The Impact of Social Learning on the Use of IHDs and the Energy-saving Behaviour of Residents Living in a Sustainable Neighbourhood

Insights from the eSmart Display Users in Eikenøtt, Switzerland

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Summary

By using the single representative and revelatory case study of the eSmart display users in the eco-neighbourhood Eikenøtt in Switzerland, this research aims to answer the following research question: What is the effect of the use of IHDs on the energy-saving behaviour of households living in the Eikenøtt sustainable neighbourhood and what is the impact of social learning on this relationship? The rationale behind this thesis concerns the literature gap explaining how smart metering systems can aid the sustainability of eco-districts projects by ensuring that the residents, actually engage in an energy-saving behaviour. Moreover, existing research on sustainable neighbourhood developments argued that it provides a great context where people are expected to exchange pro-environmental norms and values – as the context promotes high social cohesion – and therefore this paper uses Eikenøtt as an opportunity to verify this. In order to do so, theory testing is used to undercover the effect of the of IHDs on the households' energy-saving behaviour and to look into the moderating effect of social learning in the neighbourhood on the relationship between the use of IHD and the households' energy-saving behaviour.

The households of Eikenøtt having access to the eSmart devices have been sent invites to participate in an online survey and thus this allows to make statistics (via Survey Monkey). Due to the Covid-19 epidemic, the number of valid questionnaires was very limited. However, the results of the statistical analysis – which have been run on the IBM SPSS programme – have shed light on many relationships and trends concerning the concepts investigated. In a first place, the findings indicate that the use of social learning is positively associated with the energy-saving behaviour of the households. In a second place, the analysis does not allow to confirm that social learning has a significant moderation effect on the relationship between the use of the eSmart display and the energy-saving behaviour of the households living in Eikenøtt. Nonetheless, the analysis shows that there is a trend and that the non-significant moderation effect is probably due to the low number of respondents. Furthermore, social cohesion and social learning have been found to be positively correlated and therefore one can argue that this shows the importance of the consideration of public space in the creation (design) of eco-neighbourhoods. To conclude, one should bear in mind that this research cannot be generalized and therefore the findings of this study cannot be assumed to be the same in other contexts.

Keywords

Energy-saving behaviour; Use of IHD; Direct feedback; Social learning; Transformative learning, Instrumental learning; Social cohesion; Eco-neighbourhood; Eikenøtt; Switzerland

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Clarisse

Abbreviations

ICT	Information and Communications Technology
IT	Information Technology
IHD	In-Home-Displays
QR	Quick Response

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1. Introduction

The Chernobyl nuclear disaster of 1986 and the Fukushima Daiichi nuclear disaster of 2011 have led to an international re-questioning of the use of suzch power plants (Laka Foundation, 2012). As a result of this, the Swiss authorities have decided to promote the transition to renewable energies and the country has started to undergo nuclear decommissioning – which led to the shutting down of the Muehleberg power plant in 2017 (Agence, 2017; Bourreau, 2019). Thus, the interests from the local planning authorities and the development industry in renewable energies and energy efficiency has gained great popularity (Barton, 1998; Bottero et al., 2019). Moreover, the international context appears to be favourable for reducing greenhouse gas emissions emitted from housing (Biello, 2011).

Accordingly, many eco-neighbourhood projects are being developed throughout the country as more companies are seeking for innovative ways to rethink of urban areas (Swiss Confederation, 2015). These past years have seen a growing interest in green certification from the project developers to create efficient buildings (Mohareb & Row, 2014, p. 24). As a result, Saiu (2017) argues that real estate developers perceive high potential to make profit out of these initiatives as there is an increasing demand for living in such buildings. For instance, the use of solar as renewable energy used in the building sectors can allow for the provision of hot water as well as electricity to the households (Dimoudi & Zoras, 2016). Nonetheless, living in energy-efficient buildings does not ensure that the residents will adopt the desired energy-efficient behaviour desired by the project developers (Azizi et al., 2019). Hence, this paper seeks to understand how an eco-neighbourhood can constitute a favourable context for households to reduce their energy consumption.

1.1 Problem Statement

Many scholars have looked into the enabling type of intervention from the project developers that concerns the enabling of direct feedback to the households – which provides real-time information on the households' energy use (Elgazzar & El-Gazza, 2017; Azizi et al., 2019). Accordingly, IHDs have been recognized to explain the energy-saving behaviour of households as a result of feeling empowered by the monitoring use of IHD. Indeed, Karlin et al. (2015) have argued that people tend to reduce their consumption according to, among other factors, price sensitivity and efficacy. However, Westskog (2015) has pointed out that many households tend to not use IHD to reduce their energy use but rather to be able to see when they consume too much

and therefore there is a gap in the literature concerning what can strengthen the relationship between the usage of such devices and the energy-saving behaviour of the households.

The design of eco-districts constitutes a restructuring type of intervention from the developers and therefore the pro-environmental context of the neighbourhood is expected to have an effect on the habits of the residents. Social learning – within the sustainable neighbourhood context – can represent this missing piece of the puzzle. Indeed, eco-districts are created to strengthen social cohesion and therefore they are quite popular for enabling the social interactions amongst the neighbours and strengthen the relationships between the residents (Wilkinson, 2007; Anquetil, 2009; Reed et al., 2010; Medved, 2017). Accordingly, people are expected to meet on a daily basis where they share information and advices (Tsai, 2014). Thus, such get-togethers (e.g. informal and formal) allow for individuals to learn new knowledge (i.e. instrumental learning) or/and re-evaluate their own knowledge (i.e. transformative learning) (Reed et al., 2010). Hence, it is expected that social learning influences the use of IHD by households in the sense that it empowers them – as they are informed about how to act in order to be fully in control over their energy consumption.

1.2 Case selection: The sustainable neighbourhood of Eikenøtt, Switzerland

This research seeks to uncover a precise phenomenon and therefore considers the Eikenøtt sustainable neighbourhood as a representative and revelatory case (Bryman, 2012, p. 70). The former refers to a case offering a suitable context and the latter relates to a case looking into a phenomenon that has not been investigated yet (Bryman, 2012, p. 70). Eikenøtt is the first sustainable neighbourhood of the French-speaking part of Switzerland. It is located in the commune of Gland in the canton of Vaud and benefits from being in the middle of the two biggest cities of the French-speaking part of Switzerland, namely Geneva and Lausanne (Architectes.ch, n.d.). The Eikenøtt project is the result of a strong collaboration between Losinger-Marazzi – which is the swiss subsidiary of Bouygues Construction – and the City of Gland and the construction was finalized in 2014 after six years of planning and implementing (Architectes.ch, n.d.; Losinger-Marazzi, n.d.). Since then, Losinger-Marazzi has become the pioneer of sustainable development throughout the entire country (Segovia et al., 2014).

Actually, there are more or less 1'200 inhabitants in the eco-district (Architectes.ch, n.d.). The twenty-one buildings in the neighbourhood have been certified with the Minergie-ECO label – which ensures that the construction and the end product are energy-efficient – rely on district heating system which relies of wood chips and the buildings' energy mainly comes from thermal

solar panels, photovoltaic panels, and recovery and re-infiltration of rainwater (Architectes.ch, n.d). To ensure that the households make efforts to reduce their energy consumption, Losinger-Marazzi has decided to supply the IHDs of the company eSmart in 230 apartments -out of the 485 apartments available on the site (Architectes.ch, n.d.; eSmart, 2015a).

Additionally, the urban design of a neighbourhood plays an important part in making it sustainable (Bottero et al., 2019, p. 7). In the sense that Eikenøtt offers a variety of meanings to the public and private spaces as it has been thought in such a way that it promotes social responsibility and the residents' consciousness about the impact on the environment (Losinger-Marazzi, n.d.). In 2015, the neighbourhood association AQEnøtt has been created and organizes various activities for the people of the community to interact (AQEnøtt, n.d.).

1.3 Research Objectives

With respect to what has been said in the problem statement, this research aims at understanding to what extent social learning can strengthen the relationship between the usage of IHD and the energy-saving behaviour of the households in the Eikenøtt eco-district. Based on the existing theory regarding the use of IHD, energy-saving behaviour, and social learning, this research seeks to:

- Test the effect of the use of IHD on the households' energy-saving behaviour.
- Test the moderating effect of social learning on the effect of the usage of IHD on the households' energy consumption.

1.4 Research Question

What is the effect of the use of IHDs on the energy-saving behaviour of households living in the Eikenøtt sustainable neighbourhood and what is the impact of social learning on this relationship?

1.4.1 Research sub-questions

- What are the characteristics of energy-saving behaviour of households?
- What are the characteristics of energy-saving behaviour within the context of a sustainable neighbourhoods?
- What is the effect of the use of IHD on the energy-saving behaviour of the households?
- How is social cohesion related to social learning?
- What is the effect of social learning on the usage of IHD for the energy-saving behaviour of the households?

1.5 Significance of the study

1.5.1 Societal relevance

The developments of sustainable neighbourhoods have been recognized as an alternative to the growing problems that arise within the cities' traditional neighbourhoods (i.e. unaffordable housing, congestion, pollution, etc.) by improving the quality of life of the residents, regenerating green areas and public spaces, and promoting environmental awareness (IBERDROLA, n.d.). Although being criticized to be a top-down governance process throughout the design stage of the planning, eco-districts heavily rely on the commitment of the residents to make the projects sustainable (Zamora & Carballo, 2018). As a result, this thesis considers the households of eco-neighbourhoods as key players to ensure the durability of the initiatives. Also, it seems more important than ever to research the role that technology and humans can play, together, to increase the quality of life of the citizens living in urban areas – that have been, until today, proven to be facing multiple challenges (IBERDROLA, n.d.). ICT has gained a lot of popularity in the urban planning field as governments wish to make their cities smarter (Nam & Pardo, 2011). However, some are afraid that this builds a technology-driven society which aims to only serve the interest of private businesses (Datta, 2015). However, citizens are also important to overcome these challenges as they can organize themselves to solve complex issues (Castelnovo, 2015). Hence, this thesis can shed light on the use of certain technologies and whether this affects sustainable behaviour. Moreover, this thesis takes the research further by looking into what the role of the social context could play in this relationship.

1.5.2 Academic relevance

It appears that many the researchers have been interested to look into the potential of eco-neighbourhoods as alternatives to the challenges that arise from living in urban areas (Flurin, 2017; Medved, 2017; Zamora & Carballo, 2018; Zhang et al., 2018). However, many academics have looked into the various dimensions of such districts and assumed that they each had a distinct purpose (Barton, 2000; Bottero et al., 2019). The issue that arises from this is that the academic literature tends to focus on what sustainable neighbourhoods should look like and the great potential of these urban developments. However, the results of such projects remain very broad and vague. As a result, this thesis seeks to understand whether multiple aspects of sustainable neighbourhood – namely the use of ICT to develop pro-environmental habits and social cohesion which can constitute favourable context for social learning – can have an influence on the energy-

saving behaviours of the residents. Hence, this research offers a great opportunity to add to the existing literature concerning smart and sustainable cities by looking into this phenomenon – which has not yet been looked into – in order to shed light on the relationships between the concepts of energy-saving behaviour, use of IHD, and social learning.

1.6 Scope and Limitations

This research focuses on the eco-neighbourhood of Eikenøtt, in Switzerland. More precisely, it concerns the households which have access to the eSmart IHDs. However, a variety of challenges are expected to occur throughout the process. One shall bear in mind that the respondents can respond in a more socially desirable way – for instance, pro-environmental demonstrations throughout the world have developed new norms – which might lead to a certain bias as the households might feel ashamed of not acting accordingly and therefore might not respond honestly (Félonneau & Becker, 2008).

Additionally, the access to the neighbourhood might be more limited than expected as a consequence of the recent complications to travel and interact with people due to COVID-19. Moreover, the data collection for this thesis relies on the households' responses to a survey. Unfortunately, this pandemic might make the residents less willing to discuss with people they do not know. Thus, the unwillingness to participate has a negative influence on the amount of data collected and thereby the (external) validity of the information gathered. The validity and reliability of the collected data is elaborated in the methodological framework.

2. Theoretical Framework

This chapter provides insights on the concepts and develops on the existing relationships amongst them. Firstly, the theoretical framework elaborates on the direct effect of the usage of IHD and the energy-saving behaviour of the households within the context of a sustainable neighbourhood. Secondly, the theoretical framework discusses the concept of social learning within the context of a sustainable neighbourhood and argues that the presence of social learning in the district strengthens the relationship between the usage of IHD and the energy-saving behaviour of the households. Finally, the conceptual model draws the relationships between the concepts and therefore sums up what has been said in the theoretical framework.

2.1 The energy-saving behaviour of households in sustainable neighbourhoods

This study uses the concept of habitual energy-saving behaviour as the optimization of energy resources by households (García et al., 2017). According to Gadenne et al. (2011), an individual's behaviour is the reflection of his or her attitude in his or her actions. Thus, Karlin et al. (2015) have argued that the psychological factors of environmental concerns, price sensitivity, and comfort can explain people's motivations to conserve energy (p.1211). Consequently, energy-saving behaviour is understood as acting, purposely or not, in a pro-environmental way (Gadenne et al., 2011).

Azizi et al. (2019) have argued that the strategy of environmental enabling coming from the developers have an influence on the energy habits of the residents in sustainable neighbourhoods (p. 730). Accordingly, eco-districts offer the possibility for citizens to live in energy-efficient building – also known as green buildings (Omar, 2018). These habitats allow people to have a low consumption of energy, maintain the comfort they are used to, and live in a healthy environment (Tong, 2017). However, Azizi et al. (2019) have demonstrated that buildings' energy performance, although displaying energy-saving technology, is highly affected by the occupant's behaviour towards energy consumption. Indeed, their study has demonstrated that living in energy-efficient buildings does not ensure that people will adopt an energy-saving behaviour even if their consumption is lower than people living in conventional buildings (p. 190). This means that it is not sure whether the residents of an eco-district will adopt pro-environmental behaviour although living in a context that provides a pro-environmental climate for buildings' occupants. According to Gadenne et al. (2011), individual who demonstrate a pro-environmental behaviour at this stage have already strong environmental concerns (prior to moving in an energy-

efficient building). Hence, to overcome this issue, Elgazzar and El-Gazzar (2017) have advocated for the use of smart solutions to achieve sustainability in urban areas. In addition to being already (almost) dependent of renewable energies and being energy efficient, the buildings in eco-districts can offer direct feedbacks to its residents (Jackson et al., 2009).

2.1.1 Functions of the IHD

Sustainable neighbourhoods enable the monitoring behaviour of the residents by offering the possibility to install direct feedback devices. Real-time energy feedback has gained popularity in the energy consumption behaviour discussion as researchers have noticed that providing feedbacks instantly can lead to energy savings in households. Darby (2006) has developed that the immediacy of information provided by direct feedback is more effective that indirect feedback. Hargreaves (2018) defines energy feedback as the "provision of, principally, numeric information to consumers (through improved bills, metering or displays) about their levels of electricity and gas use" (p. 332). Direct feedback can be available through various platforms such as self-meter-reading and direct display on monitors (Darby, 2006). Contrarily to standard paper billing and enhanced billing, direct feedback through IHD – such as screens or phones – allows for consumers to see their energy use and costs instantly (Mohareb & Row, 2014, p. 20; Geelen et al., 2019).

In addition to allowing the consumers to see their consumption in real-time, by combining IHD with smart meters, the study of van Houwelingen and van Raaij (1989) has demonstrated that the use of IHD has an effect on the energy consumption of the households in the sense that the people have changed their behaviour towards energy to a more efficient one (p. 99). Users adapt to the building environment by developing energy efficient behaviours as long as they still perceive comfort and satisfaction in living there (Paone & Bacher, 2018). Thus, IHD offers the possibility for households to reduce their consumption without reducing their well-being (Karlin et al., 2015). IHDs provide to be effective means for consumers to perceive their energy use as the displays are most of the time made in such a way that it motivates frequent use (Geelen et al., 2019). For instance, the electronic device can show information relating to the weather or offer the possibility of thermostat control and goal setting (Karlin et al., 2015; Geelen et al., 2019). As a result, researchers have found it difficult to contest the relationship between the households which use IHDs and their consumption of energy (Geelen et al., 2019, p. 1635; Koroleva et al., 2019; Zangheri et al., 2019).

2.1.2 The energy-saving behaviour of the households and the use of IHD

The enabling strategy developed by Azizi et al. (2019) can be illustrated by the use of IHDs which allow for people to not drastically change their habits with regard to comfort but mainly to be able to control their energy use for financial, comfort, or environmental reasons (Karlin et al., 2015). Although the use of IHD has been recognized to have an effect on the energy-saving behaviour of people, Westkog et al. (2015) have recognized that this would probably be not so effective without the empowering effect of using such devices. According to the Merriam-Webster's online dictionary (n.d.-a), empowering refers "to make able or possible". Azizi et al. (2019) have argued that habits are often dominated by the lack of awareness and limited controllability (p. 729). Hence, people are more likely to change their behaviour once they notice the difference between their attitudes and their behaviour (Kantola et al., 1984). Therefore, this assumes that the household has already some kind knowledge on how to reduce its consumptions. Based on the existing academic literature on direct feedback, IHD device give the power to individuals to act on their attitudes (Kantola et al., 1984; Westskog, 2015; Geelen et al., 2019). In fact, having control over consumption due to the various functions that an IHD can serve (i.e. direct feedback, remote heating control, and goal setting) can make households change their daily habits. Hence, the concept of empowering is strongly linked to the perceived control the households have over their finances (Westskog, 2015, p. 5431). By having access to an IHD, consumers have the choice to reduce their consumption and therefore it can empower the end-users to manage their resources efficiently (Ehrhardt-Martinez et al., 2010). This leads to the following hypothesis.

H1 The use of IHD is positively associated with the energy-saving behaviour of households.

2.2 Social Learning in the eco-neighbourhood as a moderator in usage of IHD and energy-saving behaviour of household

In addition to the enabling strategy of the sustainable neighbourhood developers, Azizi et al. (2019) have argued environmental restructuring can be useful to make the residents develop a pro-environmental behaviour by living in a pro-environmental context. Therefore, this section places the energy-saving behaviour of the households in a context of neighbourhood rather than only considering that the households suffice to themselves to feel empowered and act in a pro-environmental way (Mersal, 2017). A crucial feature of the development of eco-neighbourhoods is to generate social interactions amongst the residents. Hence, it is expected that social learning

strengthens the relationship between the monitoring use of IHD and the energy-saving behaviour of the household.

2.2.1 Eco-neighbourhood and social cohesion

Based on the work of Azizi et al. (2019), the residents will re-judge their habits by living in pro-environmental context. Indeed, evidence from Medved (2017) suggests that the design of sustainable neighbourhoods can generate strong social cohesion (p. 120). Social cohesion is understood as the membership attitudes and behaviours of the individuals that are a part of a community (Friedkin, 2004). Anquetil (2009) has looked into the effect of the design of green spaces on the neighbourhood social cohesion and has developed upon three dimensions of this phenomenon, namely *sense of community*, *place attachment*, and *neighbouring* (p. 2). According to Davidson and Cotter (1993), the psychological sense of community refers to "a strong attachment that people may experience toward others based on factors such as where they live, where they work, where they go to school, or with which groups they affiliate' (p. 59).

Wilkinson (2007) defines place attachment as "the capacity of a specific neighbourhood or community to induce in individuals desire to continue residing there" (p. 216). Based on the research of Raymond et al. (2010), the role of community – or in this case, neighbourhood – is of high importance to create place attachments (p. 423). For this, community attachment, belongingness, rootedness, and familiarity of the residents have become valuable determinants of place attachment (Raymond et al., 2010, p. 423).

Neighbouring translates "the interactions between residents and the support they may bring to each other" (Anquetil, 2009, p. 2). Sustainable neighbourhoods are built in a certain way to allow for certain activities to take place (e.g. pedestrian access areas) (Barton, 2000, p. 5). Ujang et al (2018) show that place attachment depends of the social interactions taking place in the public space. This in turn, has an influence on the sense of community that the residents can develop (Francis et al., 2012). Hence, neighbouring seems to be the initial feature of social cohesion. Accordingly, Tsai (2014) elaborates on three types of social interactions at the neighbourhood scale: formal meetings, informal meetings, and informal casual meetings (p. 27772). Firstly, formal meetings taking place in eco-districts can be understood as collective gatherings, or activities, organized by community associations (Barton, 2000, p. 152; Tsai, 2014). Secondly, informal meetings illustrate the frequency of regular individual gatherings between the residents – which can take place in restaurant, parks, recreational centres, etc. (Tsai, 2014). Finally, informal casual meetings relate to the neighbours running into each other on a daily basis (Tsai, 2014).

Consequently, this section has developed that sustainable neighbourhoods are places which generate a strong social cohesion through disposing the means for greater social interactions. Thus, Macias and Williams (2016) believe that residents "are exposed to a greater diversity of views and information upon which they may base their attitudes and behaviour" when the neighbourhood demonstrates a strong social cohesion (p. 394).

2.2.2 Social cohesion and social learning

Gadenne et al. (2011) have discovered that social influence is positively associated with environmental behaviour attitudes as people act according to social norms and social pressure – which tend to be present in the opinions and actions of an individual's (close) peers (p. 7692). Reed et al. (2010) have argued that the concept of social learning – defined as "a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks" – is strongly connected to social interactions – considered to be the neighbouring feature of sustainable neighbourhoods ("Conclusion," para. 2). Certain features of living in neighbourhood facilitate the development of social networks through the interaction of the people within the space (e.g. convivial relations or exchange of small services) (Bridge, 2002). Here, local social networks are understood as sets of dyadic ties and social interactions between individuals (Mittenburg & van der Meer, 2018, p. 155). One may argue that a sustainable neighbourhood create a context where residents with different views and knowledge come together and therefore might result in a context "in which social learning might take place" (Reed et al., 2010, "Learning through social interaction," para. 3).

Reed et al. (2010) distinguish two types of social learning: instrumental and transformative ("A change in understanding," para. 1). The former refers to assimilating new knowledge via social interactions and the later refers to a change in attitudes, behaviour, and social norms. This form of social learning is different in the sense that the individual questions what he/she has learned from the interaction(s) with others. Koroleva et al. (2019) have elaborated on the socio-technical behaviour change model and have argued that individuals act once they are aware of the need for change and are ready to act on it (p. 6). However, a change of understanding does not necessarily lead to a behaviour change and therefore Bandura (1977) argues that the stage of reproducing what he/she has learned from others shows the effect of social learning. Nonetheless, the transformative type of social learning is not only about gaining more insights on energy-saving behaviour due to interactions with peers, but it is also about learning about the social norms and

wanting to conform to them (McDonald & Crandall, 2015, p. 148). Indeed, the research of McDonald and Crandall (2015) has demonstrated that social norms "have powerful, and often unappreciated, influence on everyday behaviour decisions" (p. 149). Hence, the change referred to in transformative learning relates not only to the understanding of the way one approaches his/her energy consumption but also the understanding of what is actually represents for your community. All in all, social cohesion in an eco-neighbourhood is expected to be positively related to social learning.

2.2.3 Social learning and energy-saving behaviour of households

IHD can lead to energy-saving behaviour once the individual has realized the need to act on the information displayed by the device (Koroleva et al., 2019). Nonetheless, Ehrhardt-Martinez et al. (2010) have argued that electronic devices, alone, cannot explain why people decide to reduce their energy consumption. Accordingly, an might have an IHD but may not see it as a means to take control over his or her finances. Thus, having control over energy consumption implies that the individual is aware of how he or she can reduce the use. According to Retallack et al. (2007), people might feel helpless when they are given the information about environmental problems but do not have the means to change (p. 11). Thus, social learning has been acknowledged to be another explanation for the behaviour change of individuals (Carruth, 1976; Wilhite, 2014). Wilhite (2014) has looked into insights from social learning theory for sustainable energy consumption and has stipulated that the energy consumption behaviour of individuals is highly influenced by his or her peers. Therefore, this paper sees the use of IHD and social learning as complementary factors that can lead to energy-saving behaviour of the residents.

Macias and Williams (2016) have discovered that the time people in the same neighbourhood spend together has an important effect on the "environmental lifestyles" (p. 391). By interacting with other members of the eco-neighbourhood, the residents can "compare and assess their levels of energy use with other households living in similar dwellings" (p. 27). Indeed, people gain knowledge on the habits of others as well as exchange energy-saving advices (Odom et al., 2008). Koroleva et al. (2019) has elaborated a socio-technical model of behaviour change towards energy consumption by stating that advices can generate the feeling of behavioural control where the individual moves from being unaware of the need for change to taking the first action (p. 6). In addition to being subject of instrumental and/or transformative learning, social learning is also a way to share the environmental norms of the neighbourhood (Sen & Airiau, 2007; Gadenne et al., 2011). Indeed, the more the residents become conscious of environmental issues,

the more they are likely to act accordingly. Thus, such norms can be expressed through social interactions that take place within the eco-district context (Reed et al., 2010).

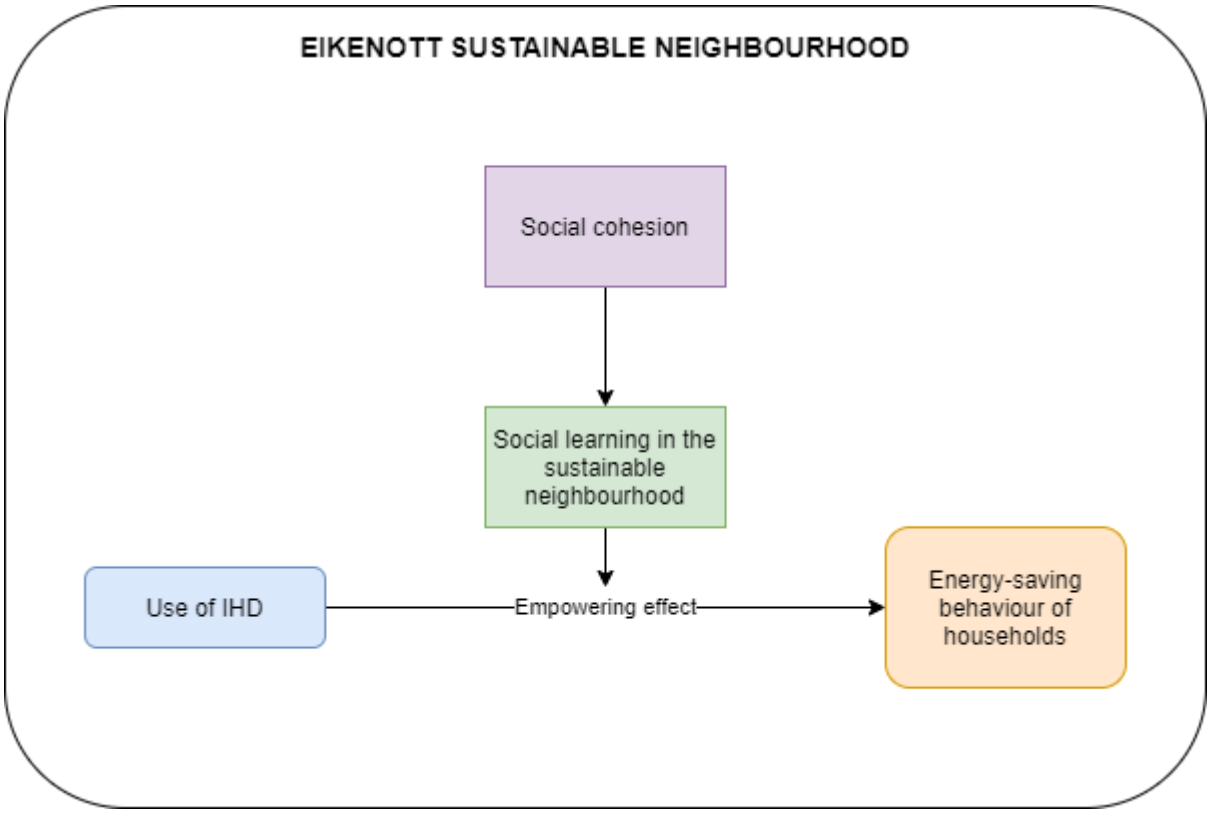
Hence, it can be expected that the usage of IHD is more strongly associated to the household's energy-saving behaviour when households experience social learning on environmental behaviour in the eco-neighbourhood than when households perceive low levels of social learning. When social learning to be high, social interactions will cause the households to understand the value of using IHD and therefore this may increase the energy-saving behaviour of households. When social learning is low, the households are least likely to be aware of the need to act on their attitudes or how to act and therefore the use of IHD does not lead to energy-saving behaviour. This leads to the following hypothesis.

H2 Social learning moderates the relationship between the use of IHDs and the energy-saving behaviour of the households in such a way that the relationship between the use of IHDs and the energy-saving behaviour of the households is stronger when the level of perceived social learning is high than when social learning is low.

2.2.4 Conceptual model

The usage of IHDs is used as independent variable, or predictor, as it allows for the end-users to develop a sense of control over the dependent variable, or outcome, of energy-saving consumption. Nonetheless, social cohesion is expected to have a moderating effect on the relationship between the use of IHD and the energy-saving behaviour of the residents. Indeed, the residents are assumed to meet and share experiences quite frequently and therefore social interactions can strengthen the relationship between the use of the displays and the energy-saving behaviour of the households living in the eco-district. As argued in the section 2.2.2., social cohesion is understood to be an independent variable which impacts the variable of social learning. Therefore, the following conceptual model draws the relationships that have been developed upon in since the beginning of the theoretical framework.

Figure 1: Conceptual model.



Source: based on own findings.

3. Methodological framework

This chapter discusses the methodological framework which guides the research. The operationalization of the main concepts of this study shortly defines them and displays of the chosen indicators that are used to measure the concepts. After having elaborated on the research strategy for this research, the data collection method sheds light on how the data is going to be collected as well as how the sample size and selection have been determined. Then, a segment of this chapter explains how the data is going to be analysed and how to ensure the validity and reliability of the chosen indicators. Finally, the fieldwork limitations section closes the methodology chapter.

3.1 Operationalization

3.1.1 Definitions

Usage of IHD

The term of 'use', here, follows the following definition of the Merriam-Webster's online dictionary (n.d.-b): "the act or practice of employing something". The use of IHD can have various functions and therefore the relationship between the energy-saving behaviour of the household is determined by the function associated with it (eSmart, 2015b). Although, the theoretical implications affiliated to energy-saving behaviour in the literature concerning direct feedback and smart metering systems only discusses the functions of monitoring, goal-setting, and remote heating control, it seems important to consider the other functions that the IHD looked into this thesis could serve (e.g. intercom, weather, transports, etc.). Although also being able to measure the function of use by considering it as a nominal variable, this study uses the use of IHD as an ordinal variable in order to allow the respondents to be neutral over their response. Therefore, the function of the use can be asked through a series of Likert-scale questions (1 = strongly disagree, 5 = strongly agree) based on the functions of the device elaborated by eSmart (2015b). This allows to verify for which purpose the residents of Eikenøtt use their IHD. With respect to the use of the IHD, the Cronbach's Alpha is estimated at .611. As Ursachi et al. (2015) argue, the Cronbach's Alpha which finds itself between 0.6 and 0.7 "indicate an acceptable level of reliability" (p. 681). Hence, the variability in the composite score of the use of IHD is considered to be reliable.

Energy-saving behaviour

The residents of the neighbourhood can notice that they have an energy-saving behaviour by looking at the evolution of their energy bill (Zangheri et al., 2019). In a first place, a question should ask the respondents if they believe that their average annual energy bills have reduced since living in the neighbourhood. By doing so, the respondent does not need to go back to his bills but make a quick estimate in his/her head and therefore a dichotomous question (Yes/No) should be enough. However, adopting an energy-saving behaviour does not necessarily imply the reduction of the energy bills as behaviour means acting and therefore energy-saving behaviour is a combination between the daily life actions led by the households, to reduce their own energy consumption. Hence, Gadenne et al. (2014) displays a set of environmental behaviours indicators, which he calls household habits factors and that are subject to Likert-Scale questions – among others "I turn lights off in unused rooms", "I wait until there's a full load for washing", "I turn the heat/air conditioning system off in unused rooms", etc. (p. 7689). Adding to the seven indicators developed by Gadenne et al. (2014), the author of this thesis has developed five more indicators. Firstly, Petersen (2013) has argued that reducing the time spent under the shower is considered to be a significant indicator of energy-saving (and pro-environmental) behaviour. Secondly, hanging the laundry instead of putting it in the dryer has been recognized to save energy ("5 Reasons to Ditch your Dryer," n.d.). Another indicator of energy-saving behaviour used in this study relates to cleaning clothes at 30°C as it has been acknowledged to allow the energy end-users to save electricity compared to if they were washing their clothes at higher temperatures (Rutt, 2017). Fourthly, selecting the eco mode on washing machines and dishwashers also illustrates energy-saving behaviour as the eco mode allows to use less water and also to not use hot water (Potter & Richard, 2020). Finally, unplugging the devices when going on holiday is very well known as an energy-saving behaviour as it stops the electricity from running without being used (Writer, 2020). As a result, the Cronbach's Alpha of the 12 indicators used to measure the energy-saving behaviour of the households – based on the indicators of household habits developed by Gadenne et al. (2011) and the indicators developed by the author of this thesis – is of .748. This means that, the Cronbach's Alpha denotes an acceptable level of reliability for the indicators used in this research, with respect to the concept of energy-saving behaviour.

Social learning

Social learning has been established by Reed et al. (2010) as taking two forms – namely instrumental and transformative learning. To understand whether the respondents have developed new energy-saving habits since moving in the neighbourhood, the survey should ask a

dichotomous question concerning the fact that they have developed new energy-saving behaviours (Yes/No). Concerning transformative learning, Likert-scale questions can be derived from the work of Reed et al. (2010). Indeed, the authors quite commonly refer to "change" when speaking of transformative learning ("A change in understanding," para. 1). This change does not only reflect the change of energy behaviour but also the questioning of the underlying assumptions of one's actions based on the attitudes, behaviours, or norms of others. Although not developed already as clear indicators, instrumental and transformative learning can be measured by Likert-scale questions (1 = strongly disagree, 5 = strongly agree). To first be able to understand whether people discuss and exchange ideas with respect to pro-environmental behaviour, the survey should ask the respondents to rate the following statement: "I often share advices with other residents on ways to pollute less". With respect to instrumental learning, the author of this thesis has developed the statements: "I have developed new energy habits by discussing with other residents as I have discovered new ways to reduce my consumption" and "I have developed new energy habits by participating in neighbourhood activities as I have discovered new ways to reduce my consumption". By doing so, this allows to perceive if the social interactions have made the respondents develop new ways of reducing their energy use. To measure transformative learning, the statements: "I have changed my energy behaviour because the beliefs and actions of the other residents have made me question my energy consumption habits" and "I have changed my energy behaviour because the norms and values of the neighbourhood have made me question my own energy consumption habits". This aims at showing whether the respondents have experienced questioning their initial habits and acting upon this. The Cronbach's Alpha of the five items is estimated to be of .894 which means that the level of reliability is very good and thus the items seem to be measuring the same construct (Ursachi et al., 2015).

Social cohesion

Moreover, the survey should also ask about social cohesion as social learning can be best measured once the quality of the interactions within a community and the engagement of the respondent is known (Wilhite, 2014). Accordingly, Anquetil (2009) has developed the three sub-variables of social cohesion: sense of community, place attachment, and neighbouring (p. 2). In order to measure these three sub-variables, Fone et al. (2006) have developed an adapted neighbourhood cohesion scale which is a set of Likert-scale questions (1 = strongly disagree, 5 = strongly agree) and allows to measure social cohesion in the eco-neighbourhood of Eikenøtt ("Factor analysis," para. 1). A sample item is: "overall, I am attracted to living in this neighbourhood". The two questions of "Given the opportunity, I would like to move out of the

neighbourhood" and "I rarely have neighbours over to my house to visit" are reversed scored for the analysis. The results of the reliability statistics have demonstrated that the level of reliability of the eleven items used to measure social cohesion – based on the work of Fone et al. (2006) – is very good as the Cronbach's Alpha is .873 (Ursachi et al., 2015).

3.1.2 Indicators

Based upon what has been said in the Definitions section, **Table 1** lays down the indicators and types of questions used to measure the concepts of the use of IHD, the energy-saving behaviour of the households, and the perceived social learning in the eco-neighbourhood.

Table 1: Operationalization of the main concepts.

Concepts	Sub-variables	Indicators	Questions
Use of IHD (predictor)	Function of use	Monitoring	Likert scale questions (1 = strongly disagree; 5 = strongly agree)
		Intercom	
		Transports info	
		Goal-setting	
		Remote heating control	
		News info	
		Weather info	
		Communication	
Energy-saving behaviour (outcome)	Pro-environmental habits	Reduce the temperature in the hot water system	Likert scale questions (1 = strongly disagree; 5 = strongly agree)
		Turn the tap off when cleaning teeth	
		Use shower rather than bath	
		Keep heating/air conditioning low to save energy	
		Reduce time spent under the shower	
		Turn the lights off in unused rooms	
		Wait until there's a full load for washing	

		Turn the heat/air conditioning system off in unused rooms	
		Hang the laundry instead of putting it in the dryer	
		Washing clothes using 30°C or less rather than higher temperatures	
		Select eco mode on washing machine and/or dishwasher	
		Unplug appliances before leaving on holiday	
Social learning in the neighbourhood (moderator)	Instrumental learning	Often share advices with other residents on ways to pollute less	Likert scale questions (1 = strongly disagree; 5 = strongly agree)
		I have developed new energy habits by discussing with other residents as I have discovered new ways to reduce my consumption	
		I have developed new energy habits by participating in neighbourhood activities as I have discovered new ways to reduce my consumption	
	Transformative learning	Changing energy behaviour because discussing with other residents have made me question my energy habits	Likert scale questions (1 = strongly disagree; 5 = strongly agree)
		Changing energy behaviour because the norms and the values of the neighbourhood have made me question my energy habits	

Social cohesion (independent variable)	Sense of community	Feeling of belonging to the neighbourhood	Likert scale questions (1 = strongly disagree; 5 = strongly agree)
		Friendships and associations with other residents mean a lot	
		Perception of being similar to the other residents	
	Place attachment	Attraction to the neighbourhood	Likert scale questions (1 = strongly disagree; 5 = strongly agree)
		Wishing to move out, when given the opportunity	
		Working with other residents to improve the neighbourhood	
	Neighbouring	Assisting at the activities organized by the community organization (AQEnøtt)	Likert scale questions (1 = strongly disagree; 5 = strongly agree)
		Visiting other residents in their homes	
		Going to someone in the neighbourhood to get advice	
		Rarely have neighbours over to my house to visit	
		Regularly stop to discuss with other residents	

Source: based on own findings.

3.1.3 Control variables

The analysis of the data should consider the presence of control variables throughout the process (Salkind, 2010). Thus, demographic chrematistics of the respondents are quite important to recognize as they allow a better understanding of the sample (Susanti et al., 2015). For this, the age, the gender, the highest level of education, the current employment status, the household composition, and the household income are important to acknowledge, especially with regard to energy behaviour. Indeed, a senior resident might have more difficulty to use the electronic

displays of eSmart because they lack digital literacy (Schäffer, 2007). Hence, demographic questions should be asked in the questionnaire. Adding to these demographic components, one might want to consider looking at the environmental concerns prior to moving in the neighbourhood as Gadenne et al. (2011) have argued. Indeed, the authors' main assumption was that residents who show energy-saving behaviours tend to have already strong environmental concerns before acting upon their beliefs. Hence, the environmental concerns prior to moving in the neighbourhood is measured by asking a yes/no question.

3.2 Research Strategy

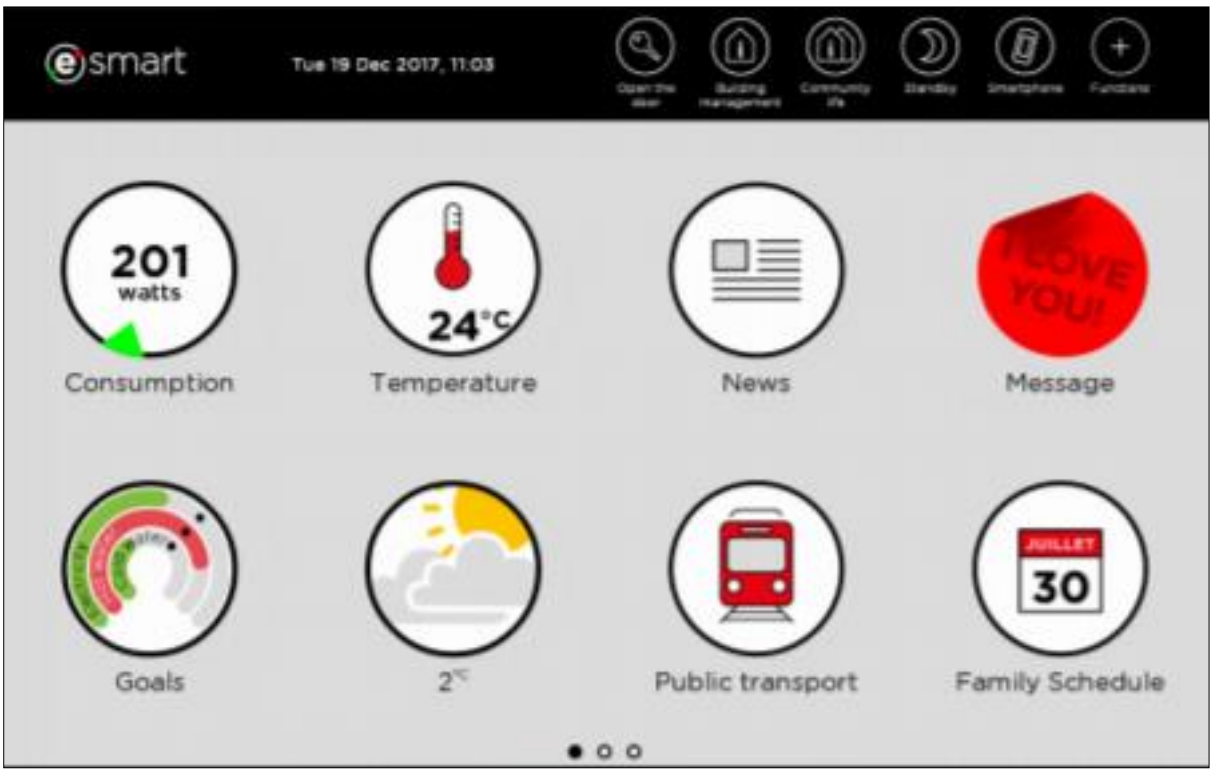
This thesis is deductive in the sense that it seeks to test existing theories (Bryman, 2012, p. 36). In order to be able to do so, a quantitative survey is developed to quantify the collected data. As a result, the features of the dataset collected from the questionnaire are elaborated through statistical tests and a descriptive analysis.

3.2.1 Case-study

According to Bryman (2014), a survey on a single case can reveal important features about its nature (p. 66). Therefore, the research strategy chosen to answer the research question object of this thesis follows a case study design focusing on the eco-neighbourhood of Eikenøtt (Bryman, 2012, p. 67). The chosen case is selected as it is considered to be a representative case – which Bryman (2012) describes as a case providing "a suitable context for research questions to be answered" (p. 70). Eikenøtt is one of the fist eco-districts projects in Switzerland which has been developed by the construction company Losinger-Marazzi, and which has been strongly supported by the City of Gland. The neighbourhood combines residential, which can host up to 1'200 residents, and commercial uses (Architectes.ch, n.d.). Accordingly, the district has been praised for its innovative approach to tackle the challenges of urban areas (Chabas, 2017). Which means that this case can also be described to be a revelatory case as it allows to uncover a precise phenomenon that has not yet been looked into (Bryman, 2012, p. 70). G. Payne and J. Payne (2011) argue that a revelatory case "gives fresh access and generates new ideas" (p. 3). This choice is justified as, although the relationships between the concepts have been discussed by looking into the effect of direct feedback, there still exists some gaps in literature concerning the relationship between the use of IHDs and energy-saving behaviour and whether social learning impacts this relationship. Hence, this phenomenon remains unexplored and a revelatory case can give various insights with respect to these gaps. All the buildings are energy-efficient and are dependent upon different

sources of renewable energies (i.e. district heating, thermal solar panels, photovoltaic panels, and recovery and re-infiltration of rainwater) (Chabas, 2017). In addition to this, Losinger-Marazzi worked with eSmart to provide interactive home-connected IHDs in 230 apartments. This device offers the functions of monitoring the use of energy (i.e. heating, hot water, and electricity), regulating temperature of rooms at distance, goal setting, and videophone (eSmart, 2015b). The touch screen is also interactive in the sense that people have access to the information concerning weather, transports, news, and communication with the building managers and the concierges (eSmart, 2015b).

Figure 2: Home screen of the eSmart IHD.



Source: eSmart (2015b).

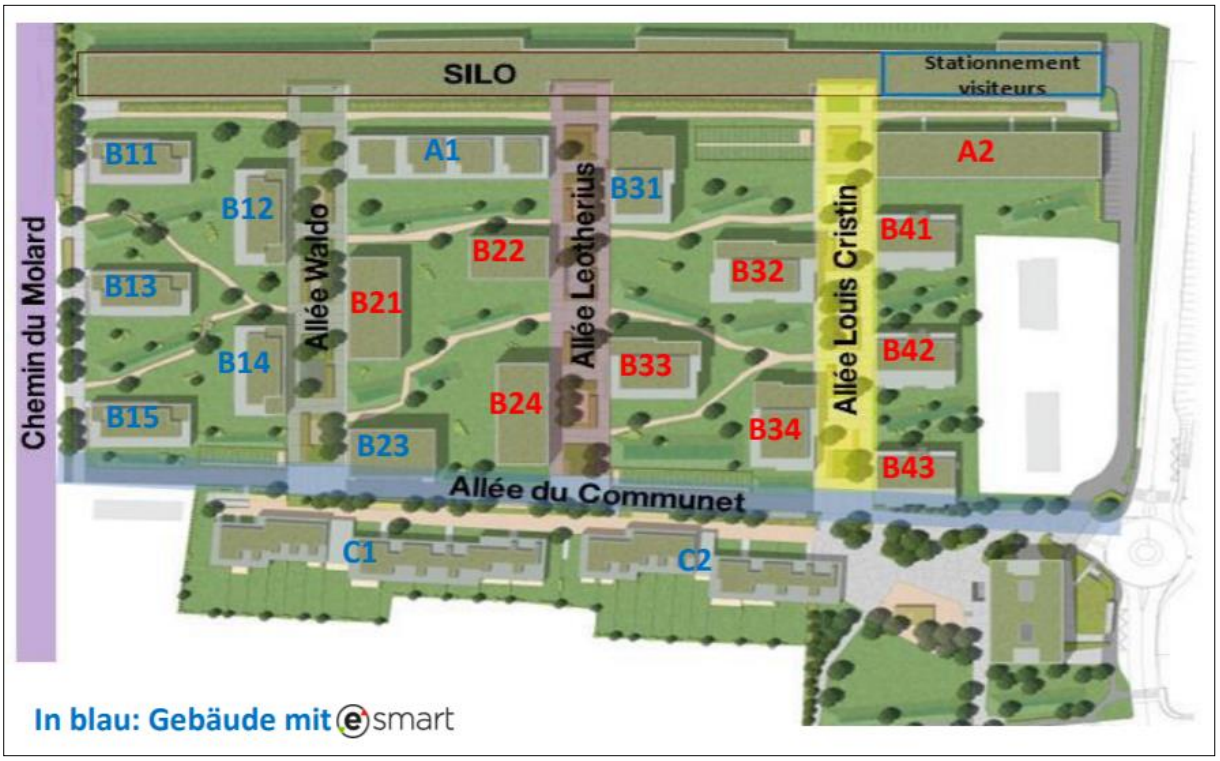
Moreover, the richness of the neighbourhood can be found in its social diversity with different social classes and a strong generational mix (Restrepo, 2015). To strengthen the sense of community of the residents, the district has been designed in such a way that it supports social gatherings among the neighbours (i.e. green and public spaces) (Restrepo, 2015). Furthermore, the neighbourhood organization AQEnøtt was created in 2015 with the purpose to support, inform, and facilitate social gatherings for the residents of the neighbourhood (AQEnøtt, n.d.). Hence, through its unique features, the eco-neighbourhood of Eikenøtt provides to be a great

representative and revelatory case which allows to investigate the main concepts studied in this research (Bryman, 2012).

3.3 Data Collection Method

Participants are targeted in the apartments which have access to the eSmart IHDs. Thus, the author should travel to the neighbourhood to ensure that people which do not have access to the displays do not answer the questions. Therefore, it is important to rely on the information provided by the following map of Eikenøtt which shows which are the buildings to look into and those who should not be considered.

Figure 3: Buildings with the eSmart IHD in Eikenøtt.



Source: Novatlantis (2016).

Furthermore, a link to the questionnaire will be made possible via a QR code requiring the respondents to place their mobile phones' cameras on the code to have instant access to the online questionnaire which will be available via the opensource software Survey Monkey. The QR code will be placed on a small flyer which aims to introduce shortly the author of the questionnaire, the filling out time which of maximum 6 minutes, information concerning how to read the QR code, as well as privacy information to reassure the respondents that their answers are completely

anonymous and will only be used for the purpose of the master's thesis. Finally, the flyer displays the author's email address so that the respondents can ask for the results of the study by the end of the summer 2020.

Preferably, the respondents are to be approached in real-life to enhance the chances that people respond to the survey. Nevertheless, if the residents decide to not open their doors, other measures will be taken to distribute the flyers. For instance, the author can leave the flyer in front of the households' doors, display it in the buildings' lifts, or give the flyers to the neighbourhood organizations which can then distribute them as they a are quite familiar already with the residents. However, if this becomes too complicated with the travel restrictions, one might consider leaving the flyers in the mailboxes of the buildings which have an eSmart. Due to the unforeseen events, there are big changes that this data collection approach will be used and therefore the response rate might end up being lower than expected. This is due to the fact that people might not understand fully how to use their phones to scan the QR code, that people disregard the flyers, that people find this too anonymous, etc.

3.3.1 Sample size and Selection

An online questionnaire is shared to collect the data necessary for this thesis. The individuals answering the survey are considered to be representative of the households' energy-saving behaviour and therefore the survey research has an individual-level of analysis (McKibben & Wilcoxen, 2013, p. 1002). Furthermore, the residents can decide whether they want to participate or not which makes the group of respondents a convenience sample (Leiner, 2016). Moreover, the questionnaire follows a cross-sectional design where the collection of data does not interfere with the observed phenomenon in the sense that the data is collected at a single point in time (Field, 2014, p. 13).

The data collection procedure targets the residents living in the 230 households of Eikenøtt which have access to the eSmart IHDs (Novatlantis, 2016). Hence, the optimal sample size is calculated through Slovin's formula. Which is represented as the following.

$$n = \frac{N}{(1+Ne^2)}$$

Here, "n" is the optimal sample size which makes it easier to infer things about the population (Field, 2014, p. 44). To calculate this, one should already be aware of the margin of error and the confidence level. For this study, the margin of error is .05 and the confidence level

is 95%. As a result, the optimal number required to have a representative sample of the households in Eikenøtt having access to the eSmart IHDs is 146 households.

3.4 Data Analysis Method

The analysis of the collected data is done through the use of the SPSS software. Before starting to test the hypotheses, it is important to standardize the variables – namely the use of IHD, the energy-saving behaviour of the households, social learning, and the control variables (Hanna & Dempster, 2012). By doing so, Hanna and Dempster (2012) argue that "you place the scores in the context of the data distribution from which they came" (p. 155). The analysis uses the Pearson Correlation Coefficient, which is called "r" in statistics, to measure the strength of the relationship between two variables (Field, 2014, p. 274). Accordingly, the values range between -1 and 1 and therefore values which find themselves between 0 and 0.3 or -0.3 represent a weak positive or negative linear relationship; values that range from 0.3 and 0.49 or -0.3 and -0.49 represent a moderate positive or negative linear relationship; and finally, a strong positive or negative linear relationship is understood as being the values between 0.5 and 1 or -0.5 and -1. However, this step allows to determine whether the relationship is linear and to perceive the relationships between the indicators, but not yet to confirm the hypothesis 1. To be able to do so, one can look into the results of a regression analysis to investigate whether there is a main effect ($p < .05$) – showing an association – between the use of IHD and the energy-saving behaviour of the respondents (Field, 2014).

To test the moderating effect of social learning on the relationship between the use of IHD and the energy-saving behaviour of the households, there is a need to analyse the interactions effect (Field, 2014). Before starting the analysis, the predictor and moderator need to be centred. After that, the energy-saving behaviour of the households should be regressed on the control variables, the use of IHD, social learning, and the product term representing the interaction between the use of IHD and social learning (Field, 2014, p. 398). Thus, the analysis can follow Field's (2014) following model to test for moderation (p. 398).

$$Y_i = (b_0 + b_1A_1 + b_2B_i + b_3AB_i) + Error_i$$

Where "Y" is the outcome, "b_1" represents the relationship between energy-saving behaviour and the monitoring use of IHD when social learning is zero, "b_2" represents the relationship between energy-saving behaviour and social learning when the monitoring use of IHD is zero. Furthermore, "b_3" represents the interaction between the use of IHD and social learning.

To be able to confirm hypothesis 2, the interaction term should demonstrate a significant relationship ($p < .05$) in order to show the presence of a moderating effect (Field, 2014, p. 407). Accordingly, a simple slopes analysis should be conducted if the analysis demonstrates that the interaction term result in a significant change where $p < .05$ (Field, 2014, p. 407). Doing so would allow to interpret the relationship between the use of IHD and the energy-saving behaviour at low, mean, and high levels of perceived social learning in the eco-neighbourhood of Eikenøtt.

3.4.1 Validity and Reliability

This section aims to explain the validity and reliability of the measures used in this study. As argued by Bryman (2012), reliability refers to having consistent measures for the concepts which can allow the replicability of the research (p. 168). For this, the internal reliability of the indicators will be measured with Cronbach's alpha – where the closer the coefficient gets to 1, the more it denotes perfect reliability (Bryman, 2012, p. 170). By doing so, it is possible to verify whether the indicators used to measure the concepts are adequate.

The internal validity of the measurement relates to asking whether the chosen indicators really measure the concepts elaborated on in this thesis (Bryman, 2012, p. 171). For this, the theoretical framework has been useful to understand how the academic field has already understood the main concepts and which are the sub-variables linked to them. Accordingly, the methodological framework chapter has operationalized the concepts into concrete dimensions and with direct indicators and therefore it has established the concurrent validity of the concepts' measures (Bryman, 2012, p. 171).

3.5 Fieldwork experience limitations

The limits of the fieldwork experience need to be discussed. Firstly, it has been very difficult, if not impossible, to access information relating to the company responsible for the IHDs. Due to privacy and legal factors, the company and the researchers (at the university) have been unable to share their findings with the author of this thesis. Indeed, access to the private information on the energy consumption of households and their use of the IHD is not possible although smart devices store the information. Hence, this study relies entirely on the answers of the respondents of the questionnaire.

Secondly, the respondents' answers need to be completely honest in order to avoid social desirability bias in the survey (Félonneau & becker, 2008). Indeed, 'being green' has become very

trendy in the Western democracies as there has been an increase in awareness linked to climate change (Matheson, 2008; Culiberg & Egaaïed-Gambier, 2016). Hence, to avoid that the respondents conform to pro-environmental norms – that may exist within their social network, country, or internationally – the author of this research avoids adopting a judgemental tone when writing the questions (FluidSurveys, 2013).

Thirdly, as argued by Field (2014), a bigger sample size leads to the collected data being more representative (p. 198). However, in addition to limited time and resources, this research might come across a high number of non-responses (Field, 2014, p. 199). Thus, it seems unlikely that all the 230 targeted households will answer the questionnaire and therefore explains why the sample represents a convenience sample. This issue can represent a significant problem for the author given the COVID-19 context where people are not recommended to be in contact with others and to isolate (Hoi & Fahy, 2020).

4. Results

This chapter lays down the statistical analysis required to be able to verify the two hypotheses that have been formulated in the Theoretical Framework chapter. For this, a first section gives an overview of the respondents by showing the results of the control variables – namely demographic features and the environmental concerns of the households prior to living in the eco-neighbourhood of Eikenøtt. Then, the Correlation and Regression analyses aim at looking into the relationships between the use of IHD, social learning, and the energy-saving of the households living in Eikenøtt. The internal consistency and the internal reliability of the chosen indicators displayed in the Operationalization section of the Methodological Framework chapter have been verified by measuring the Cronbach's alphas (Bryman, 2012, p. 170).

4.1 Overview of the respondents

Resulting from the 230 flyers distributed, 41 residents of the eco-neighbourhood of Eikenøtt have responded to the online questionnaire and only 33 valid questionnaires have been collected. Meaning that the number of respondents is not sufficient to be statistically representative of the entire population of the 230 households having access to the eSmart IHDs to achieve a confidence level of 95%. This is due to the fact that it was not possible to go visit the neighbourhood and discuss with the residents of Eikenøtt. Following the information displayed by Novatlantis (2016), the flyers have been sent through the mailboxes of the residents having an eSmart screen. Nonetheless, according to Harrell (2001) the number of responses collected is sufficient ($N > 30$) to carry a valid statistical analysis as the number of observations per variable is enough to ensure the validity of the collected data in a linear regression analysis. This allows for the researcher to not be too limited due to time and resources constraints. Hence, although not being able to use the responses as a representative sample, they allow to answer the research question and gain more insights concerning the use of IHD and its relationship with the energy-saving behaviour of the households living in the eco-neighbourhood of Eikenøtt.

Table 2 shows the demographic characteristics of the respondents. It can be seen that all the respondents were between 18 and 64 years old and that no respondent has answered that they were retired. The fact that there is a positive and moderate relationship between the age of the respondents and the years spent in the neighbourhood ($r = .410$, $p < .05$) could be interpreted in such a way that older people tend to have lived longer in the eco-neighbourhood of Eikenøtt.

Moreover, 90.9% of the respondents' households earn more than 50 000 CHF which is more than 4 000 CHF per month minimum (approximatively). Although not having fixed a

minimum revenue per months for the people working in Switzerland, the revenue of 4 000 CHF has been recognized by many Swiss cantons (e.g. Neuchâtel, Jura, etc.) to be the sufficient amount to be able to pay off the rent and amenities, taxes, and food and drinks (Siegenthaler, 2018; "Après les dépenses obligatoires les ménages Suisse disposent de 6984 francs par mois en moyenne," 2019). Which also means that only 9.1 of the respondents have lesser than 50 000 CHF per year. With respect to the respondents' households' annual incomes, a significant negative and moderate correlation ($r = -.490$, $p < .01$) has been with the numbers of year lived in the neighbourhood of Eikenøtt. Which means that the longer the respondents have lived in the eco-neighbourhood of Eikenøtt, the more the household's annual income tends to decrease.

The fact that most of the respondents' households earn more than 50 000 CHF yearly can be understood by looking into the professions. Indeed, 51.5% of the respondents have answered that they were employees and 36.4% of the respondents have answered to be managers or work for higher intellectual professions. Not many respondents, if not any, have answered that they worked in low qualifications industries (e.g. farmers and workers). In parallel to this phenomenon, 90.9% of the respondents have either graduated from higher education institutions or have a vocational education diploma.

Not very surprisingly, 69.7% of the respondents have agreed with the statement that they had environmental concerns prior to living in Eikenøtt which coincides with the literature explaining the interests of people in living in eco-neighbourhoods. Nonetheless, the results do not seem to show a significant correlation ($p > .05$) between the environmental concerns prior to living in the neighbourhood and the energy-saving behaviour of the households. The Theoretical Framework chapter of this thesis has discussed the argument of Gadenne et al. (2011) which concerned the fact that residents who already have strong environmental concerns before acting upon their beliefs should demonstrate an energy-saving behaviour.

Table 2: Respondents' demographic characteristics.

Characteristic	**Range**	**Percentage (%)**
Age	18-24 years	18.2
	25-34 years	27.3
	35-44 years	24.2
	45-54 years	21.2
	55-64 years	9.1

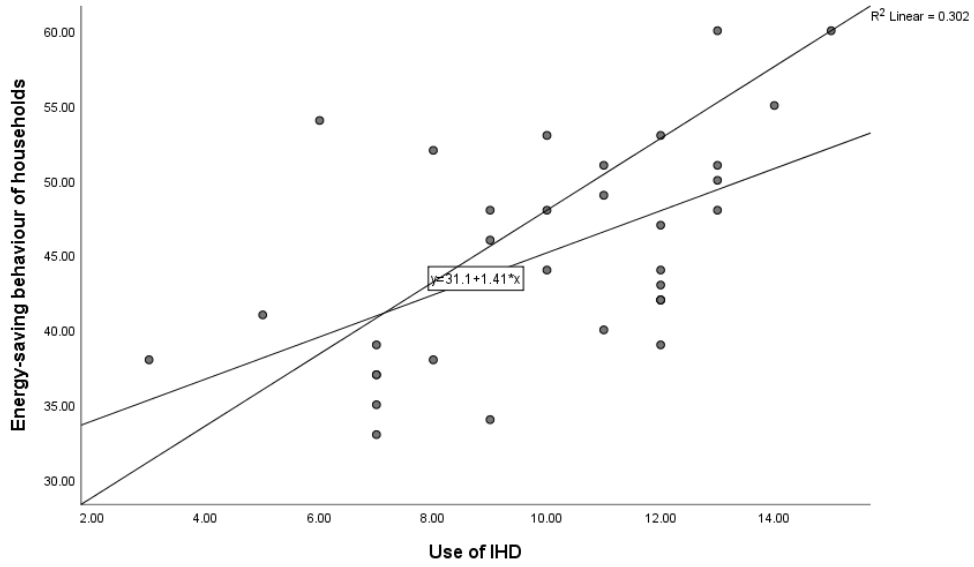
Gender	Female	60.6
	Male	39.4
Household type	Individual	18.2
	Couple	30.3
	Family	45.5
	Shared flat	6.1
Household annual income	0-49 999 CHF	9.1
	50 000-99 999 CHF	21.2
	100 000-149 999 CHF	33.3
	150 000-199 999 CHF	24.2
	200 000 CHF and above	12.1
Highest level of education	Without any diploma	3.0
	Secondary	6.1
	University	60.6
	Vocational education	30.3
Profession	Entrepreneur, craftsman, merchant	3.0
	Manager, higher intellectual profession	36.4
	Employee	51.5
	Teacher	3.0
	Inactive	3.0
	Other	3.0
Years spent in the neighbourhood	1 year or less	33.3
	2-4 years	27.3
	5-6 years	21.2
	7-8 years	18.2
Environmental concern prior to living in the neighbourhood	Yes	69.7
	No	30.3

4.2 Hypotheses testing

4.2.1 Correlations analysis

This section develops upon the relationship between the use of IHD and the energy-saving behaviour of the respondents. By doing so, this allows to understand whether there is a linear relationship between the predictor and the outcome variables. In a first place, the scatter diagram (with reference line from equation and fit line at total) displayed in **Figure 4** seems to indicate that there is a positive relationship between the two concepts.

Figure 4: Scatter diagram with reference line from equation and fit line at total representing the relationship between the use of IHD and the energy-saving behaviour of the households in the eco-neighbourhood.



Hence, one might want to look into the relationships existing between the indicators to be able to better understand the **Figure 4**. For this, **Table 3** was created which illustrates the number of respondents (N), the means, the standard deviation (SD), and the correlation (r).

Table 3: Means, standard deviations (SD) and correlations (r) between the indicators of use of IHD, energy-saving behaviour, and social learning.

		N	Mean	SD	r																	
					1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20
1.	Monitoring	33	3.39	1.273	-																			
2.	Goal-setting	33	2.88	1.409	**.614****	-																		
3.	RHC	33	3.79	1.083	.183	.155	-																	
4.	Reduce temperature in the hot water system	33	2.88	1.269	**.512****	**.527****	**.391***	-																
5.	Turn the tap off when cleaning teeth	33	4.61	.659	-.055	-.063	-.049	.151	-															
6.	Take shower rather than bath	33	4.61	.659	.340	.043	-.011	**.390***	.269	-														
7.	Keep the heating/air conditioning low to save energy	33	3.88	1.269	**.490****	**.409****	.064	**.461****	.046	.184	-													
8.	Reduce time spent under the shower	33	2.91	1.331	**.452****	.326	**.370***	**.630****	.212	.300	**.550****	-												
9.	Turn lights off in unused rooms	33	4.55	.794	.047	.047	-.323	-.020	**.534****	.247	-.097	.042	-											
10.	Wait until there is a full load for washing	33	4.39	.788	-.069	.122	-.022	.078	**.493***	.230	.164	.095	**.430***	-										
11.	Turn the heating/air conditioning system off in unused rooms	33	3.39	1.478	.247	**.403***	.003	**.363***	**.359***	.063	**.377***	**.402***	.084	.206	-									
12.	Hang the laundry instead of putting it in the dryer	33	3.45	1.481	.313	.182	.021	**.363***	**.369***	.135	**.577****	.302	.099	.297	.324	-								
13.	Clean clothes at 30°C	33	3.15	1.417	.225	.253	**.475****	**.494****	.077	.236	.177	**.394***	-.061	-.073	-.002	.096	-							
14.	Select the eco mode	33	3.76	1.347	.121	.221	.340	.257	.147	.064	.083	.325	-.131	.257	.277	.241	.168	-						
15.	Unplug devices when going on holiday	33	3.67	1.137	.181	.280	-.096	.203	-.032	-.101	.335	.309	.115	-.005	.343	.066	.128	-.012	-					
16.	Sharing advices on how to pollute less with other residents	33	2.42	1.091	**.386***	.329	.156	.187	-.051	-.106	.201	.198	-.113	-.200	-.098	-.004	.267	.026	.230	-				
17.	Developing new energy habits since speaking with other residents	33	2.42	1.251	.269	**.369***	.212	.340	-.091	-.119	.277	**.356***	-.265	-.143	.081	.089	**.346***	.262	.296	**.804****	-			
18.	Developing new energy habits since participating in neighbourhood activities	33	2.42	1.200	.292	**.413***	.070	**.385***	.055	-.123	.306	**.387***	-.127	-.067	.196	.184	.313	.291	.309	**.672****	**.904****	-		
19.	Changing energy behaviour because the beliefs and actions of other residents	33	2.48	1.121	.064	.262	.004	.164	.160	-.120	.044	.030	-.011	.041	.294	.093	.387	.138	.325	**.491****	**.663****	**.684****	-	
20.	Changing energy behaviour because of the norms and values of the neighbourhood	33	2.79	1.244	**.396***	**.521****	-.004	**.454****	.086	.080	.260	.328	.126	-.051	.226	.150	.141	.168	**.383***	**452****	**.568****	**.599****	**.558****	-

Note: **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed)

Monitoring has a positive and strong relationship with goal-setting (r = .614, $p < .01$). In other words, these results show that the two indicators tend to move in the same direction – the respondents that use their eSmart device to monitor their energy-consumption tend to use their device to set energy goals for themselves, and vis-versa. Monitoring has also been found to be associated with several indicators of the energy-saving behaviour of the households. Indeed, there is a positive and strong relationship between monitoring and the lowering of temperature in the hot water system (r = 512, $p < .01$). Monitoring has a positive and moderate relationship with keeping the heating and air conditioning low to save energy (r = .490, $p < .01$). Monitoring has a positive and moderate relationship with reducing the time spent under the shower (r = .452, $p < .01$). This does not show causation but demonstrates that if the one variable's value increases, then the other one's value tends to increase as well. The table also demonstrated that the use of the IHD as a goal-setting device had certain relationships with energy-saving behaviour indicators. Firstly, goal-setting has a positive and strong relationship with lowering the temperature in the hot water system (r = .526, $p < .01$). Secondly, goal-setting has a positive and moderate relationship with keeping the heating and air conditioning low to save energy (r = .409, $p < .01$). Finally, goal-setting has a positive and moderate relationship with turning the heating and air conditioning system off in unused rooms (r = .403, $p < .05$). Remote heating control has been also found to

have certain correlations. For instance, remote heating control has a positive and moderate relationship with lowering the temperature in the hot water system ($r = .391$, $p < .05$). Additionally, remote heating control has a positive and moderate relationship with reducing the time spent under the shower ($r = .370$, $p < .05$). Further, remote heating control has a positive and moderate relationship with cleaning clothes at 30°C ($r = .475$, $p < .01$).

Interestingly, the results also seem to show various significant and positive correlations between the indicators of social learning and the indicators of the use of IHDs. Except for the remote heating control use of the eSmart screen, the goal-setting and monitoring use have certain relationships with instrumental and transformative learning. On the one hand, the respondents that have agreed with the use of the eSmart screen for goal-setting purposes tend to agree the more with the following statements: "I have developed new energy habits since speaking with other residents ($r = .369$, $p < .05$), "I have developed new energy habits since participating in neighbourhood activities" ($r = .413$, $p < .05$), and "I have changed my energy behaviour because the norms and values of the neighbourhood have made me question my own energy consumption habits" ($r = .521$, $p < .01$). On the other hand, the respondents that have agreed with the use of the eSmart screen for goal-setting purposes tend to agree the more with the following statements: "I share advices on how to pollute less with other residents" ($r = .386$, $p < .05$) and "I have changed my energy behaviour because the norms and the values of the neighbourhood have made me question my own energy consumption habits" ($r = .396$, $p < .05$).

Further, one can find many significant and positive correlations between the indicators of social learning and the energy-saving behaviour of the respondents on **Table 3**. For instance, the people that have agreed the most with reducing the time spent under the shower tend to have agreed the most with the following statements: "I have developed new energy habits since speaking with other residents" ($r = .356$, $p < .05$), "I have developed new energy habits since participating in neighbourhood activities ($r = .387$, $p = < .05$), and "I have changed my energy behaviour because the norms and values of the neighbourhood have made me question my own energy consumption habits" ($r = .454$, $p < .01$). All in all, it seems complicated to infer causality from these results, but the results still allow to understand more thoroughly how every concept used in this research relate to one another.

While looking into the **Table 3**, one can notice that the usage of IHD has less correlations with the energy-saving behaviour indicators. To be able to understand better the differences between the types of uses, the **Table 4** has been drawn. This following table shows that remote heating control demonstrates a positive and non-significant relationship with the energy-saving

behaviour of the households. In addition to showing that monitoring and goal-setting have a positive and strong relationship, **Table 4** mainly shows that goal-setting has a stronger relationship with the energy-saving behaviour of the households.

Table 4: Relationships between the use of the IHD to monitor, to set energy use goals, for remote heating control, and the energy-saving behaviour of households.

	Monitoring	Goal-setting	RHC	Energy-saving Behaviour of Households
Monitoring	-			
Goal-setting	**.614****	-		
RHC	.183	.155	-	
Energy-saving Behaviour of Households	**.469****	**.489****	.265	-

Note: **. Correlation is significant at the 0.01 (2-tailed).

Pearson's correlation coefficient (r) was calculated with Spearman's rho (ranks) to be able to perceive the correlation between the predictor and the outcome variables. To do so, the indicators established for the use of IHD were combined into one item as well as the indicators established for energy-saving behaviour of the households. The average (mean) of the three Likert-scale questions has been used to be able to summarize the variable of use of IHD (Kostoulas, 2014). The results of the correlation analysis with the combined items is shown in **Table 5**.

Table 5: Relationship between the use of IHD and the energy-saving behaviour of the households.

	Use of IHD	Energy-Saving Behaviour of Households
Use of IHD	1	.555** [.232, .798]
Energy-Saving Behaviour of Households	.555 [.232, .798]	1

Notes: **. Correlation is significant at the 0.01 level (2-tailed). BCa bootstrap 95% Cis reported in brackets.

To conclude this section, the results do not yet confirm the hypothesis 1 as they showed a positive and strong correlation between the predictor and the outcome variables ($r = .555$, $p <$

.01). This shows that the respondents who use their eSmart device tend to demonstrate energy-saving behaviour (as one variable increase there a strong tendency for the other one to increase).

Before being able to confirm the hypotheses 1 and 2, the author of this thesis wanted to verify the relationship between social cohesion in the eco-neighbourhood of Eikenøtt and social learning. The results displayed in **Table 6** from the correlation analysis demonstrate a significant positive relationship ($r = .554$, $p < .01$). Although not establishing the causality chain between the concepts, the results of the correlation have demonstrated that the value of social cohesion increases when the value of social learning increases – and vis-versa.

Table 6: Relationship between the social cohesion and social learning.

	Social cohesion	Social learning
Social cohesion	1	.554** [.282, .738]
Social learning	.554** [.282, .738]	1

Notes: **. Correlation is significant at the 0.01 level (2-tailed). BCa bootstrap 95% Cis reported in brackets.

Table 7 is drawn to give more details concerning how the indicators of social learning and social cohesion are related. On the one hand, this table shows that the indicators of social cohesion that have the highest number of significant (positive) correlations ($p < .01$) with the indicators of social learning are: "I rarely have other residents visiting me at home" (reversed scored), "I visit other residents in their homes", and "the friendship and associations with other residents mean a lot to me". On the other hand, this table also demonstrates that the indicators use to measure the place attachment aspect of social cohesion "when given the opportunity, I want to leave" (reversed scored) and "I work with other residents to improve the neighbourhood" do not have any significant correlations ($p < .01$) with the indicators of social learning. Of course, given the low number of respondents, it seems dangerous to conclude anything from these non-significant relationships. Another interesting phenomenon concerns the indicator "I have developed new energy habits since participating in neighbourhood activities". In fact, the analysis has found three significant moderate and positive correlations with "feeling of belonging to the neighbourhood" ($r = .451$, $p < .01$), "I visit other residents in their homes" ($r = .573$, $p < .01$), and "the friendship and associations with other residents mean a lot to me" ($r = .651$, $p < .01$).

Table 7: Means, standard deviations (SD) and correlations (r) between the indicators of social cohesion and social learning.

		N	Mean	SD	r														
					1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1.	I assist at the activities organized by the community organization	33	2.73	1.526	-														
2.	Overall, I am attracted to the life in the neighbourhood	33	3.67	1.137	**.592** **	-													
3.	Feeling of belonging to the neighbourhood	33	3.52	1.202	**.503** **	**.844** **	-												
4.	I visit other residents in their homes	33	3.00	1.118	.401*	.170	.298	-											
5.	The friendships and associations with other residents mean a lot to me	33	3.52	1.202	**.520** **	**.605** **	**.705*** *	**.444*** *	-										
6.	When given the opportunity, I want to leave the neighbourhood	33	3.70	1.015	.089	.321	.253	-.299	.005	-									
7.	I can ask other residents for advice	33	3.76	.902	**.469** **	.412 *	.410*	.278	.432*	.022	-								
8.	I work with other residents to improve the neighbourhood	33	3.67	1.164	**.666** **	**.638** **	**.610*** *	.302	**.556*** *	.185	**.509** **	-							
9.	Feeling of being similar to the other residents	33	2.94	.899	.130	.373 *	.345*	.108	.309	.254	.203	.292	-						
10.	Rarely have other residents visiting me at home		2.76	1.062	.422*	.193	.418	.519*	.562* *	-.064	.249	.211	.121	-					
11.	I regularly stop to speak with other residents	33	3.48	1.253	.334	**.465** **	**.706*** *	.384*	**.658*** *	.046	.296	.413 *	.172	**.462*** *	-				
12.	I share advices on how to pollute less with other residents	33	2.42	1.091	.420*	.330	**.552*** *	**.491*** *	**.548*** *	-.241	.230	.285	.304	**.468*** *	**.517*** *	-			
13.	I have developed new energy habits since speaking with other residents	33	2.42	1.251	**.522** **	.342	**.517*** *	**.585*** *	**.654*** *	-.214	.150	.396 *	.242	**.759*** *	**.500*** *	.804	-		
14.	I have developed new energy habits since participating in neighbourhood activities	33	2.42	1.200	.384*	.284	**.451*** *	**.573*** *	**.651*** *	-.150	.061	.333	.333	**.729*** *	**.429***	**.672*** *	**.904*** *	-	
15.	I have changed my energy-behaviour because the beliefs and actions of the other residents have made me question my energy consumption habits	33	2.42	1.121	.191	.089	.169	**.476*** *	**.480*** *	-.280	.171	.316	.372 *	**.493*** *	.275	**.491*** *	**.663*** *	**.684** **	-
16.	I have changed my energy behaviour because the norms and values of the neighbourhood have made me question my own energy consumption habits	33	2.79	1.244	.019	- .006	.163	.280	.377*	-.214	- .096	-.015	.059	**.455*** *	.171	**.452*** *	**.568*** *	**.599** **	**.558** **	-

Note: **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed)

All in all, this section allows to perceive the strengths of the relationships between the concepts analysed in this research. To be able to verify the hypotheses formulated in the Theoretical Framework chapter, the following section discusses the regression analysis in order to look into the association between the use of IHD and the energy-saving behaviour as well as the moderating effect of social learning in this relationship.

4.2.2 Regression analysis

The hypothesis 1 was: the use of IHD is positively associated with the energy-saving behaviour of the households living in Eikenøtt. For this, **Table 8** demonstrates that there is a positive association between the use of IHD and the energy-saving behaviour variables as one can notice a main effect – which is the effect of the independent variable on the dependent variable ($t = 2.47$, $p < .05$). This adds to the previous correlation section of the Analysis chapter by showing that a higher value of the use of IHD results in a higher value of energy-saving behaviour by the respondents. The results of the regression analysis illustrated in **Table 8** confirm hypothesis 1.

Table 8: Linear Model of predictors of energy-saving behaviour.

	b	SE B	*t*	*p*
Constant	-0,274 [-2.43, 1.88]	1.053	-0.26	.80
Use of IHD (Centred)	1.273 [0.22, 2.33]	0.516	2.47	.02
Social Learning (Centred)	0.185 [0.36, 0.73]	0.265	0.697	.49
Use of IHD X Social Learning	0.070 [-0.16, 0.30]	0.111	0.633	.53

Note: $R^2 = .28$

The hypothesis 2 concerned the moderating impact of social learning in the neighbourhood on the relationship between the use of IHD and the energy-saving behaviour of the households. In the correlation analysis, the results seemed to indicate that various items used to measure energy-saving behaviour and social learning positively correlated. In order to confirm hypothesis 2, the interaction term of social learning in the neighbourhood and the use of IHD should result in a significant change in explaining variance in the energy-saving behaviour of the households. To do so, **the Table 8** illustrates the linear model of predictors of energy-saving behaviour. The table demonstrates that the interaction term does not result in a significant change ($p > .05$) in explaining variance in energy-saving behaviour of the respondents and thus hypothesis 2 cannot be confirmed. Hence, the **Table 8** shows that the moderation effect of social learning on

the relationship between the use of IHD and the energy-saving behaviour of the respondents is not significant ($t = 0.697$, $p > .05$). Nonetheless, it is possible that the results do not demonstrate a significant effect as the number of respondents remains very low. According to Field (2014), a "very large and important effects can be missed simply because the sample size was too small" (p.75). This matter is very important to keep in mind as this should be considered when wanting to replicate this study.

Although not finding a significant moderating effect, Field (2014) argues that examining the simple slopes would help to understand better how a variable might affect the relationship between the predictor and the outcome variables (p. 403). As a result, **Table 6** lays down the conditional effect of the use of IHD on the energy-saving behaviour of the respondents at values of social learning in the neighbourhood. The simple slopes allows to understand the results of three different regressions: the regression for the use of IHD as a predictor of energy-saving behaviour when the perceived social learning in the neighbourhood is low (-4.19), at the mean value of perceived social learning in the neighbourhood (0), and when the value of perceived social learning is high (4.19). The **Table 9** shows the results of the three regressions.

Table 9: The effect of IHD on energy-saving behaviour at different values of social learning.

Social Learning	Effect	se	*t*	*p*
-4.19 [-0.18, 2.14]	0,9803	,5663	1,7312	.094
0.00 [0.22, 2.33]	1,2734	,5162	2,4669	.0198
4.19 [-0.07, 3.20]	1,5666	,8005	1,9569	.06

Table 9 appears to indicate that the value of the effect of the use of IHD on the energy-saving behaviour increases when the level of perceived social learning goes up, while non-significant. When social learning in the neighbourhood is low, there is a non-significant positive relationship between the use of IHD and the energy-saving behaviour of the respondents, $b = 0.98$, 95% CI [-0.18, 2.14], $t = 1.73$, $p > .05$. At the mean value of the perceived social learning in the neighbourhood, there is a significant positive relationship between the use of IHD and the energy-saving behaviour of the respondents, $b = 1.27$, 95% CI [0.22, 2.33], $t = 2.47$, $p < .05$. When the perceived social learning in the neighbourhood is high, there is a non-significant positive relationship between the use of IHD and the energy-saving behaviour of the respondents, $b = 1.57$, 95% CI [-0.07, 3.20], $t = 1.96$, $p > .05$. Hence, it is not possible to confirm hypothesis 2 with the existing results but one can argue that there is a trend for this statement as the relationship

between the use of IHD and the energy-saving behaviour of the households is stronger when the level of perceived social learning is high than when social learning is low.

5. Theoretical implications

When trying to make sense out of the control variables and the outcome variable, it has been surprising to find out that having environmental concerns prior to living in the neighbourhood is not strongly associated with the energy-saving behaviour of the respondents. This is the opposite of what Gadenne et al. (2011) have argued concerning having strong environmental concerns prior acting on their beliefs and therefore they have considered this variable as an important determinant of developing pro-environmental habits. Nevertheless, one should bear in mind that many factors may be responsible for not finding a significant relationship at this stage (e.g. limited number of responses collected).

Before going further, it seems important to remind that the Theoretical Framework chapter has developed that various functions of direct feedback – namely goal-setting and remote heating control, smart metering systems – could have an important influence over the energy-saving behaviour of the households living in energy-efficient buildings (Karlin et al., 2015; Hargreaves, 2018; Geelen et al., 2019). According to Geelen et al. (2019), the influence of IHDs on the energy consumption of the end-users are more effective when the screen combines various functions and therefore implies that the consumer uses the device more frequently. The effect has been developed as an empowering effect as Westkog et al. (2015) have argued that using direct feedback devices gives a sense of control over the energy consumer's own spending and usage. With respect to this, the eSmart device offers various services – namely monitoring, setting energy targets, and controlling heating remotely – and therefore this can explain the findings of this research. Hence, the choice of looking into the IHD eSmart and its effect on the energy habits of the households in the eco-neighbourhood of Eikenøtt. Although the Analysis section has laid down surprising results, the correlation analysis has looked into the significant relationships between the indicators of the use of IHD and the energy-saving behaviour and one can notice that the three functions affiliated to energy-saving are correlated with many features of energy-saving behaviour. The correlation and the regression analyses have allowed to confirm the hypothesis 1 by showing that there is a main effect between the predictor and the outcome variables – which demonstrates that the use of IHDs is positively associated with the energy-saving behaviour of the households. Consequently, the findings are in line with what has been said in the academic literature with respect to the influence of direct feedback devices on the energy-saving behaviour of households, including those that live in energy-efficient buildings (Kantola et al., 1984; Ehrhardt-Martinez et al., 2010; Westskog, 2015; Geelen et al., 2019). As a result, this thesis has shown that the effect of the use of the eSmart IHDs on the energy-saving behaviour of the households living in Eikenøtt

is not without consequence and that direct feedback does seem to play a crucial role in empowering the residents to control their energy consumption and to act in a pro-environmental way.

The findings of the analysis seem coherent with what Reed et al. (2010) have said with respect to the relationship between social cohesion and social learning within a neighbourhood. The underlying assumption of their research related to the fact that people learn through social interactions either by accumulating new knowledge or by changing their understanding of what energy consumption means. The results of the analysis indicate that there is a strong positive correlation between the two concepts. This seems relevant, especially in the discourse of eco-neighbourhoods, as sustainable neighbourhoods are thought in such a way that they create a strong social network where people are encouraged to share experiences together (Barton, 2000; Anquetil, 2009; Tsai, 2014; Medved, 2017). In accordance with what Francis et al. (2012) have said with respect to the importance of public space, Price et al. (2010) have argued that the design of sustainable districts can enable a strong sense of community, place attachment, and neighbouring "by providing opportunities for face-to-face interaction" (p.9). The findings of the Correlation Analysis section seem to indicate that certain aspects of social cohesion related to the sense of community and neighbouring have an important number of significant relationships with the indicators of social learning. Interestingly, the Correlation Analysis section also shed light on the fact that the respondents that saw themselves develop new energy habits since participating in neighbourhood activities organized by AQEnøtt in Eikenøtt were also where they felt that the friendships and associations made in the neighbourhood mean a lot to them. This seems to verify what McMillan and Chavis (1986) have argued when stipulating that people "who participated in block associations" tended to report higher levels of sense of community (p. 7).

The purpose of not establishing a causality chain between the two concepts of social learning and social cohesion is due to the fact that the existing literature has established that both concepts are related but does not come to an agreement concerning how one affects the other (Anquetil, 2009; Azizi et al., 2019). On the one hand, social interaction can influence social learning as the people who interact might develop a strong attachment to the area in which they live. On the other hand, social learning might have an influence on social cohesion as people who discuss their energy-related experiences and norms might lead to a stronger feeling of commitment towards the neighbourhood and towards the advocacy of the environmental norms within the eco-neighbourhood (Azizi et al., 2019). This being said, the results of this research appear to indicate that social cohesion and social learning in the eco-neighbourhood of Eikenøtt are positively related. As a recommendation for further research, one might consider looking more thoroughly

into the association (effects) between the three sub-variables of social cohesion and the indicators used to measure social learning.

Moreover, this research has not considered social learning as a predictor of energy-saving behaviour of the households living in eco-neighbourhoods but as a variable which could strengthen the relationship between the use of IHDs and the energy-saving behaviour of the households. The regression analysis has shown that there is no main effect between social learning and the energy-saving behaviour although the correlation analysis has laid down many significant relationships between the indicators used to measure social learning and the indicators used to measure the energy-saving behaviour of the households. Thus, one can presume that they are significantly related however how these findings do not allow to understand how one concept affects the other one. On the one hand, one may presume that the people who share more pro-environmental habits advices and norms are the people that actively engage in energy-saving behaviours. On the other hand, one may trust that the households that engage the most in energy-saving behaviours are the most prone to share advices and/or to be willing to learn from others' habits and norms. Even if this analysis has been particularly useful in order to understand how the concepts relate to one another and the strengths of their relationships, it appears difficult to establish a clear causality chain between social learning and the energy-saving behaviour with the current results.

Yet, the Theoretical Framework chapter assumed – based on the existing literature – that social learning might strengthen the relationship between the use of IHD and the energy-saving behaviour and therefore that social learning in the eco-neighbourhood of Eikenøtt moderates this relationship (Carruth, 1976; Ehrhardt-Martinez et al., 2010; Wilhite, 2014; Macias & Williams, 2016). Macias and William (2016) have shown that people are prone to reflect upon their environmental lifestyles by spending time with other residents in the same neighbourhood. Hence, hypothesis 2 was developed to test whether the use of IHD is more strongly associated to the households' energy-saving behaviour when the perceived social learning in the neighbourhood was high. The reasoning behind hypothesis 2 has been that for people to feel empowered by the use of such a technology; people have to know how to adapt their behaviour to the information and functions offered by the eSmart IHDs. Certain residents might not necessarily know about ways in which they can change or develop new energy habits and this is why social learning has been assumed to have an impact on the relationship between the use of the eSmart screen and the energy-saving behaviour of the households living in Eikenøtt (Ehrhardt-Martinez et al., 2010). However, the results of the regression analysis do not confirm the hypothesis 2 as the interaction term is not significant. Nonetheless, the simple slopes analysis has allowed to perceive a trend as

the relationship between the use of IHD and the energy-saving behaviour of the households is stronger at higher levels of social learning – although the relationship between the predictor and the outcome is not significant when the value of social learning is high. Based on this, it remains impossible to confirm hypothesis 2 as the moderation effect of social learning on the relationship between the use of IHD and the energy-saving behaviour of the respondents is not significant. To sum, the analysis allows to shed light on interesting relationships, but it is important to recognize that the sample size remains an important factor which could explain not finding a significant relationship (Field, 2014). Consequently, further research is welcomed to test the moderating effect of social learning on the relationship between the use of the eSmart IHD and the energy-saving behaviour of the households living in Eikenøtt.

6. Conclusions, limitations and implications

With respect to everything that has been said previously, this section aims to conclude this research by answering the research question and displaying the main findings of the Analysis chapter. Moreover, it is important to show the principal limitations of the findings in order to be able to discuss the implications and the recommendations for further research.

6.1 Conclusion

This thesis has sought to respond to the following research question: What is the effect of the use of IHDs on the energy-saving behaviour of households living in the Eikenøtt sustainable neighbourhood and what is the impact of social learning on this relationship? The eco-neighbourhood Eikenøtt in Switzerland has been chosen as it appeared to be a representative and revelatory case study which allowed to look into the relationships between the variables. After having developed upon the relationship between the concepts used in the Theoretical Framework chapter, the Analysis chapter has demonstrated that there is a strong and positive correlation between the respondents' use of the IHD for energy-related purposes and their energy-saving behaviour.

Although not being able to generalize the results, this research shed light on many phenomena which may be interesting to investigate in the future. The first research sub-question concerned the effect of the use of IHD on the energy-saving behaviour of the households. As a response, the results of the analysis indicate that the use of IHD is positively associated with the energy-saving behaviour of the households living in the sustainable district of Eikenøtt. The main effect found in the regression analysis allows to give a direction to the relationship investigated in the correlation analysis. Thus, the findings align with the existing body of literature concerning the effect of direct feedback on pro-environmental behaviours. The Theoretical Framework chapter has developed that people living in energy-efficient buildings do not necessarily act accordingly to reduce their energy use and therefore this might alter the long-term goals of implementing such infrastructures. Hence, in certain cases – such as in Eikenøtt – the construction companies have decided to incorporate smart metering systems for the buildings in order to respond to this issue. Further, the analysis adds to the existing knowledge concerning this phenomenon that IHD – by combining various functions of direct feedback – empowers the end-users to control their energy use and their spending by being able to monitor their consumption, set energy targets, and control their heating remotely. The underlying assumption for this effect has been argued throughout this

paper to be due to the fact that the households are enabled and empowered to engage in an energy-saving behaviour. Consequently, the results allow to confirm hypothesis 1.

Before looking into the impact of social learning on the relationship between the use of the eSmart IHDs and the energy-saving behaviour of the households having access to the device, the Theoretical Framework chapter developed that social cohesion and social learning are positively related. The Analysis chapter has verified this assumption by looking into the relationships between the indicators used to measure the two concepts. Of course, this does not show how does one affect the other but indicates how the concepts are connected. This sheds light on the value of recognizing the role of the design of an eco-neighbourhood to create a place where the residents can develop a strong sense of community, place attachment, and neighbouring. By creating an environment where people are expected to exchange and spread environmental norms, the residents can learn from one another in terms of energy-saving habits and environmental norms. The results also pointed out the need to know more about the role that AQEnøtt plays by indicating that the people that believe that the friendships and associations in the neighbourhood mean a lot to them are also the people that have developed new energy habits by participating in activities organized by the community associations.

Finally, it appears difficult to confirm hypothesis 2 – with respect to the moderating effect of social learning on the relationship between the use of IHD and the energy-saving behaviour of the households living in Eikenøtt – as the interaction term between the use of IHD and the social learning in the eco-neighbourhood does not result in a significant change in explaining variance in the energy-saving behaviour of the respondents. This is probably due to the fact that there is a limiter number of respondents. Nonetheless, the results of the simple slopes analysis demonstrate a trend with respect to hypothesis 2 as the relationship between the use of IHD and the energy-saving behaviour of the households in Eikenøtt is stronger when the level of perceived social learning is high, than when social learning is low. Thus, one can summarize these findings by arguing that social interactions and the norms in the sustainable district of Eikenøtt are important for the households having access to eSmart screens to engage in energy-saving behaviours. The effect of peers on the pro-environmental behaviour of others has been recognized throughout this study to allow people to reduce their energy when they initially feel helpless or unaware of the need to change their habits. Moreover, instrumental and transformative learning in eco-neighbourhoods can take place under the form of participation to neighbourhood activities, daily encounters, formal meetings, etc (Tsai, 2014). All in all, some people might be unaware of the effect of using their eSmart IHD and the need to act in a pro-environmental way and therefore social interactions and norms in the neighbourhood might constitute a solution to this matter as

the households can discover new ways of reducing their consumption and/or change their understanding of what it actually means to pollute less.

6.2 Limitations

Indubitably, this research has come across various obstacles which are important to mention here. The first one being the very low response rate concerning the online survey. Having 33 respondents allowed to investigate some relationships but does not allow to perceive the results as representative of the entire targeted group – namely the households which have access to the eSmart devices in the eco-neighbourhood of Eikenøtt. In the Methodological Framework chapter, the calculation of Slovin's formula has showed that the optimal sample size should be of 146 households. In order to overcome this small sample issue, households living in Eikenøtt and the community organization AQEnøtt have been contacted through LinkedIn and Facebook. Due to the COVID-19 epidemic, the people have demonstrated a lower level of willingness to collaborate and the idea of conducting interviews has been excluded.

Additionally, the epidemic has also resulted in the important difficulty to physically go to the neighbourhood as the transports were cancelled or disrupted during the researching process period. Another alternative which has been sought was to discuss with the project developers working at the Municipality of Gland, Losinger-Marazzi and at eSmart. The purpose of doing so was to understand the trends with respect to the energy consumption of the households living in Eikenøtt. However, this alternative has also been rejected as the companies have quickly argued that it was impossible to share this information because of the data privacy matter.

Finally, the choice of Eikenøtt has some limitations in the sense that one can assume that people living in a sustainable district are more inclined to focus on sustainability. In other words, the findings are reduced to the context of an eco-neighbourhood and therefore this narrows even more the external validity of the findings. However, it has been argued in the Methodological Framework chapter that this case has been chosen to be representative of the investigated phenomenon and to reveal certain relationships. Thus, one cannot conclude from these results that the use of IHD and social learning have the same effect on the energy-saving behaviour of residents living in other settings.

6.3 Implications and further research

The study of eco-neighbourhoods has become very important as urban developments have become more experimental over time. Indeed, the entire concept of *living lab* has been created in order to give more room for the designers, policy-makers, and residents to think about ways to overcome complexity in urban areas (e.g. pollution, high-density, gentrification, etc.) (Scholl & Kemp, 2016). This research contributes to the knowledge of eco-neighbourhoods in the sense that it has demonstrated that various factors relating to the conception of the district might have an effect on the long-term energy behaviour of the residents. For instance, the design of public spaces – where people could meet and interact – and the integration of smart metering systems in the buildings could ensure that people act in a pro-environmental way in a neighbourhood which promotes such values. Of course, due to a lack of time and resources, the regression analysis cannot predict how one variable affects the other one over time. Therefore, one might want to consider conducting a longitudinal study concerning data retrieved in different points in time (Caruana et al., 2015). This would contribute even more to the existing knowledge of the use of IHD and the energy-saving behaviour or households living in eco-neighbourhoods by tracking change over time.

The quantitative aspect of this research has helped to understand relationships and trends concerning a phenomenon that remains overlooked. Notwithstanding, the presence of statistical correlation is an important step towards the exploration of the relationships between the energy-saving behaviour of the households living in a sustainable neighbourhood, the use of IHD, and the perceived social learning in the neighbourhood. This study used Eikenøtt as a representative and revelatory case and therefore the findings cannot be generalizable. In order to go deeper in this exploration and be able to look into the external validity of the findings, one might consider conducting a cross-case analysis. More recently, Losinger-Marazzi has worked again with eSmart in Zurich to implement smart metering system in the development of the Greencity project (eSmart, n.d.). Looking into projects from the German- and the French-speaking regions of Switzerland might also shed light on the different energy-saving behaviour (Mühlemann, 2012). At the moment, using this case seems a bit to fresh to use in a research as not all the residents have moved in yet, but one might find it interesting to use Greencity, in a few years, to conduct a cross-case analysis.

It has been said that the number of respondents is far too small to be able to interpret the results as representative of the households living in Eikenøtt which have access to an eSmart device. Meaning that a higher level of respondents answering the survey might change the

significance of the relationships and effects between the investigated variables. For example, having more respondents might also shed light on the surprising non-significant correlation between having environmental concerns prior to living in the neighbourhood and the energy-saving of the households living in the eco-neighbourhood of Eikenøtt. Thus, with more time and resources, one may want to consider going physically to Eikenøtt and collect more responses which would allow to have a representative sample for testing the two hypotheses. By doing so, the data collection process would respect the initial idea when writing the research design.

Another way to add more insights with respect to the quantitative data would be to combine methods by doing a quantitative and qualitative research. According to Bryman (2012), a mixed methods approach allows to understand the "perspectives of the people" and thus this would enable to ask questions relating to the experience of the users of the eSmart device and how they believe that this IHD could affect their energy behaviour (p.647). For instance, conducting interviews could shed more light on the opinions of the people living in the sustainable district of Eikenøtt with respect to the relationship between social cohesion and social learning in the neighbourhood. Indeed, the positive correlation between both variables might be interesting to further investigate as it could highly contribute to the existing knowledge on the concept of an eco-neighbourhood and its design considerations. Even though the direction of this relationship was not the central focus of this research, this seems relevant to point this out as social cohesion should be considered necessary for the success of urban neighbourhood development processes. Additionally, when running the correlations, the results demonstrated interesting relationships between the functions of IHD. For instance, using the IHD as a monitoring device and using it as a goal-setting device are related. Consequently, it seems interesting to look into this to contribute to the field of direct feedback and how these screens – which are a combination of multiple usages – are used by the end-users and how can the various functions play a role in helping the consumers to reduce their energy consumption.

Finally, as a more general recommendations for further research, one might want to consider contributing to the discussion surrounding data privacy by investigating who and why people are interested in giving their data more visibility. In fact, the issue of data privacy has been met when asking the developer of the eSmart device to share certain information as they are not allowed to store and use the data. The only actor allowed to use the data is the construction company and, with the current state-of-affairs, cannot transfer the data to any external party. This matter is more important than it appears to be as the many academics have argued in favour of making the information public as there is a strong belief that people who compare their energy

consumption will reduce their use. Hence, it would be interesting to learn more about this topic which remains unclear (Ehrhardt-Martinez et al., 2010; Cellina et al., 2019; Zangheri et al., 2019).

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Annex 1: The Invitation to Participate to the Online Questionnaire

UNIVERSITÉ ERASMUS DE ROTTERDAM, PAYS-BAS

INVITATION POUR PARTICIPER À UN QUESTIONNAIRE EN LIGNE

Chers résidents d'Eikenott,

Afin de finaliser ma **thèse de master** en Administration Publique à l'Université Erasmus de Rotterdam, **J'ai besoin de votre aide (et opinion)** à propos de certains sujets pour pouvoir vérifier les theories et liens entre les concepts utilisés dans ma recherche. Vous pouvez accédez au sondage en ouvrant votre application pour prendre des photos sur votre téléphone et pointer l'appareil photo pour **scanner le QR-code** ou vous pouvez **copiez le lien** dans votre navigateur.

https://fr.surveymonkey.com/r/eco-quartier-eikenott

Vous avez certainement d'autres choses à faire en cette période difficile, mais je voulais juste vous faire savoir que **cela ne devrait prendre que 6 minutes de votre temps** et que **vos réponses seront anonymes**. De plus, **les données collectées ne seront utilisées qu'à des fins académiques** et vous pouvez toujours m'envoyer un e-mail si vous êtes intéressé par les résultats de ma recherche à clarissedecerjat@gmail.com. Je tiens à vous remercier d'avance pour votre temps et votre aide.

Sincèrement,
Clarisse

Annex 2: The Survey (translated from French)

Eikenott: Understanding the Energy Consumption of Residents in an Eco-neighbourhood
I am a student studying the MSc Public Administration with a specialization in Urban Governance at the University of Rotterdam (Netherlands). I wish to test certain theories by using the eco-neighbourhood framework of Eikenott. I would like to take this opportunity to reassure you about the confidentiality of the data as your responses will be anonymous and will only be used for academic purposes.
Also, the questionnaire displays 18 questions and should not take more than 6 minutes of your time. For this research to be valid and relevant, I need you to be as honest as possible. Just know that there are not good and bad answers!

1. How old are you?

Below 18
18-24
25-34
35-44
45-54
55-64
65 and over

2. What is your gender?

Female
Male
Other

3. What kind of household do you live in?

Individual
Couple
Family
Shared flat
Other

4. What is the approximate annual income of your household?

Between 0 and 49 999 CHF
Between 50 000 and 99 999 CHF
Between 100 000 and 149 999 CHF
Between 150 000 and 199 999 CHF
200 000 and over

5. What is your highest level of education?

Without diploma
Primary
Secondary
Vocational school
University
Other

6. Which of the following professions best describes your profession?

Craftsman/Merchant/Entrepreneur
Manager higher intellectual profession
Farmer
Employee
Worker
Teacher
Student
Retired
Unemployed
Inactive
Other

7. Since when you live in the neighbourhood?

1 year or less	5-6 years
2-4 years	7-8 years

8. Were you already concerned about the environment and global warming before moving in the neighbourhood?

Yes
No

9. Do you have an eSmart screen in your home?

Yes
No

10. What is the function of your use of the eSmart screen?

Monitoring energy consumption	Receive weather information
Remote heating control	Receive transport information
Set goals	Communication
Intercom	Other
Receive news (international/local)	

11. How often do you use your eSmart screen to monitor your consumption/remote heating control/set energy goals?

Never	At least once a week
At least once a year	Every day
At least once a month	

12. What is your perception of using the eSmart screen?

	No control perceived at all	Very little control perceived	Little control perceived	Average level of perceived control	A lot of perceived control
What is your level of control perceived over you own finances?	○	○	○	○	○
What is your level of control perceived over your own	○	○	○	○	○

consumption
of energy

13. Have your annual energy bills decreased since you started living in the neighbourhood?

Yes
No

14. Regarding your environmental behaviour, please rate the following statements.

	Totally disagree	Disagree	Neutral	Agree	Totally Agree
I reduce the temperature in my hot water system	o	o	o	o	o
I turn the tap off when cleaning my teeth	o	o	o	o	o
I take a shower rather than a bath	o	o	o	o	o
I keep the heating/air conditioning low to save energy	o	o	o	o	o
I reduce time spent under the shower	o	o	o	o	o
I turn lights off in unused rooms	o	o	o	o	o
I wait until there's a full load for washing	o	o	o	o	o
I turn the heating/air conditioning system off in unused rooms	o	o	o	o	o
I hang my laundry instead of putting it in the dryer	o	o	o	o	o
I clean my clothes at 30°C	o	o	o	o	o
I select the eco mode on washing machine/dishwasher	o	o	o	o	o
I unplug my devices when going on holiday	o	o	o	o	o

15. Do you believe that all the residents living in the neighbourhood of Eikenott share the same environmental norms and values?

Yes
No

16. Regarding your relationships with other residents, please rate the following statements.

	Totally disagree	Disagree	Neutral	Agree	Totally agree
I attend activities organized by the community organization	o	o	o	o	o
Attraction to the neighbourhood	o	o	o	o	o
Feeling of belonging to the neighbourhood	o	o	o	o	o
Visiting other residents in their homes	o	o	o	o	o
Friendships and associations with other residents mean a lot	o	o	o	o	o
Wishing to move out, when given the opportunity	o	o	o	o	o
Going to someone in the neighbourhood to get advice	o	o	o	o	o
Working with other residents to improve the neighbourhood	o	o	o	o	o
Perception of being similar to	o	o	o	o	o

the other residents					
Rarely have neighbours over to my house to visit	o	o	o	o	o
Regularly stop to discuss with other residents	o	o	o	o	o

17. With respect to your development of new energy habits, please rate the following statements.

	Totally disagree	Disagree	Neutral	Agree	Totally agree
I share advices on how to pollute less with other residents	o	o	o	o	o
I have developed new energy habits since speaking with other residents	o	o	o	o	o
I have developed new energy habits since participating in neighbourhood activities	o	o	o	o	o

18. With respect to your energy consumption habits, please rate the following statements.

	Totally disagree	Disagree	Neutral	Agree	Totally agree
I have changed my energy behaviour because of the beliefs and actions of the other residents have made me	o	o	o	o	o

question my energy consumption habits					
I have changed my energy behaviour because the norms and values of the neighbourhood have made me question my own energy consumption habits	○	○	○	○	○

Annex 3: The Code Book

Variables	Sub-variables	Indicators	Code in SPSS	Scale
Use of IHD	Functions of use	Monitoring own consumption Intercom Receive information on transports Set energy goals Remote heating control Receive international and local news Receive information on weather Communicate	Monitor Intercom Transports GoalSet RHeatCont News Weather Comm	1 (totally disagree) – 5 (totally agree)
Energy-saving behaviour	Pro-environmental habits	Reduce the temperature in my hot water system I turn the tap off when cleaning my teeth I take a shower rather than a bath I keep the heating/air conditioning low to save energy I reduce time spent under the shower I turn lights off in unused rooms I wait until there's a full load for washing I turn the heating/air conditioning system off in unused rooms I hang my laundry instead of putting it in the dryer I clean my clothes at 30°C I select the eco mode on washing machine/dishwasher I unplug my devices when going on holiday	HotWatS Tapoff Shower HearAirLow Timeundsh Turnlightsof WaitFull Htunusedroom Hang Clean30°C Ecomode Unplug	1 (totally disagree) – 5 (totally agree)
Social learning		I share advices on how to pollute less with other residents I have developed new energy habits since speaking with other residents I have developed new energy habits since participating in neighbourhood activities I have changed my energy behaviour because the beliefs and actions of the other residents have made me question my energy consumption habits I have changed my energy behaviour because the norms and values of the neighbourhood have made me question my own energy consumption habits	Shareadv NEHspeak NEHcomorg CBDiscuss CBDNorms	1 (totally disagree) – 5 (totally agree)
Social cohesion		I assist at the activities organized by the community organization (AQEnøtt) Overall, I am attracted to the life in this neighbourhood Feeling of belonging to the neighbourhood I visit other residents in their homes Friendships and associations made in the neighbourhood mean a lot to me When given the opportunity, I want to leave the neighbourhood I can ask other residents for advice	Activpart Attract Belong Visitoth Friendsh Leave Askadv	1 (totally disagree) – 5 (totally agree)

		Work with other residents to improve the neighbourhood Feeling of being similar to the other residents Rarely have other residents visiting me at home I regularly stop to speak with other residents in the neighbourhood	ImprNei Simil Novisit Stopspeak	
Control variables	Age		Age	1 (below 18) 2 (18-24) 3 (25-34) 4 (35-44) 5 (45-54) 6 (55-64) 7 (65 and above)
	Gender		Gender	1 (Female) – 2 (Male)
	Household type		Househld	1 (Individual) 2 (Couple) 3 (Family) 4 (Shared flat)
	Household's annual income		AnIncome	1 (0-49 999 CHF) 2 (50 000-99 999 CHF) 3 (100 000-149 999) 4 (150 000-199 999) 5 (200 000 and above)
	Highest education diploma		HighEduc	1 (Without any diploma) 2 (Primary) 3 (Secondary) 4 (Apprenticeship) 5 (Higher education institution)
	Profession		Profes	1 (Entrepreneur, craftsman, merchant) 2 (Manager, higher intellectual profession) 3 (Farmer) 4 (Employee) 5 (Worker) 6 (Teacher) 7 (Student) 8 (Retired) 9 (Unemployed) 10 (Inactive) 11 (Other)
	Years spent in the neighbourhood		LivInNeigh	1 (1 year or less) 2 (2-4 years) 3 (5-6 years) 4 (7-8 years)
	Pro-environmental beliefs		EnvConc	1 (Yes) – 2 (No)

Annex 4: Data Analysis

Table 10: General characteristics of the respondents

Indicator	Frequency (N)	Percentage (%)
Age		
Below 18	0	0
18-24	6	18.2
25-34	9	27.3
35-44	8	24.2
45-54	7	21.2
55-64	3	9.1
65 and above	0	0
Gender		
Female	20	60.6
Male	13	39.4
Household type		
Individual	6	18.2
Couple	10	30.3
Family	15	45.5
Shared flat	2	6.1
Household annual income		
0-49 999 CHF	3	9.1
50 000-99 999CHF	7	21.2
100 000-149 999 CHF	11	33.3
150 000-199 999 CHF	8	24.2
200 000 CHF and above	4	12.1
Highest level of education		
Without a diploma	1	3.0
Primary	0	0
Secondary	2	6.1
University	20	60.6
Vocational school	10	30.3
Profession		
Entrepreneur, craftsman, merchant	1	3.0

Manager, higher intellectual profession	12	36.4
Farmer	0	0
Employee	17	51.5
Worker	0	0
Teacher	1	3.0
Student	0	0
Retired	0	0
Unemployed	0	0
Inactive	1	3.0
Other	1	3.0
Years lived in the neighbourhood		
1 year or less	11	33.3
2-4 years	9	27.3
5-6 years	7	21.2
7-8 years	6	18.2
Environmental concerns prior to living in the neighbourhood		
Yes	23	69.7
No	10	30.3

Table 11: Function of the Use of IHD

Indicators	Frequency (N)	Percentage (%)
Monitoring		
Do not agree at all	6	18.2
Do not agree	0	0
Neutral	6	18.2
Agree	17	51.5
Totally agree	4	12.1
Intercom		
Do not agree at all	2	6.1
Do not agree	0	0
Neutral	4	12.1
Agree	10	30.3
Totally agree	17	51.5
Transports		

Do not agree at all	14	42.4
Do not agree	5	15.2
Neutral	7	21.2
Agree	6	18.2
Totally agree	1	3.0
Goal-setting		
Do not agree at all	9	27.3
Do not agree	3	9.1
Neutral	8	24.2
Agree	9	27.3
Totally agree	4	12.1
Remote heating control		
Do not agree at all	2	6.1
Do not agree	1	3.0
Neutral	8	24.2
Agree	13	39.4
Totally agree	9	27.3
Receive news		
Do not agree at all	14	42.4
Do not agree	5	15.2
Neutral	9	27.3
Agree	2	6.1
Totally agree	3	9.1
Receive weather information		
Do not agree at all	12	36.4
Do not agree	5	15.2
Neutral	6	18.2
Agree	7	21.2
Totally agree	3	9.1
Communication		
Do not agree at all	19	57.6
Do not agree	8	24.2
Neutral	3	9.1
Agree	1	3.0

Totally agree	2	6.1

Table 12: Descriptive statistics on the indicators of household energy habits

	N	Minimum	Maximum	Mean	Std. Deviation
I reduce the temperature in my hot water system	33	1	5	2.88	1.269
I turn the tap off when cleaning my teeth	33	3	5	4.61	.659
I take a shower rather than a bath	33	3	5	4.61	.659
I keep the heating/air conditioning low to save energy	33	1	5	3.88	1.269
I reduce time spent under the shower	33	1	5	2.91	1.331
I turn lights off in unused rooms	33	2	5	4.55	.794
I wait until there's a full load for washing	33	2	5	4.39	.788
I turn the heating/air conditioning system off in unused rooms	33	1	5	3.39	1.478
I hang my laundry instead of putting it in the dryer	33	1	5	3.45	1.481
I clean my clothes at 30°C	33	1	5	3.15	1.417
I select the eco mode on washing machine/dishwasher	33	1	5	3.76	1.347
I unplug my devices when going on holiday	33	1	5	3.67	1.137
Valid N (listwise)	33				

Table 13: Descriptive statistics on the indicators of social learning

	N	Minimum	Maximum	Mean	Std. Deviation

I share advices on how to pollute less with other residents	33	1	4	2.42	1.091
I have developed new energy habits since speaking with other residents	33	1	5	2.42	1.251
I have developed new energy habits since participating in neighbourhood activities	33	1	5	2.42	1.200
I have changed my energy behaviour because of the beliefs and actions of the other residents have made me question my energy consumption habits	33	1	4	2.48	1.121
I have changed my energy behaviour because the norms and values of the neighbourhood have made me question my own energy consumption habits	33	1	5	2.79	1.244
Valid N (listwise)	33				

Table 14: Descriptive statistics on the indicators of social cohesion

	N	Minimum	Maximum	Mean	Std. Deviation
Assisting at the activities organized by the community organization	33	1	5	2.73	1.526
Attraction to the neighbourhood	33	1	5	3.67	1.137
Feeling of belonging to the neighbourhood	33	1	5	3.52	1.202
Visiting other residents in their homes	33	1	4	3.00	1.118

Friendships and associations with other residents mean a lot	33	1	5	3.52	1.202
Wishing to move out, when given the opportunity	33	1	5	3.70	1.015
Going to someone in the neighbourhood to get advice	33	1	5	3.76	.902
Working with other residents to improve the neighbourhood	33	1	5	3.67	1.164
Perception of being similar to the other residents	33	1	5	2.94	.899
Rarely have neighbours over to my house to visit	33	1	4	2.76	1.062
Regularly stop to discuss with other residents	33	1	5	3.48	1.253
Valid N (listwise)	33				

Annex 5: Reliability Statistics

Use of IHD

Reliability Statistics

Cronbach's Alpha	N of Items
.611	3

Energy-saving behaviour

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.748	.743	12

Social learning

Reliability Statistics

Cronbach's Alpha	N of Items
.894	5

Social cohesion

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.873	.869	11