework to design elements for serious games that function as a tool to help players making conscious decisions in household improvements and conversely lower the environmental impact of their household. By providing useful, credible and concrete information on possibilities and their impacts on comfort, finances and the environment, the game aims to empower players in real-life, so that they can more readily translate their biospheric values and norms into pro-environmental behaviour.

The framework recognizes and leverages elements that provide strong support for normative goal-frames, by addressing elements that put these goals in focus, or by making them more easily focal (e.g., by aiding in clarification of complicated smart norms). In this way, it is proposed that serious game elements that leverage these parameters allow normative goals to compete more easily with gain and hedonic goals.

However, while the framework is readily able to substantiate an increase in strength of normative goals, it is unclear whether this is enough to compete with the perceived importance of contextual barriers, such as high costs. In the Ameland sessions, it seemed that gain and hedonic goals are very much prominent, and the technical model on its own was not able to change this.

The key strategy that this framework utilizes to induce behaviour is via an aimed increase of knowledge for players, as this supports a normative goal-frame via multiple psychological pathways and tackles barriers that seem most prominent. The proposed design elements and recommendations ensure that information is tailored to players and relevant.

This does mean that the ultimate success factor of a serious game designed in this context is dependant on the ability to effectively teach players knowledge, which can only be verified with empirical data, which this research lacks. The same goes for the identification of where exactly the most prominent barriers lie in terms of difficulty of performing the behaviour: are barriers mostly internal (lack of confidence, willpower, feeling of behavioural control, skills, etc.) or external (demands from other persons, social pressure); are barriers concerned with obstacles in terms of self-efficacy, or rather perceived behavioural control?

Similarly, informational intervention strategies inherently focus on psychological factors rather than contextual factors, while barriers concerning the targeted behaviour seem mostly contextual factors. Normally, this asks for structural intervention strategies, which might also be suitable to target these types of behaviour. Nevertheless, the interplay between informational and structural intervention strategies is necessary for any aimed behavioural change, so there is no doubt that informational intervention strategies such as the proposed serious gaming framework are useful, although the distribution between the two is unclear (Steg & Vlek, 2009).

Learning via this serious gaming framework focuses on knowledge, rather than attitudes or awareness. This provides an opportunity for the framework to be extended, to include other targets in learning and thereby leverage normative goal-frames. While knowledge is identified as important, awareness and attitude are often mentioned in literature as possible targets as well.

7.1 Recommendations for further research

In this research, I propose a comprehensive framework to design serious games aimed at pro-environmental behaviour in households, in particular one-time purchasing behaviours. To effectively cover the whole scope of behaviours in households, further research should focus on the extension of the framework in terms of curtailment behaviours in households. Also, the importance of contextual factors is necessary to determine whether focusing on normative goal-frames is fruitful, or that effort is best put into the development of structural intervention strategies.

Furthermore, the most important step for now is to apply the framework to serious game design, for example using the proposed design elements in Chapter 6. Validation of the framework is dependant on the availability of empirical data, which this research was not focused on. Therefore, a logical next step is to collect this data, and doing that is quite straightforward: play the game!

It should be acknowledged that the serious game is not expected to have the power to convince everyone who plays it to achieve "nul op de meter" within a reasonable amount of time. It is merely a piece of the puzzle, a tool meant to accelerate the process. What piece that exactly is and how great the share of that particular piece of the puzzle is, remains to be seen after validation and application of designed tools.

The current energy transition in the built environment is an enormously complex transition, not comparable to any transition that this sector has gone through before. It requires new creative solutions to not only reach its goals in time, while providing solutions that are scalable and does not result in winners and losers, but something that is beneficial for all stakeholders. Serious gaming seems to be a valuable asset in the arsenal of the energy transition in the built environment. If the goals of the Klimaatakkoord in 2030 are to be reached, there is still a long way to go and exploration of tools like the WeEnergy House game can prove to be a much-needed catalysator in this transition.

8 Bibliography

Abrahamse, W. (2007). *Energy conservation through behavioral change Energy conservation through behavioral change : Examining the eff ectiveness of a tailor-made approach.*

Abrahamse, W., & Matthies, E. (2012). Informational strategies to promote pro- environmental behaviour: changing knowledge, awareness and attitudes. In L. Steg, A. E. Van den Berg, & J. I. M. De Groot (Eds.), *Environmental Psychology: an introduction* (pp. 223–232). John Wiley & Sons.

Abrahamse, W., & Steg, L. (2011). Factors Related to Household Energy Use and Intention to Reduce It: The Role of Psychological and Socio-Demographic Variables. *Human Ecology Review*, *18*(1), 30–40.

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology*, *25*(3), 273–291. https://doi.org/10.1016/j.jenvp.2005.08.002

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. *Journal of Environmental Psychology*, *27*(4), 265–276. https://doi.org/10.1016/j.jenvp.2007.08.002

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology*, *32*(4), 665–683. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x

Arya, B., & Chaturvedi, S. (2020). Extending the theory of planned behaviour to explain energy saving behaviour. *Environmental and Climate Technologies*, *24*(1), 516–528. https://doi.org/10.2478/rtuect-2020-0032

Attari, S. Z., DeKay, M. L., Davidson, C. I., & De Bruin, W. B. (2010). Public perceptions of energy consumption and savings. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(37), 16054–16059. https://doi.org/10.1073/pnas.1001509107

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. In *Social foundations of thought and action: A social cognitive theory.* (pp. xiii, 617–xiii, 617). Prentice-Hall, Inc.

Bang, M., Gustafsson, A., & Katzeff, C. (2007). Promoting new patterns in household energy consumption with pervasive learning games. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *4744 LNCS*, 55–63. https://doi.org/10.1007/978-3-540-77006-0_7

Barr, S., Shaw, G., Coles, T., & Prillwitz, J. (2010). ' A holiday is a holiday ': practicing sustainability , home and away. *Journal of Transport Geography*, *18*(3), 474–481. https://doi.org/10.1016/j.jtrangeo.2009.08.007

Batson, C. D., Thompson, E. R., Seuferling, G., Whitney, H., & Strongman, J. A. (1999). Moral hypocrisy: Appearing moral to oneself without being so. *Journal of Personality and Social Psychology*, *77*(3), 525–537. https://doi.org/10.1037/0022-3514.77.3.525

Bird, S., & Legault, L. (2018). Feedback and Behavioral Intervention in Residential Energy and Resource Use: a Review. *Current Sustainable/Renewable Energy Reports*, *5*(1), 116–126. https://doi.org/10.1007/s40518-018-0106-8

Bogner, A., Menz, W., & Littig, B. (2009). Interviewing Experts. In *Interviewing Experts*. https://doi.org/10.1057/9780230244276

Bolderdijk, J., & Steg, L. (2014). *Promoting sustainable consumption: The risks of using financial incentives* (pp. 328–341). https://doi.org/10.4337/9781783471270.00033

Bolderston, A. (2012). Conducting a research interview. *Journal of Medical Imaging and Radiation Sciences*, *43*(1), 66–76. https://doi.org/10.1016/j.jmir.2011.12.002

Bord, R., O'Connor, R., & Fisher, A. (2000). In What Sense Does the Public Need to Understand Global Climate Change? *Public Understanding of Science*, *9*, 205–218. https://doi.org/10.1088/0963-6625/9/3/301

Centraal Bureau voor Statistiek. (2021). *Drie kwart Nederlanders maakt zich zorgen over gevolgen klimaatverandering*. https://www.cbs.nl/nl-nl/nieuws/2021/22/drie-kwart-nederlanders-maakt-zich-zorgen-over-gevolgen-klimaatverandering

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A Focus Theory of Normative Conduct: Recycling the Concept of Norms to Reduce Littering in Public Places. *Journal of Personality and Social Psychology*, *58*(6), 1015–1026. https://doi.org/10.1037/0022-3514.58.6.1015

Cojuharenco, I., Cornelissen, G., & Karelaia, N. (2016). Yes, I can: Feeling connected to others increases perceived effectiveness and socially responsible behavior. *Journal of Environmental Psychology*, *48*, 75–86. https://doi.org/10.1016/j.jenvp.2016.09.002

Csikszentmihalyi, M. (1998). *Finding Flow: The Psychology of Engagement With Everyday Life* (p. 144).

de Vries, G. (2020). Public Communication as a Tool to Implement Environmental Policies. *Social Issues and Policy Review*, *14*(1), 244–272. https://doi.org/10.1111/sipr.12061

Delmas, M. A., Fischlein, M., & Asensio, O. I. (2013). Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012. *Energy Policy*, *61*, 729–739. https://doi.org/10.1016/j.enpol.2013.05.109

Döringer, S. (2020). 'The problem-centred expert interview'. Combining qualitative interviewing approaches for investigating implicit expert knowledge. *International Journal of Social Research Methodology*, *24*(3), 265–278. https://doi.org/10.1080/13645579.2020.1766777

Ebrahimigharehbaghi, S., Qian, Q. K., Meijer, F. M., & Visscher, H. J. (2019). Unravelling Dutch homeowners' behaviour towards energy efficiency renovations: What drives and hinders their decision-making? *Energy Policy*, *129*(December 2018), 546–561. https://doi.org/10.1016/j.enpol.2019.02.046

Fox, J., & Bailenson, J. N. (2009). Virtual self-modeling: The effects of vicarious reinforcement and identification on exercise behaviors. *Media Psychology*, *12*(1), 1–25. https://doi.org/10.1080/15213260802669474

Fuchslocher, A., Niesenhaus, J., & Krämer, N. (2011). Serious games for health: An empirical study of the game " Balance" for teenagers with diabetes mellitus. *Entertainment Computing*, *2*(2), 97–101. https://doi.org/10.1016/j.entcom.2010.12.001

Gardner, G., & Stern, P. (2002). *Environmental Problems and Human Behavior, Second Edition*.

Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, *66*(4), 290–302. https://doi-org.proxy-ub.rug.nl/10.1037/a0023566

Gifford, R. (2014). Environmental psychology matters. *Annual Review of Psychology*, *65*, 541–579. https://doi.org/10.1146/annurev-psych-010213-115048

Gugerell, K., & Zuidema, C. (2017). Gaming for the energy transition. Experimenting and learning in co-designing a serious game prototype. *Journal of Cleaner Production*, *169*, 105–116. https://doi.org/10.1016/j.jclepro.2017.04.142

Guo, Z., Zhou, K., Zhang, C., Lu, X., Chen, W., & Yang, S. (2018). *Residential electricity consumption behavior : In fl uencing factors , related theories and intervention strategies*. *81*(January 2017), 399–412. https://doi.org/10.1016/j.rser.2017.07.046

Heath, C., & Heath, D. (2010). *Switch : how to change things when change is hard*. Broadway Books.

Huang, Y., & Warnier, M. (2019). Bridging the Attitude-Behaviour Gap in Household Energy Consumption. *Proceedings of 2019 IEEE PES Innovative Smart Grid Technologies Europe, ISGT-Europe 2019*. https://doi.org/10.1109/ISGTEurope.2019.8905660

Hynes, N., & Wilson, J. (2016). I do it, but don't tell anyone! Personal values, personal and social norms: Can social media play a role in changing pro-environmental behaviours? *Technological Forecasting and Social Change*, *111*, 349–359. https://doi.org/10.1016/j.techfore.2016.06.034

IPCC. (2014). Climate Change 2014. In *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.

Johnson, D., Horton, E., Mulcahy, R., & Foth, M. (2017). Gamification and serious games within the domain of domestic energy consumption: A systematic review. *Renewable and Sustainable Energy Reviews*, *73*(February 2016), 249–264. https://doi.org/10.1016/j.rser.2017.01.134

Klimmt, C. (2009). Serious Games and Social Change: Why They (Should) Work. In U. Ritterfeld, M. J. Cody, & P. Vorderer (Eds.), *Serious Games : Mechanisms and Effects* (pp. 248–270). Routledge. http://site.ebrary.com/id/10330978

Kok, R., Falkena, H. J., Benders, R. M. J., Moll, H. C., & Noorman, K. J. (2003). *Household metabolism in European countries and cities*.

Lacasse, K. (2016). Don't be satisfied, identify! Strengthening positive spillover by connecting pro-environmental behaviors to an "environmentalist" label. *Journal of Environmental Psychology*, *48*, 149–158. https://doi.org/10.1016/j.jenvp.2016.09.006

Lacroix, K., Gifford, R., & Chen, A. (2019). Developing and validating the Dragons of Inaction Psychological Barriers (DIPB) scale. *Journal of Environmental Psychology*, *63*(April 2018), 9–18. https://doi.org/10.1016/j.jenvp.2019.03.001

Lehman, P. K., & Geller, E. S. (2004). Behavior Analysis and Environmental Protection: Accomplishments and Potential for More. *Behavior and Social Issues*, *13*(1), 13–33. https://doi.org/10.5210/bsi.v13i1.33

Lesic, V., De Bruin, W. B., Davis, M. C., Krishnamurti, T., & Azevedo, I. M. L. (2018). Consumers' perceptions of energy use and energy savings: A literature review. *Environmental Research Letters*, *13*(3). https://doi.org/10.1088/1748-9326/aaab92

Lindenberg, S. (2005). Smart norms . How do they work and does the school have an important function for making them work ? Durkheim : vagueness of abstractness ? *De Strijd Om Het Curriculum*, 85–107.

Lindenberg, S., & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social Issues*, *63*(1), 117–137. https://doi.org/10.1111/j.1540-4560.2007.00499.x

Lindenberg, S., & Steg, L. (2014). Goal-framing theory and norm-guided environmental behavior. In H. C. M. van Trijp (Ed.), *Encouraging sustainable behaviour* (pp. 37–54). Psychology Press.

Liobikiene, G., & Poškus, M. S. (2019). The importance of environmental knowledge for private and public sphere pro-environmental behavior: Modifying the Value-Belief-Norm theory. *Sustainability (Switzerland)*, *11*(12). https://doi.org/10.3390/su10023324

Lorenzoni, I., Nicholson-Cole, S., & Whitmarsh, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, *17*(3–4), 445–459. https://doi.org/10.1016/j.gloenvcha.2007.01.004

Mayer, I., Bekebrede, G., Harteveld, C., Warmelink, H., Zhou, Q., Van Ruijven, T., Lo, J., Kortmann, R., & Wenzler, I. (2014). The research and evaluation of serious games: Toward a comprehensive methodology. *British Journal of Educational Technology*, *45*(3), 502–527. https://doi.org/10.1111/bjet.12067

McDonough, D. (2013). Similarities and Differences between Adult and Child Learners as Participants in the Natural Learning Process. *Psychology*, *04*, 345–348. https://doi.org/10.4236/psych.2013.43A050

Merriam, S. B., & Bierema, L. L. (2013). *Adult learning: Linking theory and practice*. John Wiley \& Sons.

Midden, C. J. H., Kaiser, F. G., & Mccalley, L. T. (2007). Technology's four roles in understanding individuals' conservation of natural resources. *Journal of Social Issues*, *63*(1), 155–174. https://doi.org/10.1111/j.1540-4560.2007.00501.x

Milieu Centraal. (2021). *Inzicht in de energieverbruik*. https://www.milieucentraal.nl/energie-besparen/inzicht-in-je-energierekening/gemiddeld-energieverbruik/#waar-hangt-mijn-gas-en-stroomverbruik-van-af

Morganti, L., Pallavicini, F., Cadel, E., Candelieri, A., Archetti, F., & Mantovani, F. (2017). Gaming for Earth: Serious games and gamification to engage consumers in pro-environmental behaviours for energy efficiency. *Energy Research and Social Science*, *29*(May), 95–102. https://doi.org/10.1016/j.erss.2017.05.001

Namazkhan, M., Albers, C., & Steg, L. (2020). A decision tree method for explaining household gas consumption: The role of building characteristics, socio-demographic variables, psychological factors and household behaviour. *Renewable and Sustainable Energy Reviews*, *119*(June 2019), 109542. https://doi.org/10.1016/j.rser.2019.109542

Ölander, F., & Thøgersen, J. (2014). Informing Versus Nudging in Environmental Policy. *Journal of Consumer Policy*, *37*(3), 341–356. https://doi.org/10.1007/s10603-014-9256-2

Ouariachi, T., Olvera-Lobo, M. D., & Gutiérrez-Pérez, J. (2017). Analyzing Climate Change Communication Through Online Games: Development and Application of Validated Criteria. In *Science Communication* (Vol. 39, Issue 1). https://doi.org/10.1177/1075547016687998

Ouariachi, T., Olvera-Lobo, M. D., & Gutiérrez-Pérez, J. (2019). Serious Games and Sustainability. *Encyclopedia of Sustainability in Higher Education*, 1–10. https://doi.org/10.1007/978-3-319-63951-2_326-1

Ouariachi, T., Olvera-Lobo, M. D., Gutiérrez-Pérez, J., & Maibach, E. (2019). A framework for climate change engagement through video games. *Environmental Education Research*, *25*(5), 701–716. https://doi.org/10.1080/13504622.2018.1545156

Perlaviciute, G., & Steg, L. (2014). Contextual and psychological factors shaping evaluations and acceptability of energy alternatives: Integrated review and research agenda. *Renewable and Sustainable Energy Reviews*, *35*, 361–381. https://doi.org/10.1016/j.rser.2014.04.003

Pierie, F., Groningen, A. A., Sciences, E., Groningen, A. G., Datum, I., Pierie, F., & Groningen, A. A. (2020). *Proposal ESTRAC Post doc project : Methods and tools to help communities in the energy transition . Designing approaches and tools for awareness , acceptance , and planning of renewable communities , using interactive modeling and serious gaming principle.*

Prensky, M. (2002). The motivation of gameplay. *On The Horizon*, *10*(1), 5.

Programma Aardgasvrije Wijken. (2021). *Proeftuin uitgelicht*. https://aardgasvrijewijken.nl/proeftuinen/proeftuinuitgelicht/default.aspx

Rijksoverheid. (2019). Klimaatakkoord. *Klimaatakkoord*, 250. https://www.klimaatakkoord.nl/binaries/klimaatakkoord/documenten/publicaties/2019/06/28/klimaatakkoord/klimaatakkoord.pdf

Rizzi, P. (2019). *Neo-Simulation and Gaming Toward Active Learning* (Vol. 18). http://link.springer.com/10.1007/978-981-13-8039-6

Rumore, D., Schenk, T., & Susskind, L. (2016). Role-play simulations for climate change adaptation education and engagement. *Nature Climate Change*, *6*(8), 745–750. https://doi.org/10.1038/nclimate3084

RVO. (2020). *Monitor energiebesparing gebouwde omgeving 2012* (Issue December).

Scarlatos, L. L., Tomkiewicz, M., & Courtney, R. (2014). Using an agent-based modeling simulation and game to teach socio-scientific topics. *Interaction Design and Architecture(S)*, *19*(1), 77–90.

Schultz, P. W. (2014). Strategies for promoting proenvironmental behavior: Lots of tools but few instructions. *European Psychologist*, *19*(2), 107–117. https://doi.org/10.1027/1016-9040/a000163

Schwartz, S. H. (1992). *Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries* (M. P. B. T.-A. in E. S. P. Zanna (ed.); Vol. 25, pp. 1–65). Academic Press. https://doi.org/https://doi.org/10.1016/S0065-2601(08)60281-6

Soekarjo, M., & Oostendorp, H. Van. (2015). *Measuring Effectiveness of Persuasive Games Using an Informative Control Condition. 2*(2).

Spagnolli, A., Chittaro, L., & Gamberini, L. (2016). Interactive Persuasive Systems: A Perspective on Theory and Evaluation. *International Journal of Human-Computer Interaction*, *32*(3), 177–189. https://doi.org/10.1080/10447318.2016.1142798

Spandagos, C., Baark, E., Ng, T. L., & Yarime, M. (2021). Social influence and economic intervention policies to save energy at home: Critical questions for the new decade and evidence from air-condition use. *Renewable and Sustainable Energy Reviews*, *143*(February), 110915. https://doi.org/10.1016/j.rser.2021.110915

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An Integrated Framework for Encouraging Pro-environmental Behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology*, *38*, 104–115. https://doi.org/10.1016/j.jenvp.2014.01.002

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, *56*(3), 407–424.

https://doi.org/10.1111/0022-4537.00175

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, *6*(2), 81–97.

Thøgersen, J. (1999). *Spillover processes in the development of a sustainable consumption pattern. 20*, 53–81.

Thøgersen, J., & Grønhøj, A. (2010). Electricity saving in households-A social cognitive approach. *Energy Policy*, *38*(12), 7732–7743. https://doi.org/10.1016/j.enpol.2010.08.025

Truelove, H. B., Carrico, A. R., Weber, E. U., Raimi, K. T., & Vandenbergh, M. P. (2014). Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. *Global Environmental Change*, *29*, 127–138. https://doi.org/10.1016/j.gloenvcha.2014.09.004

Turner, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. *Qualitative Report*, *15*(3), 754–760. https://doi.org/10.46743/2160-3715/2010.1178

Paris Agreement - UNFCCC, United Nations Climate Change (2015).

Van den Berg, J. (2021, February 24). Na twee jaar experimenteren in 'aardgasvrije wijken' zijn slechts 206 huizen van het gas af. *De Volkskrant*. https://www.volkskrant.nl/nieuws-achtergrond/na-twee-jaar-experimenteren-in-aardgasvrije-wijken-zijn-slechts-206-huizen-van-het-gas-af~bf523a4d/

van der Schoor, T., & Scholtens, B. (2019). The power of friends and neighbors: a review of community energy research. *Current Opinion in Environmental Sustainability*, *39*, 71–80. https://doi.org/10.1016/j.cosust.2019.08.004

Van Der Schoor, T., & Scholtens, B. (2015). Power to the people: Local community initiatives and the transition to sustainable energy. *Renewable and Sustainable Energy Reviews*, *43*, 666–675. https://doi.org/10.1016/j.rser.2014.10.089

Villanueva Riesco, H. (2021). *Engagement of residents in energy conservation for the energy transition : The case of the Dutch island of Ameland. 52*.

Wu, J. S., & Lee, J. J. (2015). Climate change games as tools for education and engagement. *Nature Climate Change*, *5*(5), 413–418. https://doi.org/10.1038/nclimate2566

Wu, X., Liu, S., & Shukla, A. (2020). Serious games as an engaging medium on building energy consumption: A review of trends, categories and approaches. *Sustainability (Switzerland)*, *12*(20), 1–16. https://doi.org/10.3390/su12208508

9 Appendix A: expert reviews

The expert interview as research methodology is quite established in some sciences, in particular social sciences. It is often used to gain knowledge that is not available in literature as it draws upon the expert knowledge of an individual that goes beyond what is written down in their authored publications (Bogner et al., 2009, Chapter 1).

Especially in this research, where multiple fields of science are considered, the expert interview lends itself very well as supplementary research method. It gives access to knowledge in fields that are not the expertise of the researcher, and it does so in a very efficient and concentrated manner (Bogner et al., 2009, Chapter 1). As such, its goal in this research is to clarify where the literature is unclear or lacks, but also to include expertise from fields of research that have interfaces with this project, while the researcher lacks experience in these fields.

To give some structure and methodological validity to the interviews, literature on the expert interview as qualitative empirical research method was used (Bogner et al., 2009; Bolderston, 2012; Döringer, 2020; Turner, 2010).

Bogner and Menz (Bogner et al., 2009, Chapter 2) describe several forms of the expert interview. These forms are different in their proposed goals and epistemological functions, as well as the relation between the interviewer and the interviewee. For this research the *exploratory expert interview* is most suitable; it is meant to orientate in fields that are relatively unknown to the interviewer and it is also characterized by its suitability for an asymmetrical relation between interviewer and interviewee: the layman (me) versus the expert.

This raises the question of what an expert is, or what someone has to be or has to have accomplished in order to be considered an expert. This question is discussed quite extensively by Bogner and Menz (Bogner et al., 2009), but it concerns mostly theory of epistemology and ironically, I would need to interview an expert on expert interviews to fully comprehend it. Because of the relation between me and the interviewees and their fields of expertise (i.e., I have very little experience in social psychology), any person with experience in research in those fields might be considered an expert.

This expert-layman relationship between myself and the interviewee results in an dialogue dynamic that is very suitable for orientation and generating theory, because the interviewee will have every freedom to explain what he or she thinks is the most relevant information, regardless of the predisposition of the interviewer (Bogner et al., 2009, Chapter 2). This allows for obtaining *interpretative knowledge*, which is defined as knowledge that is really unique to the interviewed expert and by that adds intrinsic value to the interview apart from extrinsic knowledge.

The *exploratory expert interview* does not refer to a strict interview structure, but merely an approach that allows for flexible interview design while getting the most out of the interview for its intended purpose. This particular form is also characterized by its openness, as open as possible, because it allows emphasis on the individual relevancy of the experts (Döringer, 2020)(Bogner et al., 2009, Chapter 2).

Using some examples and the literature described above, an overall interview guide was developed to conduct the interviews (Bogner et al., 2009; Bolderston, 2012; Döringer, 2020; Turner, 2010):

1. As an introduction, the purpose of the research and the interview is explained.
2. To establish the layman-expert relationship, the interviewers experience with the field of expertise of the expert is explained. Possibly, a rather naïve question about the topic is asked to further establish the layman-expert relationship.
3. In the body of the interview, three or four open-ended questions are asked, with room for sub-questions in between, depending on whether the answer allows for further explanation. The open-endedness of these questions is very important to allow for the interviewee to fully 'choose their own terms' in answering (Turner, 2010). In these questions, a focus is put upon the personal experience of the interviewee with the subject, so as to encourage answers that might prove later to be *interpretative knowledge* (Bogner et al., 2009, Chapter 2)
4. Finally, the interviewee is asked to give some recommendations in the design of the WeEnergy House Game

9.1 Exploratory Expert interviews
Three interviews were conducted:

1) Interview with dr. Goda Perlaviciute, researcher in the field of environmental psychology

2) Interview with dr. Tania Ouariachi Peralta, researcher in the field of climate communication and education, and serious gaming

3) Interview with dr. Tineke van der Schoor, researcher in the field of the energy transition in the built environment

9.1.1 Interview with dr. Goda Perlaviciute

- Introduction: personal background and field of research; mostly focused on public acceptance of energy systems/policies?
    - o Public acceptance of things like heat pumps and other home appliances: do you think this works similarly?
- There are several theories that are used to explain pro-environmental behaviour, but as I am not really experiences in the field of social psychology, I'm not really sure how these theories are applied or what value they hold when designing a certain intervention strategy.
    - o Value-belief-norm theory
        - ▪ Values?
    - o Goal-framing theory
- Intervention strategies, such as our game, are focused on changing environmental behaviour, or at least promoting it. This concerns influencing peoples values, asking them to put their bio-spheric values before hedonistic values, for a longer period of time. There is quite some uncertainty still on the effectivity of these strategies on the long term; how do you think that these strategies would work for long term?
- Environmental psychology is quite an active field, would you say that there are very important changes happening or have happened in the last few years?
- Do you have any particular tips or recommendations for the design of such a serious game from your own expertise?

Kas Jansma 0:00

(introduction). So first, I wanted to ask you what what your personal background is in your current field of research?

Goda Perlaviciute 1:50

So I'm in the environmental psychology group, which means that we look at the relationship between people and their environments, and in Groningen, and we mostly look at, at how people affect their environment. So all kinds of sustainable behaviours and what motivates people to to act environmentally friendly in different ways. So energy, recycling, mobility, these kind of things.

But my, my area of expertise is energy in particular, and what energy solutions or options people find acceptable or not what what people think about wind energy, solar energy, and things like that

Kas Jansma 2:36

And so it's mostly energy generation, or is it the whole the whole scope?

Goda Perlaviciute 2:53

I totally agree with you that there are so many things, and it's nice that you already say, yeah, people also have to adjust their energy use, right? So we can't just say, Oh, we will go for renewables, and everything is solved to reduce energy use. I look less at behaviours themselves, we look at it in the in the group, but I look mostly at acceptability. But at the same time, I'm, I am interested in sort of human dimension of energy transition in general. And I always try to remind also practitioners that you need multiple things, you need people to change their behaviours, you need people to accept new technologies, right and new infrastructure. And you need people to also match energy demand and supply. So if we accept them, then we still have to use them properly, right and avoid peak times.

Kas Jansma 4:00

I think that's something that I discovered a lot in your research as well, that you really focus on the multidisciplinary background of the whole issue, because a lot of separate groups are working on separate things, improving environmental behaviour in the form of improving technology, or talking to people or looking at the behaviour side. So that's where my research is also really interesting, because I really try to combine all these things. So I'm really looking at how an intervention strategy coupled with a technical solution and communicated in some kind of way can really help promote environmental behaviour the most.

So you mentioned that you focus mostly on acceptability. I guess it's mostly about like, people not wanting windmills in their backyards and stuff like that, or is it also really focused on like, if people want to invest in maybe heat pumps in their house

Goda Perlaviciute 4:53

Also yes, and heat networks as well.

Kas Jansma 5:01

And is there a lot of difference between people do accepting like windmills and solar panels maybe, but not willing yet to invest in their homes?

Goda Perlaviciute 5:15

So the factors that predict acceptability are usually the same. So it's it's Yeah, how people perceive the cost and benefits. And the important thing to keep in mind is that people don't only think about personal cost benefit. So we always think of people just want to know how much money it costs

Kas Jansma 5:38

that was my initial approach as well. Like we just showed him how much cheaper it is, and then it will be like that. But of course, it's much more complicated than that.

Goda Perlaviciute 5:45

Yeah, it's not always that people are motivated by money. And I think especially when it when it comes to maybe lower energy savings, for example, so you look not only at Okay, will they buy a heat pump or not, and that's a large investment. But probably because your model also will show when they can save energy, and how and how much right, and sometimes their savings may not be even that large, but people are also motivated by environmental motives. So we do see in research that people do get a good feeling from also reducing co2 emissions. And

Kas Jansma 6:27

that's something that I read about in your research focused on the not only, like, you mentioned about values in and that's something that's kind of vague to me. Could you elaborate on what these values mean?

Goda Perlaviciute 6:45

yes, there are two big types. So one is more focused on yourself, another one on others. And that on yourself, there are two types. There's egoistic and there is hedonic. egoistic, yeah, it can be about money. So it's about personal resources. But it can also be other things. For example, status can be an interesting one. So yeah, the example that I give often is driving a Tesla.

Kas Jansma 7:16

Tesla in front of your door, and everybody sees it, and you feel good about people looking at your Tesla.

Goda Perlaviciute 7:22

Right? Yeah. And it's probably not maybe not even financially the most optimal thing, but it doesn't matter, right, because it could be a status symbol. And I do think that might happen with solar panels as well. But yeah, I think that's not where the sun is shining, but where the people are seeing it, at the front of their house.

These are egoistic motives, then we have hedonic models. And that's comfort and pleasure. Maybe also interesting, if you talk about insulation, for example. So he has on the one hand, you could save some money,

perhaps in a year and the bill the same time, it could also improve your comfort, right? It's the heater longer that the house maybe stays cooler during the summer.

So there's also another motive of that, yeah, that should not be necessarily ignored, right? It's not just about money. So these are two more self-related and the other two are other related, and those are biospheric values, so about the environment and that people do go for environmental options as well, right, that the green energy providers are not always the cheapest, but people still go for them for example. And you can also promote them or promote that right with stickers or with labels. And the other value there is altruistic values. And that's more about others, future generations. Not sure how much debt you can bring in. But you can see there's also the collective motive, that we do things together. And that applies very much if you have to deal with local energy communities

Kas Jansma 9:24

So when you talk about these values, and you want to design intervention strategies in order to like I guess you want to promote biospheric and altruistic value; values that tell them to maybe invest in some things that are, that might be a little bit costly, so you can't really appeal to their hedonic values. I read about these intervention strategies that they often only work on the short term. So you have an intervention strategy and maybe an information strategy. And in the year after that people, maybe save some energy or they invest in something, but in the long term that disappears. And when you talk about big investments, those are oftentimes not investments that you decide to do in one year, or you have to think about it, or you have to save some money to do them. So how would you go about designing intervention strategies that work on the long term? Is there a research being done about that? Or is that something that is still unclear?

Goda Perlaviciute 10:25

So actually, especially the very egoistic interventions can lose their effectiveness, especially if the benefits are taken away, for example, right? So if you focus on those financial benefits, and then as soon as they're not interesting anymore. The same is the case as when you focus too much on it being fun, for example, technology that is interesting at the start, but then whatever not so interesting anymore. There is some evidence that by emphasizing those environmental motives, and by reminding people like, Oh, well, you're doing good for the environment, we'll sort of develop this environmental self-identity, so they see themselves as someone who does good for the environment and that could potentially last longer.

Kas Jansma 11:25

it's really focusing on getting feedback continuously to the to people who have already invested in something that's also I read about the difference between antecedent strategies and consequential strategies. So the consequences strategies you keep reminding them about, after they already did the investments. So you say it's really a combination of both that would be the most ideal when designing a strategy. So first, you, you you talk about the antecedent factors, like if you invest now, you will have this kind of impact after, and then after they invest, you keep giving them feedback about you already saved this much by investing in insulation and something like that.

Goda Perlaviciute 12:08

Yeah, yeah. And so, we do see that people have those biospheric values, so care about the environment, but at the same time, we also cannot expect that people will always prioritize those values. So, yes, emphasize those environmental things, but at the same time, we also say in papers, well, if there are very strong contextual barriers, if, you know if it's really really costly or certain things may not be feasible, then you may have very strong biospheric values, but you also have egoistic values and hedonic values, right? So you have to be reasonable what we expect from people as well and if there are certain constraints that can be reduced, I will do that and not like that people will do everything at any cost, the same time even if you say okay, so we already reduced the effort, we reduced the price still then remember that environmental aspect of it, but if people do it, you may profit and you make it may be longer lasting, if you remind people of that environmental side.

Kas Jansma 13:26

It's quite an extensive field of research, environment psychology, and, oftentimes in papers, they talk about theories that are used to explain certain types of behaviours. So, even if value-belief-norm theory often comes to mind and the goal framing theory is often used in by professor Steg as well, but I'm not really sure how these

theories are used to design strategies. Are they used to explain certain kinds of behaviour or can they also be used to design strategies to change that behaviour.

Goda Perlaviciute 14:03

So, the goal framing theory is a good example of what we just discussed. So very briefly, the goal framing theory suggests that people have different goals in a situation and you can also activate different goals. And these are the normative, the hedonic, and the gain goal. They relate a bit to the values as well. And the goal framing theory also says well, with with certain reminders or putting emphasis on different things, you can make those goals shift. So if you always talk about money, you may put people in this gain goal, right? Then always people are in this gain mindset mindset and they start calculating and as soon as it doesn't pay off all then why would I do it?

Kas Jansma 14:55

Yeah, and it completely stops and it's not attractive anymore

Goda Perlaviciute 14:59

yeah, but if you use more this, for example, environmental things that puts people more in this normative mindset or goal, that this is the right thing to do. And that can hopefully also last longer. That's sort of a moral compass then.

Kas Jansma 15:20

Okay. So, these theories, they can be used to, to design strategies long as you ensure that in your in, in your strategy, you pay attention to all these goals or maybe like the optimal distribution of these goals.

Goda Perlaviciute 15:35

Yeah, I think that those theories can help design interventions, but also evaluate because it gives you a framework of what may be happening, right? It may or may be it may be your intervention will not work, it can also happen. The theory can be still then a way forward like okay, what happened then with the goals and, and you have a way to synthesize the findings

Kas Jansma 16:02

Okay. So it's also really nice in terms of organization. So you can attribute certain types of your intervention to certain goals, and then say what works better and what didn't work?

Goda Perlaviciute 16:12

Exactly. And you can theorize further like, Okay, I see that not only reminding, but also something else influences what goals people have.

Kas Jansma 16:22

Yeah, okay. Okay, thank you for clearing that up. Because those theories for me, I really am beta student, so everything that isn't in numbers or in measures, it's, uh, it's difficult for me, but I really find it interesting to read about all these theories, because they are all used to explain certain things that are quite well, soft for me, like not hard. So it's, it's can be this or it can be that, somebody explains it in this way somebody explains in that way. And I find it difficult to distill a strategy from that. But as I understand these theories are more used to, to get some structure in design or an evaluation. Yeah. So in that way, it's easier to use them for

Goda Perlaviciute 17:08

Yeah, and to make choices. Like, what do you want to do with your intervention and, and also to test interventions, right? You can say, I will try both, I will try financial motives, and I will try environmental or maybe no intervention at all. And then we'll compare them right.

Kas Jansma 17:26

And that's the one thing that because the my supervisor already made a serious game ctually about public acceptance of energy generation. And it's called a WeEnergy game. And it's a game where students, they design their own energy mix for the Netherlands by pasting post-its on a map like with the area that is needed, and the power generation and the costs, and they consider that will, we always use the five P's.But this evaluation step is something that is really often forgotten, and really not considered, which is kind of weird, because they have

no idea if it works or not. So that's really something that I want to spend some more time on, because they haven't done that yet. So this is really helpful.

In the field of environmental psychology, there's quite a lot of research, but a lot of research is also pretty old already. Like, I found a lot of papers from like, early 2000s. And before 2000, would you say that there has been a lot of change in the last, say, five or 10 years and how the field approaches things?

Goda Perlaviciute 18:46

So environmental psychology, I would say, in very early stages, it was even more about how environments affect us. So environmental psychology was more about how do we feel in nature versus built environments, for example. Now, it really goes into this sustainability thing. Yeah, I think basically it flourished. It expanded. It's growing very, very fast. Yeah. And yeah, more different behaviours are being studied more, more new behaviour. So we also follow the energy transition, right? That's why we look at community energy initiatives. That's why we look at storage technology. That's why we look at system integration. So yeah, yeah, it keeps up. It keeps up with the with your field.

Kas Jansma 19:47

When I talk with my supervisor, we often discuss like, in terms of technology, we are already so far on what we can do and what we cannot do, but I'm also a student in science communication. So the communication part is also Really interesting for me, like, how do you because I feel that that's the part where we are selling short for now, like we know how to solve certain things. But we do not yet have the public acceptance and the support to start implementing all these, all these things and all the systems and all the strategies. So it's really refreshing to read about how environmental psychology approaches because it feels that there's a lot of overlap, actually. And that's really interesting for me,

So, for my final question, I just wanted to ask you, if you have any tips or recommendations for me, when I start designing the intervention strategy are things that I should reread or are like the essential

Goda Perlaviciute 21:19

well, it sounds that you are already well read into. I was very positively impressed, I must say, and you also have a good feeling for psychology too so that's

Kas Jansma 21:32

Okay, so I have no further questions. So if you, I guess you have a filled schedule. So I'll let you go.

Goda Perlaviciute 23:52

It was fun to talk to you. So good PLk in the project. And thanks. I think, yeah, I was really impressed.

Kas Jansma 24:00

Okay, thank you. Well, thank you for your time, and maybe we'll speak again sometime. Bye!

9.1.2 Interview with dr. Tania Ouariachi Peralta

3. Introduction: can you explain something about your background and field of research?
- "Serious games and sustainability"
    - o In this research, you mention that findings on sustainability games are contradictory in terms of their effectiveness. Can you elaborate on where you think this contradiction comes from?
    - o Playing a game can lead to an immersion, a state of flow. This would then lead to a change in attitude and with that a change in behaviour. Can you explain a little bit how you think this state of flow is attained in a game, and how this leads to a change in attitude and then behaviour?
    - o Most of your research is related to young people and digital games. Can you explain where this focus comes from?
        - ▪ Our focus is more on offline games and directed at home owners (older people), in what way are the conclusions from your research either relevant or irrelevant for this group?
- WeEnergy game
    - ▪ This game was played both offline and online. What were the key differences?
    - ▪ Some reflection on this game
- Analyzing Climate Change Communication Through Online Games: Development and Application of Validated Criteria
    - o A change in paradigm; from 'information deficit' to interaction. What is the role of games or what role can they play?
    - o "Every game has a message to transmit on what 'victory' means". In what way is this proposed 'world view' important in reaching goals of inducing behavioural change?
    - o Some dimensions are mentioned: narratives, content and gameplay. Can you elaborate on what these dimensions mean and what their relevance is in a serious game on sustainability?
    - o Recommendations for the design of the WeEnergy House game

Kas Jansma 0:02

So I read a few of your papers, some of your papers from the University of Grenada, but also some that you have published while working at the Hanze, so first, I thought maybe you could do an introduction on what your expertise is, and what you're doing right now.

Tania Ouariachi Peralta 2:06

Yeah. Okay. So yes, I am at the moment, I'm working as a lecturer, and as a researcher at Hanze University of Applied Sciences. And as a researcher, I belong to the group Communication and the Sustainable Society, where I focus on researching, basically, in general terms, innovative media in relation to climate change, and sustainability. And within innovative media, I focused in the last years on serious games, mostly, but then I have also done a little bit with gamification and a little bit with escape rooms, that research line. I studied it in my PhD, which I studied in 2014. I think. And since then, I have been working on the same topic.

Kas Jansma 3:04

Okay, so the serious gaming is really your interest. Do you like to play games as well?

Tania Ouariachi Peralta 3:14

The thing is that I focus on serious games. And like you mentioned, like, from my point of view of communication professional, so to use games as a as a tool to communicate, and to educate, especially use some these kind of environmental topics. So I mostly look at that, that side of what kind of messages they provide, or how they topics or frame and what impact etc. If I am a gamer myself, beyond the classical games, Mario Kart classical games, I'm not into that.

Kas Jansma 3:56

Okay, so but still the serious gaming? I mean, it's, it's quite interesting, I think.

Tania Ouariachi Peralta 4:01

Yeah, yeah, definitely. Like, I don't play myself as a hobby, if that's what you mean. But yeah, out of interest. And

Kas Jansma 4:11

I would say it's one of the more fun parts of communication to end up with the serious gaming section, because it really involves the playful part of communication, like helping evolve people using things that they probably like to do, like fun having fun and playing games. I first wanted to talk about your publication, Serious games and Sustainability. I think that is one that you did while working at the Hanze in 2019, if I'm correct, which also includes the WeEnergy game. So it is in this paper, you mentioned that the findings on the effectivity on sustainability games are quite contradictory still. I was wondering if you could elaborate?

Tania Ouariachi Peralta 4:58

yeah. Yeah, what I mean, I don't know if in the context of that paper or not. But what I mean with contradictory results is that some scholars say serious games are effective, while others say they're not very effective. Some say that they are effective for mostly awareness and knowledge, while others say also on attitudes and behaviour. Most of the research is based on case studies, story specific cases. And in those studies, there are many factors that influence the results, whether that is a profile of the players, the session itself that is taking place, and external circumstances or even the previous knowledge or the previous level of awareness that players have. So that makes it hard sometimes to arrive to very generalist conclusions. Also, research has mostly focus on effects in the short term, and not in the longer term. Like, okay, after two years, what do players remember of the topic? Or did they change some attitude? That might have to do also with the type of studies or the financing of studies themselves because taking these kind of longitudinal studies, where you see effects, many years after, then it is a bit harder.

Kas Jansma 6:37

it's very difficult. It's good to say that because I also recognize that from my from my preliminary study and the social on the psychology part, they also mentioned that the really a lot of the intervention strategies are focused on short term engagement. And then after a few years, it's hard to tell whether it still has an effect.

Tania Ouariachi Peralta 7:00

Yeah. But generally, apart from that, I think most of studies have noticed the effectiveness in awareness, mostly in their knowledge and to a very lesser extent to change in real attitudes and behaviours.

Kas Jansma 7:19

Quite a gap between the behaviour and attitudes. Yeah.

Tania Ouariachi Peralta 7:23

Other there are other gaming strategies like gamification, like apps, etc, those are more targeting the changing of behaviour. But I think that is not the main purpose of serious games. Or at least that's the effect. At least that's also what I have encountered in my studies with the two case studies that I have been dealing with one more WeEnergy, the other energy 2020 with teenagers.

Kas Jansma 7:54

Okay. So in the paper, it also talks about, like a state of flow that is attained within a game and that state of flow would then exhibit this change in attitude, at least and then maybe in change the behaviour. So the state of flow is it's quite unclear to me what this really means, like, is this something that you can measure? It seems kind of vague.

Tania Ouariachi Peralta 8:19

Yeah, I think these days, it is difficult to measure because there are different variables influencing that. For me, I usually take the conceptualization of flow from an alpha code I don't know how to pronounce so. But basically the author says that the importance of having a challenging activity that requires a skill, but that shouldn't be too easy or too hard. And that is some of the factors that influence the flow when it's too easy. When you don't feel that urge to continue when it's too difficult, then you'll give up so really, with having clear goals, having direct feedback for the end, would you actually with like a sense of control or a sense of empowerment with what you're doing?

Kas Jansma 9:42

This is really where we focus on that where I tried to focus on this self efficacy, we call it and so you mentioned setting goals is very important?

Tania Ouariachi Peralta 9:56

the challenging activity with a balance Frequently that goes into direct feedback that can create a sense of control.

Kas Jansma 10:06

So these are things that can be sort of embodied in the game design. Okay, cool. So I noticed that most of your research is focused on digital gains, and as well, and also younger people. Is this a particular focus?

Tania Ouariachi Peralta 10:32

Well, yeah, that was a decision I do. Like, at the beginning of my research with a PhD, was mostly I was interested in how you say, interactive tools, and getting close to the communicative paradigm of the youth. And because I wanted to focus on youth and even more teenagers, so because they are really are working, or used to online environments, digital atmospheres, and, and also to playing games themselves, mostly virtual, then I decided to focus on that, so it was more like looking for communication, tools that were interactive, participatory, immersive, and that they fit the communication paradigm?

Kas Jansma 11:33

So they say to the shorter concentration span that young people mostly have when playing virtual games or digital games? I recognize that within myself as well.

Tania Ouariachi Peralta 11:43

Yes. I mean, it's, I mean, of course, it is, it has his positive sites in they arealready used to work in online environments and our in digital environment cetera, but it is also important to be aware of the limitations or the negative sides know that. Yeah, to what extent being in a virtual environment will bring you also to an offline environment to take action on different things. And and also, how much time can you really be behind a computer without being damaged? You know, so, things have to be taken into account when we talk of, okay, benefits of online serious games, etc. We have to be cautious, also look at the context and the limitations.

Kas Jansma 12:38

Yeah. Okay. So and because the the game that we are designing is mostly focused on homeowners, probably older people, I guess. And also, I think it would play it offline. And because I think that the social part is really important for something like this. Do you think there are very there are key differences between designing a game for online? Well, obviously, if you design in an online game, you do it in a virtual environment? But in terms of communication strategy, do you think there are very important differences playing it offline?

Tania Ouariachi Peralta 13:10

There could be differences, I think with any communication strategy, you need to study first, your target group, and the target group is very different. We talk of teenagers or young adults or senior home owners. So yeah, I'm sure there will be different aspects in the kind of messages you are transmitting on how to frame the topic. On what are those dynamics game dynamics are more appealing to other people? No, perhaps younger people are more into competing or the people perhaps more into collaborating? No. So this type of player profiles might be different. Yeah, so I don't know exactly what the differences are, because I haven't really focused on this target. But yes, I'm sure you will have to do first a very good research for the target group.

Kas Jansma 14:10

So, how did you do that?

Tania Ouariachi Peralta 14:16

Well, the thing is, I haven't designed myself any game. So I have as a researcher, I have mostly identified what has been done or what kind of things have been done, I have analyzed them in terms of communication. And I have studied the impact of effectiveness but I have never developed that myself. For now.

Kas Jansma 14:43

You would you would like to design such a game. Okay, so that brings us to the WeEnergy because you were involved with the WeEnergygame, I guess. This was played both offline and online. Because of current measures, I guess that was switched to online. Did you notice any key differences in playing these games online as well?

Tania Ouariachi Peralta 15:05

To be hsomeone'st, the times that I have participated as a researcher or an observer have been mostly offline. I haven't. Like I have seen it online but we haven't really done experiments with effects of online. So, not sure. In reality, there are many differences.

Kas Jansma 15:26

Yeah. So but in the offline section, you noticed that it was useful.

Tania Ouariachi Peralta 15:33

Yeah. So basically, what we find out what we have implemented in with students at Hanze, and we did find out I was successful in achieving more of a cognitive engagement, so understanding the topic or having some knowledge. And to some extent, also, effective engagements so they are more concerned or (?). So making players get more practical insights into the energy possibilities, understand advantages. And overall be aware of the complexities.

Kas Jansma 16:16

I think I agree, as I played the WeEnergy game, during my, during, I think last year, during one of my courses for the environmental sciences master. So we played it as well. And what you mentioned, like the deeper insights in in the advantages and disadvantages, were really, I think they were communicated quite clearly using the cateogires and the labels and the bars. I think that was very nice.

Tania Ouariachi Peralta 16:38

However, the game is not really successful in motivating an attitudinal or behavioural change. But I don't think that was neither the main aspect, the main objective of the developers for the developers wanted was to spark all conversations for curiosity. Not for students, but for really city planners to start collaboration, so I don't think their main reason was we are going to change the behaviour of them. So then. Yeah, it's the

Kas Jansma 17:18

communication structure also changes. Of course, if you want to attain really attain a behaviour change, you usually need some deeper engagement to really learn something. Okay, so um, I wanted to move on to one of your other papers that you wrote at the University of Grenada, analyzing climate change communication through online games. This, I think this is really interesting, because it talks a little bit about the change in paradigm that is currently going on within the science, education and also science communication. We we heard a lot of the change in paradigm during the during my master's, I've been kind of engaged with it a lot. So this means so this is the change from the interface into information deficit model to their interaction. So do you think that serious gaming is maybe an embodiment of changes in direction?

Tania Ouariachi Peralta 18:08

Yeah, this is really with what I mentioned before. Games allow these two way communication somehow and other interaction and something very positive of serious games, especially for simulations is that you take actions and you see what the consequences are in the stable environment. And also it is, it's not static as for example, a message that comes from a traditional media; it is evolving. And also, in my research, we notice how messages are also a better frame like, not necessarily talking about climate change from an alarmistic tone, tone of voice or something that creates some psychological disturbances, there is nothing we can do about games usually have also a more proactive tone of voice, more encouraging and more informative. Okay, this is what happened. But this is also what you can do.

Kas Jansma 19:14

So we can change it and really in a positive, positive, playful way, like what you can do and really make it a goal to get that zero emission in your house. Okay, so in this research, you mentioned that the game has an every game has a message to transmit, what victory means so of course, when you play a regular game, you want to win most of the time. And you mentioned that did really depends on your worldview that is depicted in these

games on what victory means? Yeah. So in what ways is really important in reaching, reaching goals like behavioural change?

Tania Ouariachi Peralta 20:01

So you know games transmit messages. And these messages can be textual, audio, visual, etc. So through content, but they can also be through the game design and the game dynamics and mechanics. So it's important to take these into account. So for example, victory in games like Sims or SimCity, it was related with a competing with each other and making some money. So victory was really related to a bit of a capitalistic perspective or point of view. So that can be maybe contradictory with messages relating with sustainability and climate change, or maybe competing with each other, in order to win is not a direct approach. But perhaps it could be more about collaborating with each other.

Kas Jansma 20:58

So everybody stays happy. every stakeholder in the game is, is happy with the results, and you get a balance of positives.

Tania Ouariachi Peralta 21:07

So at the end clear directions have to be shown in the game, not just through the context and the message but also through the game mechanics. So at the end, the design of the game is very important also on what really victory means in that context

Kas Jansma 21:25

Okay, and so within this, this design of the game, you mentioned some dimensions, narratives, content and gameplay, this, I guess, this is what you said about that the design really is important for gaming, all these, these three aspects are really things that can also be used to, to establish what victory means and to really frame the communicative goal of the game.

Tania Ouariachi Peralta 21:51

So yeah, those dimension were identified. I think they were five identification, the narrative, the context, the game design, or the key aspects in the didactics. Oh, yeah, I'm seeing the game design part is very important. And it's one of those five components and it is also maybe the type of narrative context that you're using to educate players and they were actually identified as dimensions or categories that we should take into account as researchers or designers, etc. When analyzing or evaluating games or for creating games. So you can see all these five dimensions with different criteria that, as I mentioned, analyst evaluators or designers can take into account on Okay, what we should pay attention to. And that was the result of Literature Review mostly in Delphi method. I don't know you're aware of it? Yeah, it's like trying to collect the opinion from experts. In my case, there were experts from different fields, the field of communication, education and games, etc. and making them agree on what those dimensions and those criteria should be to analyze or evaluate serious games on the specific topic of sustainability or climate change. Maybe serious games on migration, require different criteria.

Kas Jansma 23:38

Okay, so using this Delphi method to establish these criteria was useful and successful.

Tania Ouariachi Peralta 23:44

Yeah, yeah, we went through two or three different rounds, until experts agree on what criteria should be in that tool

Kas Jansma 23:54

Okay, cool. So I understand that these these dimensions are really useful, both in the design of the game but also in the especially evaluation of the game like you can make fun.

Tania Ouariachi Peralta 24:05

Exactly, games are really out there. To have a better idea out there.

Kas Jansma 24:13

Okay. Thank you very much. And to finish maybe you have some recommendations for for the designs that we energy house game or specific things.

Tania Ouariachi Peralta 24:27

So I don't know if you read what I share with you these framework for climate change engagement through skills games, that I wrote also with maybach from the us and I can send it to you later. But basically, in that paper, we did a study where we come up with elements that recommendable for in general serious games in the field. I think it was more related to online games, but I think they could also be applicable for offline games. And there are important factors for engaging players are the cognitive, emotional and behavioural level because again, this is where you want to, to enable people to be concerned and think about that, but also feel connected and if possible, also to take some action. So there are elements like, yeah, like we mentioned before we they feel the challenge; challenge was important, so the balance of difficulty, and the fun aspect is also important. People are also having fun, where they are learning something. And then the relevance or the meaningful part, know that people feel really connected with what's going on.

Kas Jansma 26:03

So far, it's that they really feel that they are in control, and they can do something and they have fun exploring what they can do.

Tania Ouariachi Peralta 26:12

And of course, these meaningful part will be very different, according to which target group you are aiming at. As we mentioned before, it's not the same as of home owners that teenagers in school or young adults, etc. So I will I will send to you. Okay, and I've seen that, yeah, you have different criteria there. That was developed after having interviews with experts on games, about games that were related with serious games, most of them and others, like big scholars in the field, together with a group discussion with young people also on what aspects will engage them. Then we brought everything together. So I will send it to you.

Kas Jansma 27:02

Yeah. Okay. Thank you very much. Um, I think I guess that's it. I don't have any more questions. Thank you. Yeah, it was very nice. Well, thank you for your time. And I wish I did. And when I have some more questions, maybe I'll get back to you. But I guess you can follow the progress fee other abstract project as well. So thank you. Bye bye.

9.1.3 Interview with dr. Tineke van der Schoor (in Dutch)

- Background in andragogy (teaching adults, relevancy for current research?)
- "Voor een ingrijpende omslag als de transitie naar energieneutraliteit is draagvlak onder bewoners van groot belang" → Dat draagvlak, wat zijn de belangrijkste strategieën om die te vergroten?
- Communicatie, vormgeving, taalgebruik, niveau; recommandaties?
- In social psychology, often it is talked about barriers. Barriers for investing, becoming an energy producer. You describe this as obduracy, resistance to change. How does this obduracy precipitate in household energy use?
- To what extent is this community perspective relevant when looking at transitioning into zero-emission households?
- Recommendations for serious game
    - Rijnmarkt
    - Hoom coöperatief
    - Brochure nul op de meter → wat kan ik er mee?

Kas Jansma 00:00:00

(introduction) Waar bent u op dit moment mee bezig?

Tineke van der Schoor 00:02:55

Verschillende dingen. Het is eigenlijk een vervolg op mijn proefschrift over Community Energy, ik ben bezig met een project over netbeheer: kunnen lokale coöperaties ook de rol van aggregators spelen? Dat is een rol in die energiewereld. En hoe zouden ze dat dat aanpakken? Kunnen ze bijdragen aan het in balans houden van het energienet door het aanbieden van diensten?

Aan de andere kant ben ik ook bezig met een groot project over renovatie. Dat sluit heel erg hierbij aan. Dat gaat over de bewoner; hoe krijg je bewoners mee en hoe overtuig je ze eigenlijk om hun huis te gaan renoveren? Wat ik daarin doe is literatuurstudie naar Europese projecten, wat is er allemaal al geprobeerd op dit gebied, wat voor methodes zijn er onderzocht, waar zijn nou allemaal demonstraties van geweest van die Europese projecten, en wat kunnen we daarvan gebruiken? Dus het is wel leuk wat je nu vertelt! Veel raakvlakken.

Daarnaast doe ik nog projecten meer op gebied van historische gebouwen.

Kas Jansma 04:40

Dat is echt een aparte sectie in uw proefschrift, dat stukje. Wat maakt dat nou zo uniek? Is dat een heel ander verhaal als bij andere gebouwen?

Tineke van der Schoor 04:53

Heel veel standaardoplossingen kun je daar niet toepassen.

Kas Jansma 04:56

Omdat het een monumentaal pand is en dat in stand gehouden moet worden zeg maar.

Tineke van der Schoor 04:58

Ja, je kunt daar niet bijvoorbeeld zomaar de muren gaan isoleren, want dan zou je de historische waarde teniet doen. Datzelfde geldt natuurlijk ook voor binnensteden of beschermde dorpsgezichten, dan zou het dorpsgezicht natuurlijk totaal veranderen. Dan komt er dus een extra laag bij. Maar het zit wel eigenlijk als je het op een schaal ziet met renovatie; sommige gebouwen kun je een standaardoplossing inzetten en bij andere moet je wat meer over nadenken.

Kas Jansma 05:35

Het is dus een kwestie van hoe flexibel moet je zijn om elk gebouw te kunnen faciliteren zeg maar?

Tineke van der Schoor 05:45

(viel even weg)

Kas Jansma 07:00

Wat ik opvallend vond aan uw brochure *Nul op de meting*, daarin stond dat voor een ingrijpende omslag naar energieneutraliteit, dat draagvlak onder bewoners ontzettend belangrijk is. Daar ben ik het natuurlijk mee eens, maar ik vroeg me af: wat zijn de grootste barrières daarin op dit moment?

Tineke van der Schoor 07:31

Ik denk de grootste barrière op dit moment, is dat mensen de noodzaak ervan niet inzien. De huizen functioneren, de verwarming werkt gewoon, er is geen noodzaak vanuit dat huis om iets te doen. Huizen in Nederland zijn over het algemeen van goede kwaliteit. Bij huurwoningen ligt dat wat anders, daar heb je de coöperatie die kunnen ingrijpen om de slechts geïsoleerde gebouwen kan vervangen of renoveren. Daar is het ook moeilijk om mensen te overtuigen dat het echt meerwaarde heeft, dat het echt je comfort verhoogt, maar er is toch eigenlijk weinig noodzaak toe die mensen direct voelen, en het is heel erg duur. Dus iets waar mensen niet de noodzaak van inzien maar waar je wel 30 duizend euro voor moet betalen, tja

Kas Jansma 08:33

Maar is dat dan omdat ze de directe gevolgen van klimaatverandering niet zien of niet voelen in hun eigen leefomgeving?

Tineke van der Schoor 08:50

Ja inderdaad. En wat ook meespeelt, is het vertrouwen of het iets oplevert.

Kas Jansma 08:55

Aha, dus dat is de self-empowerment zeg maar. Het gevoel dat ze er invloed op hebben

Tineke van der Schoor 09:10

Ja, maar ook de garantie van ga ik ook echt minder energie gebruiken. Stel je hebt een groene motivatie om bij te dragen aan de energietransitie, dan nog wil je overtuigd zijn dat het ook echt helpt. Dat is ook wel een barrière, dat daar weinig garanties voor zijn.

Kas Jansma 09:25

Ja. Oké, en u had het net over sociale huurwoningen en huiseigenaren. Is er een van die twee groepen waarbij dit probleem meer speelt?

Tineke van der Schoor 09:50

Nou, je ziet dat coöperaties grotere stappen maken. Als je kijkt bijvoorbeeld naar het aantal woningen dat nul op de meter is gemaakt, dan zijn dat er echt veel meer in de coöperatiesector dan bij particuliere eigenaars. Dat is echt een gigantisch groot verschil van enkele tientallen naar meer dan tienduizenden. Die doelstelling, je hebt ook zo'n blog: duizend woningen per dag, dat is wat je eigenlijk zou moeten doen om de doelstellingen van 2050 te halen. Dus dat schiet niet echt op. De renovatiegraad is 1% per jaar gemiddeld, en dat wijzigt eigenlijk niet. Er zijn natuurlijk wel subsidies, iedere keer weer zijn er weer andere subsidies, en dat is goed want dan kan je elke keer weer andere mensen over de streep helpen. En wat ook een factor is, is mensen willen het graag wel in een aantal jaren willen betalen, dat ze niet in één keer dat geld hoeven neer te leggen en die sores in huis te hebben, en dat stapsgewijs kunnen doen. De afbetaling en de uitvoering,

Kas Jansma 11:32

Oh, dus ook dat je niet in één keer je hele huis van label g naar label a gaat maar dat je om de zoveel jaar een investering doet.

Tineke van der Schoor 11:42

Ja. Dat ligt er een beetje aan wat voor ingreep dat is, maar je hebt ook een hoop gedoe ervan. Rommel in huis, ja.

Kas Jansma 11:51

In uw proefschrift schrijft u vaak over Obduracy. Ik weet even niet hoe dat in het Nederlands gaat, koppigheid?

Tineke van der Schoor 12:05

Ja zoiets, weerstand of koppigheid

Kas Jansma 12:17

Oké. Maar wat zijn nou de belangrijkste strategieën om zelf dat draagvlak te vergroten, op welke manier kun je die mensen het beste meenemen?

Tineke van der Schoor 12:32

Nou een van de richtingen die we nu ook hebben bekeken is om te kijken of het helpt om met communities te werken, dus met lokale groepen, die dan in hun buurt activiteiten doen zoals je in het verleden had met aankoop van zonnepanelen, om dat gezamenlijk te doen, op dat gebied ook iets van een groepsgedrag creëren zodat je mensen motiveert en bij elkaar haalt, om dan zoiets te doen . En dan kun je o0k nog een wat goedkopere prijs bedingen en mensen helpen met het maken van keuzes. Want dat is ook heel gecompliceerd, een woning is eigenlijk een heel gecompliceerd ding. En dan heb je ook nog de woningen en de materialen die per jaargang bij wijze van spreken heel verschillend zijn, en ook wat er dan al gedaan is in zo'n huis kan heel erg verschillen.

Je kunt veel makkelijker een ontwerp voor een windmolen, een paar van die grote dingen, dan zet je ze neer en ben je met grote stappen snel thuis. Maar met woningen is dat niet zo, en dat maakt het voor die mensen ook lastig, want die moeten ook dan die kennis opdoen.

Kas Jansma 14:03

Aha. Dus die kennis moet op een bepaalde manier beschikbaar zijn, en in zo'n community zou dat beter werken omdat je er dan ook met elkaar over kan praten en dus ook groepsgevoel creëert.

Tineke van der Schoor 14:15

Ja. En dan kun je ook twijfels delen, en je kunt iemand in huis halen om er iets over te vertellen bijvoorbeeld. Als particulier, als individu ben je toch een beetje overgeleverd aan bouwbedrijven, installatiebedrijven, soms hebben die ook niet voldoende kennis. Dan heb jij misschien iets uitgezocht van: dat lijkt mij nou ideaal maar is dat ook geschikt voor mijn huis, dat weet zo'n installateur ook weer niet. Dat ontmoedigt ook. Dus door het samen te doen kun je in ieder geval meer kennis verwerven en meer kennis delen en dan kun je ook meer vertrouwen kweken bij de particulier.

Kas Jansma 14:55

En dat gaat dus niet alleen over beslissingen die ook echt samen gedaan zouden moeten worden zoals een warmtenet, maar ook over individuele investeringen in één huis zeg maar.

Tineke van der Schoor 14:15

Ja, dat kan ook gaan over isolatie of over HR-glas over dat soort dingen, of over welke subsidiemogelijkheden er zijn, dat dat in Nederland nog wel eens wil wisselen.

Kas Jansma 15:31

Ik zag dat u een achtergrond in andragogie heeft, dat vond ik wel interessant want daar had ik nog niet echt van gehoord. Dat is, volwasseneducatie, als ik het goed begrijp?

Tineke van der Schoor 15:44

Ja klopt, dat gaat over leren en veranderen van volwassenen. Ja die studie bestaat als zodanig ook niet meer, het is heel lang een afstudeerrichting geweest maar het zit meer in de richting van sociaal werk, samenlevingsopbouw, dat soort werk.

Kas Jansma 16:04

En dat is nu ook nog wel relevant in uw onderzoek denk ik, we hebben het natuurlijk over mensen leren over energietransitie en een bepaalde gedragsveranderingen bewerkstelligen.

Tineke van der Schoor 16:13

Ja precies, ik ben ook toen afgestudeerd op sociale bewegingen en die lokale energiebeweging is ook een sociale beweging van samendenken van: hé, wij willen dat graag anders doen en daarmee aan de slag gaan. Dus dit is gewoon een voorbeeld van een sociale beweging. Dus in die zin is die studie nog steeds wel relevant voor mij inderdaad. Maar dat is wel best wel lang geleden.

Kas Jansma 16:45

Die studierichting is nu dus een beetje omgevormd tot meer focus op publieke acceptatie van dingen en community based learning

Tineke van der Schoor 16:57

Ja, je kunt dezelfde vakken nu ook vinden bijvoorbeeld bij sociale psychologie en sociologie ook wel, en een deel ook wel bij bedrijfskunde als het organisatieveranderingen betreft, maar bij andragogie zaten al die dingen samen in één studie eigenlijk.

Kas Jansma 17:30

Oké.

Voor ons spel zijn we nog steeds een beetje zoekende naar dingen als hoe we taalgebruik en vormgeving of niveau van kennis kunnen integreren in het spel en hoever we kunnen gaan, ik zag dat u ook bijvoorbeeld in Paddepoel bent geweest om daar te vragen wat de barrières waren voor mensen, en ik vroeg me af of u misschien aanbevelingen heeft over hoe we bijvoorbeeld taalgebruik kunnen gebruiken, hoe moeilijk het moet of juist heel simpel, of bepaalde designs die goed werken, of is dat verschillend per groep?

Tineke van der Schoor 18:19

Hm. Nou, mensen haken wel af bij technisch taalgebruik. Niet zozeer bij apps ofzo, meeste mensen doen alles op internet, dat is nu zo wel wijdverspreid, er zijn maar weinig mensen die daar niet mee werken. Wat ik wel in een van die Europese projecten tegenkwam, daar was ook onderzoek gedaan naar de werking van apps en een van de conclusies was is dat je daarmee moet uitkijken; omdat het een gadget is vinden mensen het leuk maar dat zakt heel snel weer weg. De nieuwigheid is er gauw af en dan kijken ze er nooit meer op, ook niet als ze iets hebben met hun eigen huis. Dat was laatst ook weer over die slimme meter; dat mensen toch niet altijd de meterkast induiken, maar als ze zo'n ding hebben echt in your face, op de koelkast ofzo

Kas Jansma 19:25

(gelach) Dat je zo'n metertje hebt, elke keer als je het gas aan zet dat er zo'n metertje omhoog telt.

Tineke van der Schoor 19:30

Ja zoiets ja, dat je er toch elke keer aan herinnerd wordt; hoe je dat dan bewerkstelligt is een tweede natuurlijk, maar het zakt heel gauw weg. En met zo'n spel is dat natuurlijk ook een ding.

Kas Jansma 19:45

Ja dat is wel een ding. De belangrijkste strategie waar we op focussen is, wat ik net ook noemde, de empowerment, de self-efficacy heet dat dan; ik heb ook een paar interviews gehad met wat interviewers uit het environmental psychology veld, en die spraken veel over die self-efficacy. Dus dat mensen het gevoel krijgen dat ze echt impact kunnen hebben en dat ze er zelf iets aan kunnen doen en dat dat invloed voor ze heeft en dat het belangrijk is wat ze doen, omdat dat blijkbaar het gevoel is wat het meest mist en juist voor heel veel draagvlak kan zorgen. Dus het doel was eigenlijk om het spel zo op te zetten dat je het samen speelt dus niet per sé digitaal, nou op dit moment gaat dat natuurlijk niet zo goed, maar dat is wel het doel. Dus we hebben het idee dat dat daar ook aan zou bijdragen.

Mijn enige vraag is verder nog of u nog aanbevelingen heeft voor dat spel.

Tineke van der Schoor 20:45

Nou ik had nog wel de vraag; heb je ook gekeken naar die platforms die je tegenwoordig hebt voor renovatie, zoals van rijnmarkt? (nee) Die hebben ook een soort hele simpele stappen van: je vult wat dingen in en dat is dan je huis en drie klikken verder heb je een offerte aangevraagd en staat er vervolgens iemand voor de deur om het uit te voeren.

Kas Jansma 21:18

Dat is dan een platform vanuit de bouw?

Tineke van der Schoor 21:19

Ja! Er zijn er meer van, er schiet me nu alleen Van Rijnmarkt te binnen, maar er zijn meer platforms. Oh ja, Home, dat is een coöperatief iets. H O O M is dat.

Kas Jansma 21:43

Goeie aanvulling, anders vind je hem niet (haha). We doen het project samen met de GrEk, dus we werken wel samen met energiecoöperaties, we werken ook deels in opdracht van de GrEk, omdat zij graag met mensen die

energiescans willen uitvoeren, en zij willen graag dit spel met ze spelen om ze zo mee te krijgen in die investeringen. Dus het zal ongetwijfeld een beetje lijken op die platforms, maar ik denk dat het sowieso goed idee is om die ook te gebruiken als validatie voor het model bijvoorbeeld.

Tineke van der Schoor 22:15

Ja, dan kun je ook kijken naar: wat doen jullie beter zeg maar!

Kas Jansma 22:21

Ja precies. En ik kan me voorstellen, dat als je je huis wil aanpassen dat je dan ook opzoek bent naar iets van autoriteit, en dan zou zo'n installateur daar natuurlijk ook aan bij kunnen dragen, dat ze weten waar ze mee bezig zijn, of nouja dat wanneer er zo'n coöperatie bij betrokken is dat het dan beter gaat ofzo.

Tineke van der Schoor 22:45

Dat ze dan vertrouwen wekken. Ja, ik vroeg me ook nog af: ik had je geloof ik ook beantwoord met een brochure (nul op de meter) over renovatie. Die had je gelezen toch? (ja) Dat was allemaal vanuit de sector eigenlijk beschreven.

Kas Jansma 23:08

Ja dat vond ik ook wel interessant, want ik zag dat er meerdere professionals bij betrokken zijn, vanuit meerdere disciplines, dat vond ik wel heel interessant.

Tineke van der Schoor 23:27

En dan is nog, wat ik net zei: de duizend woningen per dag, de bouwhulpgroep, dat zijn hele praktische mensen maar die denken ook na over allerlei nieuwe oplossingen en die komen zelf uit de bouwsector, dus daar kan je ook nog op googlen. Dat zijn over het algemeen architecten, bouwkundigen, die echt hier heel erg met die renovatie bezig zijn.

Kas Jansma 23:49

Dus heel erg de praktische kant, dat is wel heel erg nuttig, dat missen we nog wel een beetje. Bedankt voor de tijd, en ik zal u op de hoogte houden. (afsluiting)

10 Appendix D: question form house specifications

Indicatie energievraag huis

Vragenlijst voor energieoverzicht huishouden

Voordat we aan de gang gaan met het energieverbruik van uw huis en mogelijke verbeteringen daarvoor, zijn bepaalde gegevens handig om alvast uit te zoeken.

1) Vraag naar energie

Om te beginnen kijken we naar uw jaarlijkse gas- en stroomverbruik. Die vindt u in de meest recente jaarafrekening van uw stroom- en gasleverancier.

Onderdeel huis	Waarde	Eenheid	Opmerking
Jaarlijks stroomgebruik		kWh/a	Bijv. Jaar 2020
Jaarlijks gasverbruik		m³/a	

2) Omvang van uw huishouden

Een groot gedeelte van uw gasverbruik komt door het verwarmen van water. Een groter gezin verbruikt dus meer gas, omdat er vaker gedoucht wordt en dus meer water wordt opgewarmd.

Onderdeel huis	Waarde	Eenheid	Opmerking
Volwassenen		Personen	
Kinderen		Personen	

3) Grootte van uw huis

Om goed te kunnen bepalen waar de warmte in uw huis heengaat, zijn de afmetingen van het huis erg belangrijk. Hiervoor kunt u het beste de oppervlakte van uw ramen, muren en vloeren meten met een meetlint. Dit hoeft niet op de centimeter nauwkeurig. Als een vloer 2 bij 3 meter is, dan wordt het oppervlakte (2 x 3 =) 6 vierkante meter (m^2). Meet al uw muren (inclusief raam, die wordt er in het model vanaf gehaald) en tel dat bij elkaar op; doe hetzelfde voor de ramen, deuren en het dak. Daarnaast is het nuttig om te vermelden of er (en zo ja wat voor) isolatie er in de vloeren en muren zit.

Onderdeel huis	Waarde	Eenheid	Wat voor isolatie of glas?
Vloeren		m^2	Bijv. geen vloerisolatie
Vloeren		m^2	Bijv. vloerisolatie piepschuim 10 cm
Buitenmuren		m^2	Bijv. Spouwmuur leeg
Buitenmuren		m^2	Bijv. Spouwmuurisolatie 10 cm
Ramen		m^2	Bijv. enkel glas
Ramen		m^2	Bijv. Dubbel glas
Deur		m^2	Bijv. Hout enkel glas
Deur		m^2	Bijv. Hout enkel glas
Dak		m^2	Bijv. Schuin dak geïsoleerd 5 cm
Dak		m^2	Bijv. Schuin dak geïsoleerd 5 cm

4) Warmte-opwek in uw huis

Er zijn verschillende manieren om warmte te besparen en om warmte op te wekken. Over het algemeen wordt dit gedaan door een HR-ketel, maar als u een hout- of palletkachel, een warmtepomp of een gashaard gebruikt is dat ook nuttig om te weten.

Warmteopwekking in huis	Kruis aan	Opmerkingen
Condensatie (CR) Ketel		
Hoog Rendement (HR) ketel	X	
Hybride Warmtepomp		
PLht water Warmtepomp		
Grond Warmtepomp		
HR-E Ketel (warmte en stroomproductie)		
Hout- of palletkachel		
Gashaard		
Anders namelijk _____		

5) Verspreiding van warmte in uw huis

De geproduceerde warmte wordt vervolgens in een ruimte afgegeven door bijvoorbeeld een hoge-temperatuurradiator. Sommige huizen gebruiken vloerverwarming, kruis dit hieronder aan.

Onderdeel huis	Kruis aan	Opmerkingen
Hoge temp radiatoren		
Lage temp radiatoren		
Vloerverwarming		
PLhtverwarming		
Anders namelijk _____		

3) Aanwezige besparingsopties of duurzame productie

Als u niet precies weet wat de termen hieronder betekenen of u weet het niet zeker, laat het dan leeg.

Onderdeel huis	Aantal	Eenheid	Wat voor isolatie of glas?
Warmteterugwinning ventilatie		Stuks	
Douchewarmte terugwinning		Stuks	
Warmtepanelen op het dak		Stuks	
Zonnepanelen op het dak		Stuks	
Anders namelijk _____		Stuks	

11 Appendix E: report online session Ameland

Original author: Jelmer Steenbeek

Datum: 07/04/2021

Aanwezig: _EA, CA, PL, EA, Kim van Dam, Frank Pierie, Jelmer Steenbeek

Onderwerp(en): Het presenteren en doorlopen van het huismodel. Een voorbeeldhuis wordt ingevoerd en de stappen doorlopen om te laten zien hoe het werkt en feedback krijgen van de groep, ook om te testen hoe verloopt het proces. Ideeën gedeeld over hoe het model uit te rollen in het dorp.

Tijd start: 13:00

Tijd einde: 14:30

Agendapunten

- Intro

- Frank loopt het model door met gegevens van huis van EA

- Feedback/discussie

- wvttk

Samenvatting:

1. Opstart door Kim

2. Reflectie vorige meeting Nulmeting (Jelmer)
- Nulmeting klaar voor eind april incl. methode, reflectie, en nulmeting Buren
- Label nog steeds interessant voor nulmeting kijkend naar isolatietool. Kijk wat aanvullend interessant is voor isolatie en regiotool
- Er was wat verwarring omtrent input isolatietool en nulmeting, dit gaan we duidelijker communiceren

3. Isolatie tool voor in huis
- Hoe gaat het met de bewoners die geen kennis hebben van isolatie?
- Hoe maken we het "enthousiast makend voor bewoners"
- Resultaten uit de tool moeten duidelijker
- Wel geeft de tool een mooi totaalplaatje van alle mogelijke acties in huis in plaats van gefragmenteerd aanbod markt per individueel onderdeel e.g. zonnepanelen, warmtepomp, isolatie
- Hoe kan je mensen op verschillende manieren bereiken? Kijkend naar bijv. CO_2 of winst of comfort of....
- Gebouwde omgeving is op ameland grootste energievraag dus tool kan erg nuttig zijn, hier moet ook vol op ingezet worden.
- Opleiden energiecoaches interessant maar mischien is Ameland al iets verder daarin dus iets meer complexiteit met bijv. de tool kan de volgende stap zijn.
- Dus liever van energiecoach naar expert
-

4. Verdere aanpak tool
- Idee is om test groep samen te stellen binnen buurtverreniging die de tool gaan uitvoeren. Tegerlijkertijd kan er gekeken worden hoeveel werk het is en hoe we de mensen het beste kunnen bereiken
- Er moet een goede handleiding voor de tool komen en voor de metingen die bewoners zelf kunnen doen
- Hoe haal je mensen binnen om mee te doen e.g. interesse of beloning
- Wij moeten ook aan de controlegroep vragen wanneer ze mee zouden doen en wat hun motivaties dan zijn
- Een andere optie is om een junior energiecoach programma op te zetten via de scholen

5. Planning, acties en timing
- EA gaat buurtvereniging vragen voor geinteresserde huiseigenaren
- Frank gaat handleiding verder uitwerken voor bewoners en professionals
- Jelmer gaat nulmeting verder afronden
- Jelmer gaat verslag maken

Verslag

1. Intro kim

Terugblik nulmeting, korte update: stand van zaken. Verwarring van PL kort besproken, hij gaf aan dat het verwarrend was hieruit blijkt dat een handleiding en duidelijke communiEAtie nodig is voor bewoners om de juiste data te vinden.

2. Update Nulmeting

Verslag gemaakt, door inzichten meeting aanpassing in het rapport. Verwacht dat het rapport en de nulmeting eind april klaar zijn. Bij deze meeting ook meekijken en letten op het proces, dus feedback van PL als voorbeeld was ook waardevol als inzicht in wat nog niet duidelijk is.

3. Huis model presentatie Frank

Mooi overzichtelijk plaatje, uitleg bedoeling. – in uitleg wordt gezegd dat het gebruikt moet worden door energiecoach of expert bij mensen thuis, misschien is het goed om niet de nadruk te leggen op bij mensen thuis maar ook mogelijk via een onlinegesprek. (Op de ipad wordt gezegd, maar kan ook op PC zijn, in een andere plek).

Huis van EA blijkt goed voorbeeld, er staan veel van op Ameland.

Actiepunt: zoeken hoeveel dat zijn, mogelijk goeie casus, voorbeeld voor vergelijkbare woningen.

Uitleg 3 stappen kan misschien duidelijker, met voorbeelden, zodat later in het proces overzicht wordt gehouden over welk stadium we in zijn, wat er nog komt.

Vraag van PL: wat als mensen niet weten hoe hun huis is geïsoleerd.

Kim: herinnering even inzoomen, iets te klein. Inzoomen en (highlighten) kan heel handig en belangrijk zijn om mensen mee te nemen in het proces, dat ze goed weten waar kijken we nu naar – dus tip om soms ook overdreven veel inzoomen op gedeeltes.

Vraag CA: hoe weet je wat goed of niet goed geïsoleerd is? Antwoord: de waarden kunnen worden aangepast in de database, Aanvullend van kim: kan afgeleid worden uit bouwjaar en input van bewoners. Misschien is het goed om in handleiding minder categorieen te hebben, om het makkelijker te maken om in te vullen.

Model neemt niet warmtebruggen mee in de berekeningen. Dus misschien ook goed om te combineren met warmtelek foto's.

Gesprek gaat wel redelijk over technische aspecten maar kost niet heel veel tijd, goed dat er uitleg over is, kan zijn. Model neemt mechanische en natuurlijke ventilatie mee.

EA voegt toe hoe het werkt met afmetingen, totale geveloppervlakte min oppervlakte ramen. Dat dat wel duidelijk moet zijn voor bewoners.

Kim: het is wel even werk voor de mensen die dit gaan invullen – goed om iets meer duidelijkheid te hebben, en onderscheid tussen, wie wat invult: is het de adviseur of de bewoner zelf die metingen doet en dingen invult?

Kim: verduidelijking dat de grijze vakjes oud/bestaand/huidige situatie zijn, en groen de nieuwe. EA voegt toe: is het niet mooier om dat 'Bestaand' te noemen? Dit wordt aangepast. – Misschien nog beter om het 'Huidig' te noemen?

Gesprek gaat nu wel meer over technische details ipv het model gebruiken om goeie schattingen te maken. Gesprek over wat voor glas uit welk jaar, dit zijn wel goeie gesprekken voor bewustwording van bewoners, zoals blijkt uit wat EA doet, zij gaan opzoek en willen het weten, hij gaat zn huis rondlopen om het uit te zoeken.

Reminder Frank: het hoeft niet 100% accuraat. Om mogelijkheden te vinden, niet precieze berekeningen maken.

   – goed om dit ook eerder te benoemen.

PL: heel weinig mensen weten iets over U waardes en hoe precies geïsoleerd.

   Gesprek gaat veel over kleine details, dat is waarschijnlijk niet de bedoeling met bewoners, dat zal dan ook sneller gaan dan in dit geval.

Kim grijpt in om volgende stap te introduceren. Belangrijk om zo mensen mee te nemen en focus erbij te houden.

Stroomverbruik planner

Frank ging er snel doorheen wat goed is om tijd te besparen.

Resultaten

Kim vraagt om ons meer mee te nemen. Uitleg wat zijn de grafiekjes en waar zien we wat? - hier mogelijk ook goed om wat meer dynamisch in en uit te zoomen, en duidelijke cursor kiezen. Dit is trouwens nog belangrijker als er opnames worden gemaakt van dit soort sessies, dat is vaak in lage kwaliteit dus nog lastiger om kleine dingen te zien.

Opmerking EA: vaak staat de label van een apparaat erachter of is ingebouwd, dus dat wordt gokken – hand-vatten nodig om een goeie gok te maken over apparaten?

PL merkt op: je ziet dus in dit model waar je de grootste besparingen kan halen. Positief dat hij dit ziet. Beves-tigd ook dat het hier om gaat en niet om precieze berekeningen van energie scenario's of iets waar offertes op gebaseerd kunnen worden.

Kim: kosten van aanschaf meegenomen? Ja, gemiddelde.

EA vraagt: en die 550, waar zie je die? Dit laat Frank zien – belang van dynamisch inzoomen en aanwijzen met de cursor (omdat het via een Teams scherm het toch wel kleiner is dan op je eigen scherm).

0.30 in recording

Weer springt kim bij om te benadrukken dat het nu op een ander tabblad en andere stap staat. Huis productie planner.

Herinnering EA: kosten van vastrecht van het gasnet. Dit maakt een behoorlijk verschil in kosten.

CA vraagt over de kosten: zitten hier ook de kosten bij van vervangen van apparaten? Ja die zitten erbij in, dus totale kostenplaatje van alles wat aan wordt gepast.

Vraag van EA over prijsstijging in stroom en gasprijs – kan effect hebben op terugverdientijd, dit wordt wel ge-adviseerd door EA, gemiddeld prijsstijging van 6% per jaar. Dit is nog niet meegerekend. Je kan wel een gemid-delde nemen en invullen bij stroom- en gasprijs, en frank kan ook een percentage instellen. Frank: maar het is wel een glazen bol, je weet nooit precies hoeveel het gaat zijn in de toekomst dus gemiddelde prijs is misschien beter om te gebruiken.

Frank: hoe precies willen we het weten. Zoeken balans, zodat het begrijpelijk en invulbaar blijft voor bewoners.

CA: het invullen van tevoren gaat lastig worden, mensen weten het vaak niet, veel onzekerheden. Dit blijkt uit de enquêtes omdat daar al weinig informatie in terug kwam. Of het dak/muur wel/niet is geïsoleerd etc. Hoe kom je erachter? Zelfs het aantal bewoners is niet helemaal duidelijk omdat ze vaak verplaatsen. Vooral het plaatje ' huis isolatie en warmte planner' wordt een uitdaging.

Antwoord frank: je krijgt een discussie en je zet ze aan om erachter te komen wat het is, en kan het met de tool ook berekenen. Wat ook kan is het gebruiken van de energie labels, als gemiddelde schatting.

Kim: vrij fundamentele vraag, we hebben niet zomaar het antwoord erop. Beginnen met koplopers en mensen die er redelijk verstand van hebben. Het moet ook niet zomaar door het hele dorp gaan, maar misschien met behulp van een energiecoach of expert. Je kunt ook mensen natuurlijk er niet toe dwingen.

Jelmer: er zijn ook wel manieren om goeie schattingen te doen. Belangrijk dat het een goeie schatting is, je hoeft het nog niet precies te weten. Mensen moeten geïnteresseerd worden, weten wat de mogelijkheden zijn, en op dat punt komt een isolatie of warmtepomp expert langs om de precieze berekening te maken, en offerte opstellen.

CA: over hoeveel inwoners gaat het dan eigenlijk? Wordt niet antwoord opgegeven, blijkt dat we dit nog niet weten. Discussie volgt later over hoe het uit te rollen, en met hoeveel mensen dit kan/zal zijn.

PL heeft er ook twijfels bij, m.b.t. wie er wanneer in zit. En wie wat weet. Er zit ook zo veel verschil in per seizoen, bewoners, gasten, zomergasten, etc.

CA: het is wel iets wat een keer gedaan moet worden. Je moet een keer die inventarisatie maken, huiseigenaren moeten gewoon door zo'n proces heen.

CA: hoe gaat dat met mensen die niet echt geïnteresseerd zijn? We kunnen het niet verplichten. Er zullen mensen zijn die het meteen willen maar ook mensen die er zelfs op tegen zijn. Vanuit oogpunt van dorpsbelangen wil ik er wel achter staan dat wij de bewoners enthousiast kunnen krijgen. Niet dat ze denken oh daar zijn ze weer met hun isolatieverhaal.

Kim werpt blik op de toekomst voor het uitrollen van dit systeem. We kunnen niet op korte termijn door een heel dorp gaan. We kunnen wel wat met de koplopers doen maar dan ook samen denken hoe kunnen we dit langzaam en zeker beschikbaar maken op de lange termijn. Binnen welk project past het etc.

CA: de mensen die geen zin hebben, niet mee bemoeien, middengroep en koplopers op focussen, om het model te stroomlijnen en te testen. Bottleneck zit in de middengroep die niet veel meningen heeft. Wat wij moeten voorkomen is dat wij iets willen van die groep. Gemeente of dorpsbelang moet niet wat van de bewoners willen, zij moeten het zelf willen. Hij ziet wel in dat er waarde in zit, maar bewoners moeten dat ook kunnen zien. Wij moeten het aantrekkelijk maken.

Deze discussie wijst er wel op dat er nu al na wordt gedacht over de uitrol van de tool, dus dat ze er wel positief over zijn, en alvast denken aan waar we later tegenaan kunnen lopen.

Kim benoemt energiecoaches, campagne binnen het dorp om mensen te verleiden om aan te melden.

Frank: waarde ligt ook in het mensen activeren, bewustwording,

CA: er zijn nu heel veel partijen in de markt die hier vol op inspringen, die kijken alleen naar de verdientijden binnen wat zij aanbieden. De voorlopers hebben we al gehad, maar de grote bulk zit te wachten omdat ze geen perspectief krijgen van al die verschillende markt partijen. Die partijen werken niet samen. Zo'n totaalbeeld daar kan je die kloof mee overbruggen. Dus ik zie daar wel het voordeel voor de consument. Dat moeten we nog wel beter verwoorden. Dat je hiermee een totaalplaatje krijgt, niet alleen van de koelkast verkoper en de dak-isolateur, die kunnen hun eigen verhaal wel verkopen, maar het totalenplaatje. Dan blijft er nog wel de personeel kant, van hoe worden mensen voldoende ondersteunt bij het invullen van zo'n model, maar de verkoopbaarheid van het model zie ik wel in.

Jelmer: misschien ook goed om te kijken naar mogelijk winst voor bewoners, van archetype woningen, om te laten zien er is ook financieel winst te behalen. Na de tvt, hoeveel winst levert het op? Als mensen het zien willen ze misschien ook zien voor hun eigen huis.

Reactie kim: er zijn mensen ook anders gemotiveerd, en door de nadruk te leggen op wat het allemaal kost, dan is het voor mensen misschien ook een drempel.

Frank: disclaimer dat wij niet 4% rente garanderen. Maar wel verschillende mensen op verschillende manieren prikkelen, de ene kijkt naar geld, de ander naar emissies, hoe bereik je verschillende soorten mensen.

4. Verdere aanpak van de tool

Over uitrol van het model, dat kun je niet zomaar doen. Het is zoals EAzegt ook wel lastig. Niet dat wij dat allemaal moeten organiseren maar we moeten het wel aantrekkelijk maken voor mensen om met zo'n tool aan de slag te gaan. Voorstel hier nog over te hebben op later moment, i.c.m. convenant duurzaam Ameland. Is dat een idee?

EA: gebouwde omgeving is wel de grootste uitdaging van alles. Voor Jelmer en Frank: de energiestromen van het eiland hebben wij in kaart gebracht, en de gebouwde omgeving is daar verreweg de grootste van. Dus daar gaan we wel de focus op leggen. Dus alle tools die we daarvoor kunnen gebruiken die moeten we wel inzetten. Dus lijkt mij goed om daar nog goed over na te denken.

CA: Ja dat denk ik ook wel. Je komt in een fase dat je mankracht erop moet zetten dus juiste moment om zo'n tool te gebruiken. Vanuit het rijk zal daar wel iets voor komen, wat dat precies is dat is nog niet zeker. Wij zouden daar nu al over na moeten denken.

PL: Er is ook geld voor, voor energiecoaches.

Kim: ook de waddencampus, en het IWP, dat we er studenten op kunnen zetten. – even stilte, en geen reactie op.

PL: ik vind het heel erg moeilijk, hoe **krijg je mensen geïnteresseerd om dit te doen?** Je moet misschien gericht opzoek naar de juiste mensen. Mensen die al veel aan hun huis hebben gedaan moet je niet hebben, je moet gericht opzoek naar de categorie waar we warmtescans hebben gemaakt, en wat er valt te winnen voor hun.

EA: eerst enthousiastelingen die nog niks hebben gedaan, als ambassadeur voor het geheel, als die anderen spreken worden die voor gemasseerd.

PL: ja als je die mensen kan vinden, dat werkt.

CA: groep van 10-12 om mee te starten, kan je kijken of het wat is en waar loop je tegenaan. Dat als proefpersonen titelt voordat je het breder uitrolt. Echt zien te achterhalen wat je nodig hebt. Het is nu te vroeg om het meteen breed te trekken. Als je tegen dingen aanloopt kan je het in het programma meenemen.

PL: misschien zie je dan ook dat er vergelijkbare situaties in het dorp zijn, dan kun je het voor die mensen invullen.

CA: er zijn hier anders dan op het vaste land heel veel verschillen qua verbruik en bewoning van huizen, en verschillende typen en gezinssamenstelling. Je zit ook met verhuur van kamers en appartementen. Er zit bijna geen vastigheid in.

Kim: ja goeie om het via mensen die dichter bij jullie staan om het eerst mee uit te rollen, in een praktijktest, kijken hoe het loopt.

PL: heb je bijna wel een vaste begeleider voor nodig.

Kim: ook kijken wat er via ons mogelijk is, maar is wel goed om het vanuit het dorp te doen. Vanuit Ameland, met begeleiding.

Frank: de hoop is ook een olievlek aanpak: je begint misschien met EA, en als hij 3 of 4 mensen kan opleiden om het ook te kunnen gebruiken, die kunnen het dan ook verder brengen, dus niet 1 persoon verantwoordelijk maar een groep. Die testaanpak is goed, dan maak je de tool sterker, hoe je het kan brengen, niet alleen om de techniek maar ook om de beleving.

Discussie over energiecoaches en wie expert genoeg is om advies te kunnen geven op een hoog niveau. PL was er geen fan van: dan kom je snel in de rol van installateur, en pak je iemands rol van op het eiland, dan zit je misschien zo bij iemand waar je helemaal niet wil zijn. Gevoelig, persoonlijke dingen waar ook rekening mee moet worden gehouden. Mensen zijn nu op het punt dat ze stappen vooruit willen zetten, en vragen kunnen stellen, niet een vrijwilliger die er een beetje vanaf weet.

CA: ja dan zit je op het niveau van dit model, echt gaan inventariseren wat er mogelijk is.

Kim: je hebt dus wel een energie-expert nodig die dat kan. Een EA bijv.

CA stapt uit de meeting.

PL krijgt er ook vertrouwen in dat de mensen langzaam wel die kant op gaan en dat het wel zal lukken. Moeten nog kijken hoe we het met personeel kunnen bemensen.

Kim: kunnen we die 10/15 mensen gebruiken voor het model? Combinatie Frank, EA en Jelmer, die mensen bedienen?

CA: de tijd die we erin steken om de gegevens te halen van die 10/15 mensen, als wij een hele hoop tijd erin steken om gegevens te halen, dan hebben we een hoop, maar dan kan je niet zeggen dat het bij andere woningen wel lukt.

EA: belangrijk om een goeie handleiding te schrijven voor welke informatie is nodig, en de bewoner zelf het werk laten doen.

- Actiepunt om dit te maken. Dan bespaar je tijd van ons.

Kim: mensen moeten een groot deel zelf in te kunnen vullen, die meting te doen. Belangrijk om die rollen goed te schetsen.

CA: ja dan moet je ze wel enthousiast maken om mee te werken, om daar tijd in te stoppen die hebben misschien helemaal geen zin om het uit te zoeken. Dat is een hele grote categorie, dat is jammer maar is wel zo. Die willen misschien wel maar lopen ergens tegenaan en dan zeggen ze laat dan maar. Dat is zo jammer dan dat je ze niet binnenhaalt. Moet je ze wel goed begeleiden.

EA: of belonen, net als we met die ledlampen doen. Ze krijgen lampen voor het inleveren van die vragenlijsten. Daar creëer je ook wat commitment mee.

PL: vraag het ook aan die 10/15 mensen, "waarom zou je hier wel of niet aan meedoen, wat zou je over de streep trekken?". Dat soort dingen moeten we ook beeld van krijgen. Tijd van begeleiding van iemand moeten we ook bijhouden.

PL: Idee om met scholieren de inventarisering te doen. Als een kind met zo'n opdracht thuiskomt luistert iedereen.

5. Afsluiting Kim:

Wij maken verslag hiervan, en opzet voor handleiding. EAgaat vragen bij dorpsbelangen of wij 10/15 mensen bij elkaar kunnen verzamelen. Dan kunnen wij er april/mei mee aan de slag. Dan is er nog even tijd om te denken hoe we het precies gaan doen. Wij (Kim en de groep van Ameland) spreken elkaar ook voor die tijd.

12 Appendix F: report live sessions Ameland

12.1 Tijdlijn

13:15 entree met CA

14:00 PL, CA, EA en EA sluiten aan.

14:00 – 16:45 regiomodel-sessie

- 15:00: PL vertrekt voor een uur
- 16:00: CA vertrekt, PL is terug

16:45 – 18:00 huismodel-sessie

18:00 – 19:00 diner

19:00 – 21:30 huismodel-sessie met dorpsbelang Buren (CA, Player 2, Player 4 (vertrekt om 20:00), Player 3 (naam niet opgeschreven)). EA ook aanwezig.

12.2 Inleiding sessie

- Inleiding van gehele roadmap door Kim & Frank
  - o Al vroeg in de presentatie wordt nadruk gelegd op de sociale roadmap. Ook door PL over het vraagstuk participatie: "Dat is het belangrijkste, dat zeggen wij al vijf jaar. Misschien is het ook wel het moeilijkste, welk verhaal moet je vertellen? Misschien is het beter om eerst te luisteren". Overigens vindt hij het woord participatie niet fijn
  - o In de presentatie staan wat jargondingen en er wordt vrij diep in gegaan op hoe het model in elkaar zit, dat is wat lastiger te volgen. Daarnaast staan er wat spelfouten in (gebasseerd, buisinesscase), dat komt slordig over.
  - o De uitleg over Excel valt goed, participanten zijn het eens met de uitleg en de argumentatie waarom Excel wordt gebruikt
  - o De tijdlijn roept wat meer vragen op. CA merkt op dat die tijdlijn voor iedereen anders is. Het lijkt een rechte lijn, maar het is het niet. Tool kan ook een manier zijn om het gat te verkleinen tussen verschillende mensen die in een verschillende fase zijn.
- Nulmeting
  - o Voornamelijk papierwerk, maar later in de presentatie blijkt wel hoe nuttig die meting is. Hij blijkt namelijk niet helemaal te kloppen.
  - o Er wordt benadrukt dat het WIP is, dat de data waarschijnlijk anders is. Die informatie is wel beschikbaar middels enquêteringen, maar nog niet gebruikt in de meting
- Korte inleiding huismodel
  - o Anekdote van collega met stiekeme houtkachel werkt goed, die erin houden
  - o Het gaat al vrij gauw over het belang van inzicht in geld, PL benadrukt dat dat inderdaad bij veel mensen het belangrijkst is. Er ligt bij de gemeenteraad een voorstel om vanaf volgend jaar een duurzaamheidslening te kunnen afsluiten voor bewoners die willen investeren in hun huis.
  - o EA heeft wel oren naar het gebruik van het huismodel
- Regiotool
  - o Ook bij deze inleiding gaat het veel over geld.
  - o Het gaat kort over het zonnepark, die heeft een slecht jaar gehad vorig jaar. "dan kun je hem beter uitzetten" wordt genoemd. Dat gaat natuurlijk alleen over de financiële kant ervan, niet over duurzaamheid.
- Resultaten/overzicht/concluderend
  - o In de presentatie wordt vrij diep op het model in gegaan, dat is soms lastig te volgen.

- o PL benadrukt nogmaals dat ze eerder iets geprobeerd hebben met informatie over de huidige energiesituatie, maar dat ze daar niet aan begonnen zijn omdat de informatie die gebruikt werd veel te generiek was en daarom niet van toepassing op Buren. PL: "je moet te allen tijde voorkomen dat de informatie niet goed genoeg klopt, want dan haken mensen af". Dit lijkt vooral de situatie bij de regiotool te zijn, je zoekt naar een balans tussen algemeenheid (snel, overzichtelijk, niet 100% accuraat) en specificiteit (accuraat, uitgebreid, arbeidsintensief om te meten).
- o Nu wordt het duidelijk voor de participanten dat het model gebruikmaakt van een soort toetsing. Je vult in wat je weet, als dat klopt ga je verder, zo niet kijk je waar het schort. Zo kom je iteratief tot een vrij accurate weerspiegeling van de werkelijkheid. CA ziet dat wel zitten. Dat is wel belangrijk om te benoemen bij beide modellen (regio en huis)
- o **PL** is bang dat het heel veel tijd gaat kosten om de minimale accuracy te behalen. Te veel om in hun plan te passen? Kas en Frank benadrukken dat die tijd wel echt nodig is om succes te garanderen; anders verliest het veel kracht. Kim geeft anekdote Foxwolde; het gaat mond-op-mond, het is een proces. PL: maar hoe past het in *Buren geeft Energie?* Dat is de vraag. We zouden in deze sessie wat concrete stappen kunnen afspreken (is uiteindelijk niet gebeurd). Frank benadrukt dat het ook verder loopt in het volgende project (Coöperatief in Balans).
- o **EA** benadrukt dat het nog te ingewikkeld is voor de gemiddelde bewoner om aan te haken, dat er nog een versimpeling/vertaalslag nodig is. PL beantwoordt dat het huismodel kan worden gebruikt vanuit het energieloket, als tool voor EA om mensen te helpen met die vertaalslag.
- o Eindconclusie PL: we moeten eerst de vraag accuraat hebben door in ieder geval een voldoende representatieve invulling van alle huizen in Buren te hebben. Dat is er wel/kan gedaan worden. Ook kan het huismodel gebruikt worden om die invulling deels aan te passen, mits er een accurate groep wordt behandeld.
- o Er wordt nog opgemerkt dat de waddencampus gebruikt kan worden om het huismodel door te lopen met bewoners bijvoorbeeld, dat zou wat tijd opleveren.
- o Voor vanavond wordt benadrukt door EA, EAen CA dat de presentatie meer vanaf het begin moet, iets laagdrempeliger. Het bestuur van dorpsbelang staat er vrij neutraal in namelijk.
- o Vraag Kim: hoe zit het met de type huizen? Is het representatief vanavond? Nee, het zijn wat oudere woningen, en er zit een huurwoning bij. Ameland heeft een bijzondere situatie met veel appartementen/airbnb's/etc. Maar, voor huurwoningen geldt dat de eigenaar minstens net zo graag wil verduurzamen als de bewoner (dat zien we ook in Groningen terug). Ook voor nieuwbouwwoningen is het interessant om het huismodel te doen, om het idee te enforcen dat het nuttig is en om inzicht te hebben in uitstoot/emissie/voetafdruk.

12.3 Het regiomodel
- Frank dacht dat de TV touch screen had.
- In het model is een kwart van het zonnepark aan Buren toegewezen, dat is al 40% van de (beoogde, waarschijnlijk niet accurate) elektriciteitsvraag. Wel inzichtelijk om te zien hoeveel impact zo'n park al heeft. Er is nog geen inzicht in hoeveel zonnepanelen er op dit moment in het dorp zijn, maar dat is natuurlijk inbegrepen wanneer de energievraag accuraat is.
- Eerst speel je het spel, dan vul je het model in om te kijken of het genoeg is. PL vraagt of het niet beter andersom kan? Ja, zou kunnen.
- (PL vertrekt nu)
- Frank is veel aan het woord, EA geeft veel input.
- CA vraag: hoe werkt die balans curve? → Dit is blijkbaar niet helemaal duidelijk uitgelegd in de introductie. Wel belangrijk, want bij het toevoegen van windmolens/Zon PV gaat het gesprek altijd eerst naar de balans curve.
- EAvraagt waar nog meer rekening mee moet worden gehouden: vergunningen, etc. Zit niet in het model
- EA vraagt: is het accuraat dat je bij peak load van 4000 kWh eruit klapt? → netbeheerder
  - o Er wordt op dit moment gewerkt aan verzwaring kabel
- Vraag waarom zonnepanelen alsnog impact hebben. Uitleg zware metalen, eye-opener voor participanten. Daar zijn de kaartjes erg nuttig in
- Zonnedaken op boerderijen lijken een goede optie
- CA en EA lijken erg goed betrokken, EAwat minder.
- Ook hier gaat het vaak over geld. Tesla-batterijen zijn bijvoorbeeld duur. Toch wordt geld niet meegenomen in het invullen van de kaartjes, omdat dat nu nog niet aan de orde is.

- Oppervlakte energieproductiekaartjes nog niet helemaal duidelijk. Soms kunnen ze bovenop elkaar, soms niet. Zijn de oppervlaktes accuraat? Ja, maar de variabelen zitten in het model. Er moet nog wel wat aan het model gesleuteld worden om het specifiek te maken voor Ameland. Hier moet een duidelijke handleiding bij zitten (stap 1 wanneer je het model ontvangt van Hanze: maak het accuraat voor de regio)
- Hier wordt het belang van de nulmeting ook nog benadrukt, omdat nu het model niet helemaal accuraat is en het dus lastig is om conclusies te trekken.
- Korte discussie over waterstof. Lastig om mee te nemen in het model, want toekomstmuziek en lastig te voorspellen. Vraag: in hoeverre is het handig om voor te bereiden op dit soort dingen? Er zijn altijd betrokkenen die bijvoorbeeld denken dat waterstof de oplossing op alles is (of bijvoorbeeld kernenergie, politieke kwestie). Hoe ga je daarmee om in het invullen van het model?
- Handmatig technieken invullen in het model is nog niet helemaal duidelijk, dat kan veel van deze vragen wegnemen. Maak het makkelijk om handmatige dingen in te vullen!
- Nu het einde van de sessie nadert zijn er veel positieve geluiden, we kunnen veel. Belangrijkste is om de informatie specifiek te maken en het model te bespreken met de netbeheerder. Dan scenario's vergelijken en kijken wat er kan.
- PL komt terug, EA gaat nu het model uitleggen aan PL
  - Gaat aardig, lijkt het goed te hebben begrepen.
  PL zegt grappend: geld is nooit het probleem. Hij denkt vooral al na over het uitleggen aan mensen, daar zit de crux. Het moet echt een kloppend en accuraat verhaal zijn.
  - Toevallig is er net een afspraak tussen de vier Friese eilanden en de netbeheerder om een plaatje te maken van de energievraag en de toekomst. Daar kan dit model zeker bij gebruikt worden.

- Concluderend
  - Het is erg nuttig om de netbeheerder aan tafel te hebben bij dit model, want balans lijkt lastigste kwestie.
  - De balanscurve is erg belangrijk in dit model, iets meer nadruk op leggen in uitleg?
  - Er mist een beetje een tijdlijn/structuur in het invullen van het model. Dit kan vervuld worden door de game?
  - In dit model is het wel belangrijk dat de informatie over energievraag nauwkeurig is. Daarnaast wordt er eigenlijk niet over geld gesproken, wat een goed teken kan zijn. Het doel is duidelijk ambitieus in termen van emissie.
  - Er moet veel worden ingevuld in het model. Dat kan, maar dan moet die informatie wel beschikbaar zijn. Veel info is er wel (enquêtes), maar nog niet verwerkt door Hanze. Kan Buren ook zelf doen zodra ze het model hebben.

12.4 Het huismodel (met PL, EA en CA)
- PL heeft z'n huiswerk gedaan.
- De vraag over het douchen levert leuke anekdote op.
- Er wordt weerdata van Eelde gebruikt, die van Terschelling zijn natuurlijk accurater. Graaddagen zouden ook kunnen.
- **Belangrijke opmerking PL:** voornamelijk voor de iets oudere generatie zijn investeringen eng. Timing is belangrijk, want je vervangt pas wanneer iets kapot is. Waarom overstappen? Zeker omdat terugverdientijd vaak lang kan zijn
  - Hier toch meer nadruk leggen op invloed waarde van het huis, maar ook op comfort en misschien nog wel belangrijker: emissies (of vertaling daarvan). Dat wordt nu eigenlijk heel weinig genoemd.
- Gasverbruik was niet zo accuraat, handig om erachter te komen dat waarschijnlijk de warmtepomp niet goed (niet zuinig) is afgesteld. Hier aanwezigheid en kennis van EA ook zeer nuttig.
- De uitleg hoe het model werkt van oud naar nieuw lijkt wat overbodig, waarom je moet kopiëren etc. Handig voor EA die het model gaat gebruiken maar voor PL niet zo interessant. Daarnaast; kan kopiëren niet automatisch zodra je scenario als REF zet?
- Elke verbetering wordt op technisch vlak vrij diep op in te gaan, dat vertraagt de boel misschien. Zorgt voor leuke discussies tussen EA en Frank, dat wel. De interplay tussen een praktisch persoon en de onderzoeker is interessant, misschien kan dat gebruikt worden?
- In het gesprek wordt door zowel Frank als PL als EA vaak als eerste geld genoemd als het over verschillende opties gaat. Blijkt toch het meest te leven, voor beide kanten.

- **Opmerkelijk:** PL heeft niks met emissies. Doet het niet voor CO_2. Kim en Kas vragen door; blijkt dat emissies gewoon niet de juiste naam is om aan het duurzaamheid/normatieve aspect te hangen. Dat is te abstract, te ver weg. Misschien beter om het dicht bij de persoon te houden (energieneutraal huis, groen op de meter, nul op de meter (ook al lastig want meter), kleine voetafdruk, ecocentrisme? Klimaatneutraal, goed voor het klimaat, etc).
- Het model is niet bedoeld om het proces te versnellen maar om een zaadje te planten. Zodra het natuurlijke moment komt om dingen aan te pakken (bijvoorbeeld: cv kapot/oud), dan moet er een optie panklaar zijn. Dus wel eerder.
- PL merkt op dat interactie met het spel volgens hem niet gaat werken, omdat het over één huis gaat. Dat is de vraag, spel kan natuurlijk wel een katalysator zijn voor de groepsdynamiek/social learning
- EA merkt op dat hij voor een bepaalde investering een verwachting had (gasverbruik naar nul ipv naar weinig) maar die bleek niet te kloppen (vanwege hoge investeringskosten volledige elektrificatie). Dat is de kracht van zo'n model
- **Opmerkelijk:** het huisspel ligt wel op tafel maar wordt geen enkel moment gebruikt/naar gekeken.

- Concluderend
- Belangrijk om uit te leggen dat het model niet bedoeld is om aan te sporen om NU iets te kopen. Timing hangt natuurlijk af van wanneer iets kapot gaat bijvoorbeeld, of wanneer het een gunstige situatie is. Hiermee duidelijker uitleggen dat het bijvoorbeeld ook voor comfort erg handig kan zijn, en een duidelijkere vertaalslag maken naar invloed op emissies (in de vorm van klimaatneutraal zijn, voetafdruk, uitzoeken wat het meest aanspreekt).
- De accuraatheid van het model is bij deze minder relevant dan bij het regiomodel. Dat was ook duidelijk na de inleiding.
- Het is eigenlijk geen enkel moment over impact op klimaat of uitstoot gegaan. Het 'doel' van de investeringen was voor iedereen wel duidelijk lijkt het, maar het is niet uitgesproken. De twijfels tussen verschillende opties gingen dan ook niet over het verschil in impact op klimaat, maar eigenlijk alleen maar over geld. Emissie/co2 is dus echt te ongrijpbaar, dat moet concreter en relevanter (hoe spreek je self-transcendence values aan in household energy?).
- Het gaat juist wel vooral om geld. Dat is toch de belangrijkste drempel en het belangrijkste vraagstuk voor de meesten. Comfort ook een beetje, maar stuk minder. Ook ruimte is een klein onderwerp.
- Een streetview of paar foto's van buitenkant van het huis kan nuttig zijn voor het gesprek.
- Er wordt veel gepraat over wat een technische oplossing precies kan en doet, de vraag is of dat voor iedereen relevant is.
- Het was voor dit gesprek heel nuttig dat EA erbij zat, met expertise op installatieniveau.
- Er wordt benadrukt dat het niveau in lijn moet zijn met de kennis van een persoon die meedoet (constructivisme), geef opties.
- De drempel zit volgens EA/PL voornamelijk in het niet weten wat de opties zijn. Daarom kan het zeker wel nuttig zijn om te kijken wat andere mensen hebben (modelling in social learning). Daarnaast moet het gesprek laagdrempelig zijn, persoonlijk (niet te zakelijk) en het liefst met iemand die je kent. Op het eiland is dat eenvoudiger omdat het een vrij hechte community is.

12.5 Het huismodel avondsessie (met CA, Player 1, Player 2, Player 3 en EA)

- Introductie Kim, focus ligt meer op duurzaamheid dan bij de middagsessie. Er wordt benadrukt dat het een proefsessie is, we leren van elkaar.
- Frank focust ook iets meer op duurzaamheid, geeft leuke anekdotes. De introductie is wel vrij lang, terugverdientijd wordt ook nog vroeg gebruikt.
- CAs huis
  o Waterverbruik is een lastige vraag. Frank vult een getal in op basis van de vraag: "douche je vaak". EA lijkt dat een lastige vraag te vinden "ja geen idee, gewoon normaal"
  o Vrij veel uitleg over hoe het model werkt, dat zorgt ervoor dat de anderen een beetje afhaken qua aandacht. De vraag is hoe relevant dit is
  o Het is meer echt een energy audit dan een discussie, ook geen tot weinig interactie met anderen.
  o **Opmerking CA:** behaaglijkheid en comfort zit niet in het model, wel in het papier wat op tafel ligt (maar die wordt wederom niet gebruikt)

- o Ook hier lijkt een storyline/narratief te ontbreken, dat kan het spel zijn.
  - o Als eerste resultaat na het kiezen van opties wordt er alsnog naar terugverdientijd gekeken. Geld blijft het belangrijkste frame
  - o Gaat nog wel even over emissies, maar niet heel uitgebreid.
  - o De vragen zijn wat suggestief en ook lastig misschien; wil je dit doen? Ja geen idee, dat gaan we uitzoeken met het model natuurlijk. Opzoek naar een manier om de opties te communiceren
  - o EA heeft een duidelijke toekomstvisie over waterstof, ziet dat wel zitten. Dat kan misschien ervoor zorgen dat hij minder snel investeert in dingen die daar weinig mee te maken hebben, terwijl hij wacht op een eureka-moment ergens in een laboratorium – die misschien nooit komt.
- Player 2
  - o Heeft geen afmetingen, maar dat blijkt niet helemaal noodzakelijk. Kan ook een inschatting worden gemaakt aan de hand van foto's, streetview en gasverbruik.
  - o EA geeft een suggestie voor het model: neem type huis mee, dat kan interessant zijn voor de vorm van het huis.
  - o Player 2 gaat in herfst over op dubbel glas, want herstelmoment.
  - o Verder niet zo nagedacht over investeringen. Het gaat voornamelijk over geld (wat het woord investeringen al suggereert natuurlijk)
    - ▪ Krijgt nog de vraag: waarom niet? Antwoord = geld. Wat begrijpelijk is, want daar ging het al over, dus dat is het frame
  - o Vraagt nog om een alternatieve oplossing, die wordt gegeven met als argument: dan zijn je investeringskosten dus lager! Heeft Player 2 wel oren naar. Ook mindere emissieverlaging, maar dat wordt weinig relevant geacht.
- Player 3
  - o Heeft een persoonlijk verhaal; huis van opa en oma geweest, gaat misschien binnenkort weg, daarom de vraag of het zin heeft.
  - o Het verhaal gaat vanaf het begin meteen over geld. Blijkt wel echt het belangrijkste thema voor de personen die er het minst in zitten, en dan gaat het gesprek daar gauw in mee.
  - o Hier komt EA eigenlijk pas als eerste van pas in de avondsessie, hij rekent uit hoeveel zonnepanelen mogelijk zouden zijn.
  - o Gaat veel over technische dingen maar eigenlijk niet in relatie tot emissies. Voorbeeld bierkoelkast: kun je zoveel kWh mee besparen! Dat zegt natuurlijk weinig als je daar geen affiniteit mee hebt. Beter idee: je bespaart 20% van je totale CO_2-uitstoot als je geen bierkoelkast hebt! Oid
  - o Model maakt fout mbt kosten van zonnepanelen, daar wordt even over gesproken. Lijkt geen grote drempel te zijn voor geloofwaardigheid, vanwege insteek model
  - o Er wordt even gesproken over een stekkeractie om te meten welke apparaten veel energie verbruiken, wordt opnieuw opgestart door Kim.
  - o Feedback: in 2 uur veel meer informatie gekregen dan zelf googlen. Het lijkt ver van m'n bed maar veel meer inzicht gekregen. Misschien toch investeren voor het huis, ook omdat waarde van het huis dan meer wordt (geld).

Concluderend

- Het gaat wederom niet zoveel over duurzaamheid, maar voornamelijk over geld. Het woord 'investering' wordt veel gebruikt, dat is natuurlijk sowieso al een begrip wat op geld slaat.
- Discussie kwam wat lastig los, niet zoveel interactie. Daardoor monoloog van Frank, wel informatief. Maar, zodra het over besparing gaat komt de discussie wat meer los. Dus niet het geld-stuk zorgt voor discussie, maar gedrag mbt duurzaamheid en besparing van energie. Dit gaat dan wel over curtailment gedrag (lichten uit, lagere thermostaat, minder lang douchen) en niet over efficiency gedrag (isoleren, andere warmtewinning, etc)
- Het is lastig om te zien of de tweede en derde persoon hebben geleerd van eerst meekijken met CA. Wel een beetje.
- Veel uitleg gaat over technische aspecten van hoe apparaten werken. De vraag is of dat een barrière vormt.
- Er lijkt wel positieve feedback. het is nuttig om mensen bij elkaar te zetten. blijkt een gat te zijn tussen mensen die op zoek zijn naar informatie maar lastig te vinden. installateurs weten vaak niet het hele plaatje.

- o veel geleerd in deze 2 uur, meer dan zelf uitzoeken. minder ver van m'n bed show nu, minder abracadabra. stel dat er nu een investeringsmoment komt, dan wordt er zeker op een andere manier naar gekeken.
- o vraag is: is er genoeg behandeld over emissie, zorgt het dat de barrière voor gain/hedonic lager is geworden? Het kan nog steeds veel te duur zijn.
- ook nog korte discussie over ruimte --> is ook nog vervelend, want ketels waren klein.
- Na middagsessie werd er gesproken over het nut van dubbele moderatie (Frank en EA), maar dat was bij deze sessie niet zo te merken.