Masteroppgave

NTNU
Norges teknisk-naturvitenskapelige universitet
Fakultet for samfunns- og utdanningsvitenskap
Institutt for psykologi

Sigurd Hilmo Lundheim

Consumers intention to adopt residential solar panels in Central Norway

Masteroppgave i Psykologi – studieretning læring – hjerne, atferd, omgivelser
Veileder: Stepan Vesely
Mai 2019

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Kunnskap for en bedre verden

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Sammendrag

Solsellepaneler har ikke hatt like stor gjennomslagskraft i Norge som annen høykostnads miljøteknologi, som for eksempel elbiler og hybridbiler. I de siste årene har det likevel vært en økende interesse for kjøp av solsellepanel i Norge. Hensikten med denne oppgaven er å undersøke effekten av psykologiske og sosiodemografiske faktorer på intensjonen om å bli en pilotkunde for et solsellepanelprosjekt. Teorien om planlagt atferd (theory of planned beahviour; TPB) og en utvidet modell av teorien blir brukt som grunnlag. Dataen ble samlet inn ved hjelp av et spørreskjema der 697 deltakere svarte.

Resultatene av de statistiske analysene indikerer tre variabler som på en robust måte kan predikere intensjon om å bli en pilotkunde. Den første er opplevd atferdskontroll (percived behavioural control; PBC). Opplevd atferdskontroll viser at de som ikke forventer problemer med installasjon og drift av solcellepaneler har større sannsynlighet for å bli en pilotkunde. Dette viser hvor viktig det er å få høykost-miljøatferd til å fremstå som enkel. Den andre variabelen er åpenhet for nye innovasjoner (innovativeness). Selv om effekten er svak, indikerer resultatet at åpenhet for ny teknologi predikerer intensjon på en positiv måte. Den tredje signifikante prediktoren er kjønn. Det viser seg at menn har en høyere intensjon om å bli en av pilotkundene sammenlignet med kvinner. De statistiske analysene indikerer også marginale positive effekter av blant annet holdninger og subjektiv norm på intensjonen om å bli en pilotkunde. Basert på resultatene blir mulige strategier for å spre bruk av solcellepaneler og annen høykost-miljøteknologi diskutert.

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Preface

The thesis “Consumers intention to adopt solar panels in Central Norway” is my final project as a student at NTNU. The data for my thesis is provided by Christian A. Klöckner and Trønderenergi. The data basis is in the form of a questionnaire asking about the intention to become a pilot customer for residential solar panels. It also contains questions about several other psychological and socio-demographic factors. The research question and the hypothesis were developed by me, and approved by my supervisor Stepan Vesely. I also designed the statistical models and performed the analyses. This data is as of now not a part of any research project, but it was intended to be part of a PhD project.

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1. Introduction

In the last decade, there has been a greater focus on alternatives to oil, gas, and coal. Climate change has altered many people's attitude toward fossil fuels. As the world shifts away from fossil fuels, electricity needs to be generated from alternative sources. Compared to other countries, Norway is in an atypical position. Much of the energy comes from hydroelectric power, and the high abundance of hydroelectric power causes relatively low electricity costs. Households in Norway consume 25,019 kWh per capita per year, far more than other Europeans countries like France (6,499 kWh), UK (4,657 kWh) and Italy (4,764 kWh; Index mundi, 2018).

Electric vehicles have seen a large increase in popularity in Norway. In 2018 31% of all new cars were electric cars, and 18% of all new cars were chargeable hybrid vehicles (Norsk elbilforening, 2018). This trend could be an indication of broader acceptance of pro-environmental technology. However, residential solar panels have yet to see the same wide-spread adoption in Norway, like electric vehicles. As late as 2015 the first private residential solar panels were installed in the Norwegian county of Trøndelag (Nilsen & Lorentzen, 2015). Even though solar panels are relatively uncommon on residential housing several Norwegians have experiences with other types of solar panels. These are mostly low wattage systems installed on cabins and recreational homes that are too remote to connect to the grid. From 2015 to 2016 the amount of residential solar panels increased from below 200 to about 700 residential solar panel systems in Norway (Inderberg, Tews, & Turner, 2016). There are no indications that this growth will stop (Winther, Westskog, & Sæle, 2018).

In Norway, it is possible to get financial support from Enova to reduce the initial investment costs and payback time. In addition to national support systems, there is also the possibility of local support. The municipality of Oslo pays 15 NOK per kWh produced to cover up to 40% of the installation costs of the solar panels. This project had a cap of 4 million NOK (Inderberg et al., 2016). However, even though these incentives have had an effect there remain many challenges, and there is a need to keep the momentum up.

Internationally, there have been several studies using a wide variety of psychological models to examine factors influencing either the intention or behaviour related to getting solar panels. Among these are, theory of planned behaviour (TPB; Ajzen, 1991), diffusion of innovation (Rogers, 2003) or value-belief-norm theory (Stern, 2000). However, such studies are lacking in Norway. Using data from Norway could give an interesting look into what influences high-cost environmental behaviour in a nation that gets most of its energy from renewable sources.

The goal of this thesis is to attempt to answer the following question: *What type of psychological and sociodemographic factors will influence the intention to become a pilot customer for a residential solar power system?* To answer this question six different hypotheses are devised.

Hypothesis 1. Positive attitudes towards solar panels will have a significant positive effect on intention.

Hypothesis 2. Supportive subjective norms towards solar panels will have a significant positive effect on intention.

Hypothesis 3. Perceived behavioural control will have a significant positive effect on intention.

Hypothesis 4. Sociodemographic variables will have a significant effect on intention.

Hypothesis 5. Innovativeness will have a significant positive effect on intention.

Hypothesis 6. Descriptive norms will have a significant positive effect on intention.

To answer these six hypotheses the result of a survey issued by Trønderenergi in 2016 will be analysed by different regression models. The analysis is based on the theoretical framework from TPB, a well-established theory within several fields of psychology. In addition, an extended model of TPB, including a descriptive norms variable and an innovativeness measure, will be tested using the same regression techniques. Limitations and possible further research avenues are also discussed.

2. Theory

2.1 Theory of planned behaviour

There are several theories that have made their mark within the field of environmental psychology. Among these are the norm activation theory (Schwartz & Howard, 1981), goal-framing theory (Elliot & Fryer, 2008), value-belief-norm theory (Stern, 2000), diffusion of innovation (Rogers, 2003) and theory of planned behaviour (TPB; Ajzen, 1991). The main focus of this thesis will be on TPB. This theory is one of the most commonly cited theoretical frameworks within environmental and behavioural psychology and intends to improve our ability to predict behaviour. TPB is parsimonious and it is easy to use (Klöckner, 2015).

A meta-analysis of TPB based on 185 studies (Armitage & Conner, 2001) showed that TPB explained 31% of self-reported behaviour and 20% of observed behaviour. Studying how several theories and an integrative model could be used to examine interest in residential solar panels, Wolske, Stern and Dietz (2017) showed that TPB could explain 29% of the interest in residential solar panels. This data comes from a self-report survey. As seen in the

Armitage and Conner (2001) meta-analysis, TPB can explain more of the behaviour when the behaviour is self-reported.

TPB is a continuation of the theory of reasoned action. Different from TPB, theory of reasoned action assumes that we are in full control of our behaviour. It does not account for the challenges (real or perceived barriers) that are related to the behaviour. Similar to TPB, theory of reasoned action presents the concept of attitudes and subjective norms and their influence on behavioural intention. Attitudes represent behavioural beliefs, and subjective norm represents the normative beliefs (Madden, Ellen, & Ajzen, 1992). The explanatory power of theory of reasoned action is somewhat more constricted than TPB. Theory of reasoned action can explain the behaviour in a situation where the behaviour is one hundred percent volitional Ajzen (1991). However, when there are possible barriers and challenges related to the behaviour, the TPB gives a more complete picture because of its inclusion of perceived behavioural control (see chapter 2.1.4)

In the following section the four main components of TPB, intention, attitudes, subjective norm and perceived behavioural control, will be presented (Figure 1).

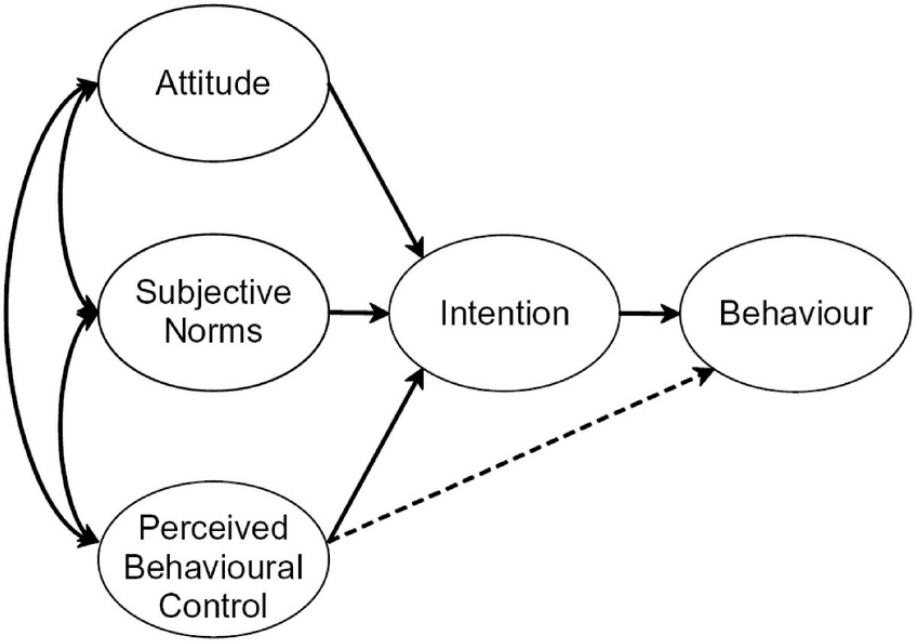

Figure 1. Theory of planned behaviour (Ajzen, 1991, page 182).

2.1.1 Intention

Intention has a central part in several theories and in research questions. Intentions can be viewed as plans that in parallel with opportunities and resources enable us to achieve our goal (Conner & Armitage, 1998). In other words, in TPB intention is meant to summarize the different motivations that influence our behaviour (Ajzen, 1991). These motivations are based on all the preceding parts of the TPB model: attitudes, subjective norms and perceived behavioural control (PBC; Figure 1).

In environmental psychology, intention has been found to be a predictor of environmental behaviour using meta-analysis (Klöckner, 2013). Several studies measures intention instead of behaviour. For example, Rahman and Reynolds (2016) examined the intention to stay at green hotels (green hotels are hotels that focus on environmental friendly practises), Pérez y Pérez and Egea (2019) investigated intentions to donate for sustainable rural development.

Intentions may be able to predict behaviour, but this prediction is not perfect. For example, Godin and Kok (1996) show that intention can explain 34% of health-related behaviours, and according to Sheeran (2002) intentions can on average explain 28% of intended behaviour. Ajzen (1985) makes an important point that intentions would be a better predictor of attempted behaviour compared to performed behaviour.

2.1.2 Attitudes

In short, attitudes are an amalgamation of all "outcome beliefs" that are related to the behaviour in question (Klöckner, 2015). In the present thesis, attitudes are all outcome beliefs related to the acquisition of residential solar panels. Some common positive and negative beliefs related to the purchase of solar panels could be: Solar panels increase the value of the house; solar panels could help passively generate savings; it will take a long time until the customer sees a return on panel investment and solar panels will require a lot more maintenance than an ordinary electrical system, as suggested by Faiers and Neame (2006). However, overall positive attitudes related to solar panels do not necessarily mean that the house owner will take the step to invest. As discussed later there are several different factors in addition to attitudes, that will influence the intention to perform a given behaviour.

Attitudes by themselves are critiqued as a means to explain behaviour. A reason for this is the lacklustre results of several studies attempting to explain behaviour using attitudes (Ajzen & Fishbein, 1977). However, attitudes can be used to explain behaviour if the attitude and behaviour are directed towards the same target and the action is the same (Ajzen & Fishbein, 1977), which should normally be (and typically is) the case. The meta-analysis by Klöckner (2013) supports the notion that attitudes can predict intentions. In the present thesis, attitudes are based on several beliefs related to solar panels. Individuals can have several outcome beliefs that are related to the same behaviour. It is not given that the same beliefs are activated every time a person considers the behaviour. This means that the attitudes can change even though the person has not changed their belief. The change is caused by different beliefs being active (Klöckner, 2015). According to TPB, attitudes will affect behaviour through the intention to perform the behaviour.

An important question is whether the attitude is formed before the behaviour, or whether the behaviour forms the attitude. This idea is discussed by Black, Stern and Elworth (1985) in their paper on personal and contextual influences on household energy conservation. They claim that it is equally plausible that an attitude-behaviour or a behaviour-attitude model is at play when influencing environmental behaviour. However, in TPB there is an established

chain of events i.e. attitudes lead to intention which again leads to behaviour (Ajzen, 1991; Figure 1).

Several other studies have found that attitudes are an important predictor in explaining high-cost environmental behaviour (Barbarossa, Beckmann, Pelsmacker, Moons & Gwozdz, 2015; Mohamed, Higgins, Ferguson, & Kanaroglu, 2016; Nayum, Klökner, & Mehmetoglu, 2015; Wolske et al., 2017). These studies look at purchasing either an electric vehicle or residential solar power systems. Moreover, attitudes might also predict low-cost environmental behaviour. Ha and Janda (2012) found that attitudes were a stronger predictor of intention to purchase energy-efficient household appliances than subjective norms. The type of behaviour examined in this thesis would be classified as relatively high-cost environmental behaviour.

2.1.3 Subjective norm

Subjective norms are a part of TPB because behaviour always exists in a social context regardless of whether there are other people around (Klöckner, 2015). Ajzen (1991, p.188) describes subjective norms as "perceived social pressure to perform or not to perform the behaviour". Similar to attitudes there are beliefs related to the subjective norms. These are called referent beliefs and are based on what other people, e.g. parents, friends, and colleagues, might think of our behaviour (Ajzen, 1991). However, referent beliefs might also be based on people that are not in our immediate social circles, such as politicians, religious organisations or healthcare professionals. These beliefs are not necessarily dependent on any immediate external stimuli, they are based on the perception of social pressure (Kalafatis, Pollard, East, & Tsogas, 1999).

Several studies have found subjective norms to be a significant predictor of environmental behaviour, including high-cost environmental behaviour. For example, Wang, Fan, Zhao, Yang, and Fu (2016) showed that subjective norms have the ability to partially influence intention to purchase a hybrid electric vehicle, and Korcaj, Hahnel, and Spada (2014) found that subjective norms are a significant predictor for the intention to purchase a photovoltaic system.

However, subjective norm is often called the weakest link in TPB. The reason for this is because of the inconsistency in the significance of subjective norms and a weak relationship between intention and subjective norms (Ham, Jeger, & Ivkovic, 2015). This is also supported by Korcaj et al. (2014) who showed that subjective norms were a weaker predictor than the rest of the TPB variables. This finding is corroborated by other studies, e.g. Smith, Olaru, Jabeen, and Greaves (2017) and Nayum et al. (2015). A meta-analysis of 185 studies also supports the notion that subjective norms seem to generally be a worse predictor of intention compared to other variables in the TPB model (Armitage & Conner, 2001).

2.1.4 Perceived behavioural control

The addition of perceived behavioural control (PBC) is the biggest difference between TPB and theory of reasoned action (Ajzen,1991). PBC is best described as a belief about whether a person can perform a certain behaviour in a given context. It should be made clear that PBC is not the same as behavioural control. Behavioural control is often related to the resources and opportunities that we have at our disposition, for example, external resources such as time, money or getting help from others. Different from this PCB is related to how easy, or how hard, the behaviour is to perform and to how much control the performer over the behaviour (Ajzen, 2002). Personal skills are an important factor that will affect the individual's PBC (Ajzen, 1991). Actual behavioural control is an important element of behavioural control. The reason for this is that the actual behavioural control will have an effect on perceived behavioural achievement (Ajzen,1991).

PBC has been found to be an important predictor in several studies within the field of environmental psychology. Scott, Jones, and Webb (2014) found that PBC was important for engaging in environmental behaviour. They also found that PBC changed based on the given behaviour. Their analysis shows that PBC was higher for installing UPVC windows than installing solar electricity. Mohamed et al. (2016) found that PBC was one of the strongest predictors towards intention to adopt electric vehicles. Moreover, Wolske et al. (2017) found that in both TPB, and in an integrated model, PBC was a significant predictor of interest in talking to an installer of solar panels. This indicates that PBC could be an important predictor when attempting to predict the intention to become a pilot customer for residential solar panels.

PBC differs from attitudes and subjective norm in the way it affects behaviour. PBC affects intention, but it also has a direct effect on behavioural achievement. Ajzen (1991) presents two arguments for this claim: 1) When holding intention at a constant the amount of effort to complete the behaviour will increase with PBC and 2) PBC can often be used as a substitute for actual behavioural control (Ajzen, 1991).

As with subjective norm, PBC is only one of a number of similar concepts that attempts to explain behaviour and intention. Locus of control (Rotter, 1966) explains much of the same concept as PBC, but PBC is dynamic and changes depending on the situation and the behaviour in question. Locus of control is more generalized and does not usually vary across different situations. Another quite similar concept is Bandura's concept of self-efficacy. Self-efficacy shares more similarities with PBC, than locus of control as it also depends on the context of the behaviour (Bandura, 1998)

2.2 Extensions of theory of planned behaviour

TPB could lend itself well to extensions. Ajzen discusses this in his review of TPB. The following quote strengthens the idea that it is appropriate to test additional variables that could be added to the model (Ajzen, 1991, p. 199):

> The theory of planned behaviour is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behaviour after the theory's current variables have been taken into account. The theory of planned behaviour in fact expanded the original theory of reasoned action by adding the concept of perceived behavioural control.

Different variables of extension to TPB have been suggested: belief salience, past behaviour, PBC vs self-efficacy, moral norms, self-identity, and affective beliefs (Conner and Armitage 1998). In the present thesis, TPB will be extended with diffusion of innovation (Rogers, 2003) and descriptive norms (Reno, Cialdini, & Kallgren, 1993). The motivation for selecting these variables are presented in the next chapters.

2.2.1 Innovativeness

Innovativeness is not necessarily related to a new product. Innovativeness can also be new ideas or practices. However, it can often be difficult to convince other people to use an innovation even though there are several obvious benefits with the innovation. In this thesis diffusion of innovation (Rogers, 2003) will be the basis for the innovativeness expansion.

2.2.1.1 Diffusion of Innovation

One of the more prolific theories concerning innovativeness is diffusion of innovation (Rogers, 2003). Firstly, what is diffusion? In this context diffusion is a form of communication in which innovation is shared through different channels over time between members of a social system (Rogers, 2003). For example, if somebody in a friend group gets a smartwatch, the positive and negative attributes would be communicated from the innovator in the group. The rest of the group might be motivated to gain more knowledge about the innovation as a result of learning about it from the innovator.

2.2.1.1.1 Stages in the innovation-decision process

Roger's innovation-decision process consists of five different stages (Rogers, 2003; Sahin, 2006): knowledge, persuasion, decision, implementation, and confirmation. Usually, these stages are built upon one another.

The first stage, knowledge stage, is characterised by seeking knowledge about the innovation. There are three main types of knowledge that the adopter wants to gain: awareness-knowledge, how-to-knowledge and principles knowledge. The persuasion stage involves the individual assessing the different qualities of the innovation. A positive assessment can reduce the uncertainty connected to the innovation. This assessment can be affected by different referents. The third stage, the decision stage, is based on either adoption or rejection of the innovation. Adoption happens if the individual believes the innovation is beneficial for the individual. The implementation stage is where the innovation is put in to practice, after the adoption of the innovation. Finally, in the confirmation stage. the individual might continue using, or stop using, the innovation. This is influenced by negative or positive opinions about the innovation (Rogers, 2003; Sahin, 2006).

2.2.1.1.2 Categories of innovation adopters

The first people to adopt an innovation in Roger's (2003) theory of diffusion of innovation are known as innovators. These are individuals who accept a great deal of uncertainty and risk because they are open to newer ideas and technologies. They are usually the ones that make the rest of the group aware of an innovation (Rogers, 2003; Sahin, 2006).

The second group of adopters is called early adopters. This group of individuals often plays a more important role in the group than innovators. They might have leadership roles and are often approached for advice. Thus, their opinion of the innovators and the innovation itself is of great importance to the diffusion of the innovation. One could say that early adopters' adoption of innovation gives the innovation credibility in the group (Rogers, 2003; Sahin, 2006).

The early majority is the first large segment of the population to adopt the innovation. As opposed to the early adopters they do not have leadership roles. However, their adoption helps the diffusion process. According to Rogers (2003), they are deliberately adopting an innovation before the latter half of the population segment adopts the innovation. This may indicate that their decision-making process is slower than that of innovators and early adopters but faster than the late majority and the laggards (Rogers, 2003; Sahin, 2006).

The late majority consists of the individuals that wait with adoption of an innovation until the innovation has become common. Their reason for adopting could be out of necessity as to not fall too far behind. Peer pressure from other individuals in their social circle will also encourage the late majority to adopt. The late majority often depends on social networks to gain information about the innovation and thus reducing uncertainty (Rogers, 2003; Sahin 2006).

The final group of adopters is known as laggards. This group of people is often very traditional and sceptical towards innovations, probably their social system often consists of people that share a similar mindset. This limits their knowledge of the innovation, especially when it comes to awareness-type knowledge. Laggards also want to make sure that other people have successfully adopted the innovation before they start using it. All of these factors

increase the decision-making time, and this makes them laggards (Rogers, 2003; Sahin, 2006).

A higher value on the innovativeness variable could indicate that the participant is more likely to belong to one of the earlier categories, either innovators or early adopters. Whereas a lower score on the innovativeness variable could indicate that the participant is more likely to belong to one of the later adopter categories, for example, laggards. In this thesis, a high score on innovativeness indicates that the person is open to new technology. Whereas a low score indicates that the person is sceptical to new innovation and enjoys a traditional way of life.

Extensions of TPB with diffusion of innovation in the present thesis is well within the line of other studies. Several studies have used diffusion of innovation to explain the spread of environmentally friendly innovations. Wolske, Stern, and Dietz (2017) used diffusion of innovation to explain the interest in talking to an installer of residential solar panels. Moreover, Ozaki (2009) found that diffusion of innovation theory could be used to explain factors that cause environmentally conscious individuals to not switch to green electricity. A Dutch study examined previous research and found that there was a greater focus on the technological challenges rather than the diffusion of the innovation. They concluded that a framework that includes a decision-making process and personal characteristics, as well as innovation characteristics, can be used in research and to improve policy making (Dieperink, Brand, & Vermeulen, 2004).

2.2.2 Descriptive norms

Descriptive norms are formed when a person observes the behaviour of others in specific situations. The norms are created by people observing which behaviours are effective in any given context. For example, if everybody stands to the right on an escalator, it opens up a second lane allowing people to walk up the escalator if they wish to do so (Reno et al., 1993). The differences between types of norms can sometimes be unclear. Subjective and injunctive norms are based on our perception of what we think other people believe we ought to do, whereas descriptive norms are based on the observed behaviour of others (Reno et al., 1993).

Several papers (Elgaaied-Gambier, Monnot, & Reniou, 2018; Cialdini, 2003; Smith, et al., 2012) have used descriptive norms as an extension to TPB, and in environmental psychology in general (i.e., outside of the TPB framework). In their meta-analysis, Rivis & Sheeran (2003) presented twenty-one different hypotheses that all used descriptive norms as a predictor. They found that descriptive norms were a better predictor than subjective norms. This could be an indication that observing behaviour might be more important than social pressure. They also showed that the effect of descriptive norms is lessened when we do not want to identify with the relevant group norms.

A relatively well-known example of disregard of descriptive norms is the Iron Eyes Cody advertisement made by Keep America Beautiful, Inc. (1971). The advertisements start with a shot of a Native American paddling his canoe in a polluted river. The next shot is a native American standing by a littered highway and somebody throws thrash from their car landing next to his feet. The final shot shows the native American's face and a single tear going down his cheek. It ends with the slogan "People Start Pollution, People Can Stop It." Revaluating this advertisement Cialdini, Kallgren & Reno (1991) point out several negatives and positives: The positive is that the advertisement presents injunctive norms in a very effective manner with the crying native American. The negative is that showing littering in an already polluted environment could lead to a stronger descriptive norm that tells other people that littering is common. This could, in turn, lead to more littering. If they had taken descriptive norms into account the environment in the advertisement would most likely have been clean (Cialdini et al., 1991). Several other papers (Demarque, Charalambides, Hilton, & Waroquier, 2015; Goldstein, Cialdini, & Griskevicius, 2008; Sussman, Greeno, Gifford, & Scannell, 2013) have also employed descriptive norms in research on environmental behaviour.

Adding descriptive norms as an extension of TPB could be beneficial as it would add a new category of social norms to the theory. Without the extension, only subjective norms account for the wide array of norms we are exposed to. Descriptive norms are based on observed behaviour, and as solar panels havebecome more common, it could be interesting to see if this has an effect on the intention to become a pilot customer.

3. Method

3.1 Data collection

The data is based on a pilot project on residential solar panels. This pilot project was initiated by the Norwegian power company, Trønderenergi. To make people aware of the pilot-project, Trønderenergi spread the word about the upcoming project in different media. The survey was then sent online to people who had responded positively on the information about the project. In total 697 participants responded to the whole or parts of the survey. The participants asked about attitudes towards solar panels, and general questions regarding the environment. The data was collected through a period of two to three weeks during the winter of 2016.

3.2 Questionnaire and variables

The questionnaire contains 114 questions (Appendix A). Most questions could be measured on a 7-point symmetrical Likert scale ranging from -3 to 3.

To answer the presented six hypotheses (page 2), intention attitudes, subjective norms, perceived behavioural control, innovativeness and descriptive norms were selected as variables. In addition, socio-demographic variables such as gender, age, level of education, type of housing and household income were selected. Based on these variables, related questions from the questionnaire were grouped. However, not every question was relevant for the models that are employed in the thesis.

The compound variables were created by using STATA (StataCorp., 2017b) and Cronbach's alpha was used to quantify scale reliability. Cronbach's alpha ranges from 0 to 1 where a higher value indicates that there is internal consistency, meaning that the items measure the same latent variables (Henson, 2001; Tavakol & Dennick, 2011). As a rule of thumb, a Cronbach's alpha of 0.7 and above is satisfactory. This means that 70% of the scale can be considered reliable and that 30% of the variance is a result of an error (Mehmetoglu & Jakobsen, 2017). It is important to note that different from test-retest Cronbach's alpha is not

a direct measure of scale reliability. Using test-retest would be too time-consuming for this thesis.

3.2.1 Variables

In the present questionnaire, the variable intention is represented only by a single item. It reads as follows "The application to TrønderEnergi was noncommitting. How certain is it that you will say yes to become one of the pilot customers?" The intention item attempts to assess how likely it is that the participants will say yes to become one of the pilot customers. This is the dependent variable in the different regressions. The distribution of answers for all the variables presented in this section is found in Appendix B.

The first independent variable, attitudes, are meant to measure the participants' general attitudes towards solar panels. These attitudes measure whether getting solar panels on their roof is perceived by the participant as damaging or beneficial, uncomfortable or comfortable, bad or good, and unprofitable or profitable (Appendix B, Table B1). To create the attitudes scale the four constituent attitude items were averaged and combined ($M = 1.39$, $SD = 1.49$) using the egen rowmean command (StataCorp., 2017a). The attitude scale has $\alpha = 0.89$ which indicates very good scale reliability.

Subjective norm was originally measured with two items in the questionnaire. Due to a low Cronbach's alpha, $\alpha = 0.58$ subjective norm is only represented by one item in the analyses (Appendix B, Table B1). The variable included reads "People that are important to me think that I should live as environmentally friendly as possible". Ajzen explained subjective norm as "perceived social pressure to perform or not to perform the behaviour" (Ajzen, 1991). The chosen variable is very close to Ajzen's explanation as the variable looks at social pressure from people that we interact with.

The issue with a cutoff point for Cronbach's alpha is that the value is influenced based on by the number of items for the calculation (Henson, 2001). Because there were only two items in the questionnaire, it is possible that the alpha value might have been good enough to include them both in the analysis.

The final variable in the basic TPB model is perceived behavioural control (PBC). Two different topics, based on the questionnaire, might represent perceived behavioural control. The first topic is how relevant the participants believe problems related to solar panels are. These problems range from "Solar panels increase the need to remove snow from my roof" to "There will be a lot of bureaucracy to get money back from my production surplus". The other component is how likely it is that a given problem (e.g. an increased need for snow removal) will occur. The rowmean method (StataCorp, 2017a) was also used to create the PBC variable (M = 4.92, SD = 3.90). In this dataset, PBC measures if the participants believe it will be a problem to install and maintain the PV system, as well as the perceived reliability of the system (i.e., higher values indicate *less* perceived control; Appendix B, Table B1). This variable has an $\alpha = 0.74$, which is within acceptable levels.

Sociodemographic variables (Appendix B, Table B2, B3, B4, B5, and B6) were added in the models to gain more information about factors that might explain the intention to become a pilot customer. These variables include the gender of the participants, their age, the participant's level of education, the type of housing and household income. Education is coded as a variable containing three different categories, describing different levels of education: secondary- and high school, higher education up to four years and higher education for more than four years. Higher education up to four years is used as a baseline category for the regression analysis. The questionnaire also asks about housing types, covering a broad spectrum from villa to home share. Type of housing was reduced from six categories to three broader categories: villa, semi-detached-housing, and apartment. Semi-detached-housing is used as the baseline category. In addition to these, the household's yearly income before tax was also added to the model. This variable is coded as several wage brackets starting at "less than 500.000 NOK" and increase in different increments up to the highest category of "above 1.500.000 NOK". The variable was recoded into a categorical variable: less than 700.000 NOK, 700.000 to 1.000.000 NOK and more than 1.000.000 NOK.

Abrahamse & Steg, (2009) shows that socio-demographic variables have a positive effect on how well the TPB-model can explain a phenomenon. Importantly, by controlling for socio-demographic variables we can also ascertain whether TPB explains intention over and above basic socio-demographics, and thus the models including socio-demographics serve as a more stringent test of the theory.

The TPB model is extended with two additional variables, innovativeness and descriptive norms. Innovativeness is based on several questions regarding scepticism towards new technology and wishing to maintain a traditional way of living (Appendix B, Table1). The variable is reversed to make it easier to interpret. The innovativeness variable (M = -0.22, SD = 1.12) has an $\alpha = 0.76$ which is an acceptable level. The second extension, descriptive norms, measures whether the participants have seen solar panels, or if they believe that solar panels are common, in Norway, locally, or in other countries. The descriptive norms scale (M = -0.16, SD = 1.02, and $\alpha = 0.76$) is within acceptable levels.

3.3 Statistical analyses

3.3.1 Missing values

Missing data comes in three different variants: data missing completely at random (MCAR), data missing at random (MAR) and data that are not missing at random (MNAR). MCAR means that there is no pattern to the missing data and that the remaining data could be used for estimation (Graham, 2009). Analysing MCAR data results in lower statistical power, but the estimates are unbiased (Graham, 2009). As with MCAR, MAR also gives estimates that are unbiased. MNAR is problematic and should be avoided since it would lead to biased estimates (Graham, 2009). An example of MNAR would be if data from people of certain socio-economic strata were missing. To make sure that the data is missing completely at random Little's MCAR test was done. The result from this test shows that the missing data in the current dataset is, in fact, missing completely at random Chi^2 (78, N = 577) = 77.97, p = 0.47. This means that bias because of the missing values should not occur.

There were 87 participants who did not complete the survey, and therefore were removed from the dataset. Following the recommendations by Hair, Hult, Ringle, and Sarstedt (2017), 15 additional observations were removed because they did not respond to a minimum of 85% of the questionnaire. Thus, any case with 15% or more missing data is removed. However, there were still between 1 and 25 missing values for some of the variables in the remaining dataset. These missing values were handled in STATA, by listwise deletion, a technique that involves deleting observations that are missing any values on one or more variable in the regression model (Mehmetoglu & Jakobsen, 2017). After performing these procedures, and STATA performing the listwise deletion, the final number of participants were N = 513 and

N = 492, respectively. The main reason for accepting the listwise deletions is the larger size of the dataset. In a smaller dataset, it would be necessary to perform an imputation procedure to avoid lowering the N. Little's MCAR test shows that listwise deletion is safe.

3.3.2 Regression methods

The aim of this study was to analyse the influence of psychological and sociodemographic factors on the intention to become a pilot customer. To answer this question two types of regression were used; multiple regression (Mehmetoglu & Jakobsen, 2017) and median regression (Beyerlein, 2014). Table 1 gives an overview of the different models used in the statistical analyses.

Multiple regression was used to study the relationship between the intention to become a pilot customer and the predictor's attitudes, subjective norms and PBC (model 1, Table 1). Sociodemographic variables that might influence the research object were added in model 2, Table 1. Finally, the effect of model extensions, innovativeness, and descriptive norms, were analysed, First, without (model 5) and then with (model 6) sociodemographic variables (Table 1). The estimated regression coefficient of multiple regression shows the effect of the independent variables on the mean of the dependent when all other values are held constant (Mehmetoglu & Jakobsen, 2017). In addition, the regression analysis provides a statistical test that shows if this relationship is significant or not (Mehmetoglu & Jakobsen, 2017). Multiple regression is beneficial since understanding intention is complex and depends on several different factors that influence the participant. It also allows the researcher to control for factors, such as demographic variables (Mehmetoglu & Jakobsen, 2017).

In addition to multiple regression, median regression, was used to examine the same relationships as those examined with multiple regression (Table 1, model 3, 4, 7, and 8). An advantage of median regression is that it is resistant to outliers and skewed data (Buchinsky, 1998). Unlike normal regression, which is based on the mean, regression is based on the median or the chosen quantile. In this thesis the chosen quantile is the median. Therefor it will be described as median regression. A regression coefficient in median regression tells us by how much a quantile (in this case the median) is shifted by a one unit increase in the independent variable when all other variables are kept constant. For example, if the continuous predictor innovativeness has a coefficient of 0.07, then for every one unit change

in innovativeness the predicted median of intention will increase by 0.07. The issue with skewed data was encountered in the current dataset, and is discussed further in the section about assumptions of least squares regression.

Table 1

Overview of the different models used in the analysis

Model description	Multiple regression	Median regression	Variables
TPB	Model 1	Model 3	Attitudes, Subjective norms and PBC
TBP and socio-demographics	Model 2	Model 4	Attitudes, Subjective norms PBC, Gender, Age, Education, Housing and Income
Extended TPB	Model 5	Model 7	Attitudes, Subjective norms, PBC, Descriptive norms and Innovativeness
Extended TBP and socio-demographics	Model 6	Model 8	Attitudes, subjective norms, PBC, Descriptive norms, Innovativeness, Gender, Age, Education, Housing and Income

3.3.3 Outliers

According to Howell (2010) outliers could be identified using studentized residuals (The Pennsylvanian State University, 2018). Studentized residual is a standardized version of a *t*-statistic (Howell, 2010). Using this method, values greater than, or less than, two standard deviations above or below the mean should be paid attention to. In this dataset, 28 observations have studentized residual that is below the cut-off point of minus two standard deviations. There was also one outlier above two standard deviations. No values were larger than three, or less than minus three. Such values could be especially problematic depending on the reason for the increase or decrease in value (UCLA Institute for Digital Research and Education, 2018).

To assess if the outlying observations are influential outliers the regressions were performed with the outlier observations, and without them (Aguinis, Gottferdson, & Joo, 2013). The regression shows that there are observations among the outliers that have a strong effect on the model fit. There is an average increase in explained variance in the ordinary multiple regression model, from $R^2 = 0.12$ to $R^2 = 0.22$ when removing the outliers. However,

median regression saw no noteworthy increase in R^2 from removing the outliers. The lack of increased explained variance is most likely because median regression is very resistant to the effect of outliers (Buchinsky, 1998).

Input error could also result in outliers. However, this data was taken straight from an online survey and directly transferred to SPSS. So, input error is unlikely in this dataset. An error outlier is a result of different inaccuracies or errors in the observations. These errors can be a result of poor data management, biased responding or sampling errors (Aguinis, Gottferdson, & Joo, 2013).

3.3.4 Assumptions

To test the assumptions underlying regression, the STATA command regcheck (Mehmetoglu, 2014) was used. For the present dataset, there are two breached assumptions, heteroscedasticity (Mehmetoglu & Jakobsen, 2017) and normal distribution of the residuals (Shapiro & Wilk, 1965) of the regression model.

The Breusch-Pagan test showed that the assumption of heteroscedasticity is violated (Table 2). This means that the residuals at each level of the predictors do not have the same variance, and this causes bias in the estimate of our standard errors. This could lead to poor hypothesis testing.

The normal distribution of the residuals was tested by Shapiro and Wilk. (1965) normality test. The breach of this assumption means that the residuals are not normally distributed. This is an important assumption because when calculating confidence intervals and significance tests normal distribution of residuals are important (Field, 2014).

Table 2

Table showing the results of test of heteroscedasticity and test of normality

Model description	Breusch-Pagan test	Shapiro-Wilk normality test
TPB	χ^2 (1) = 108.98, $p < .001$	Z = 9.51, $p < .001$
TPB and socio-demographics	χ^2 (1) = 99.92, $p < .001$	Z = 9.23, $p < .001$
Extended TPB	χ^2 (1) = 99.49, $p < .001$	Z = 9.53, $p < .001$
Extended TPB and socio-demographics	χ^2 (1) = 91.54, $p < .001$	Z = 9.26, $p < .001$

Note. Assumptions test for all the different TPB regression models. Degrees of freedom in parentheses.

3.3.4.1 Dealing with breached regression assumptions

To solve the issue of these breached assumptions Huber-White standard errors were used to estimate the regression. The same method was used by Sintov, Geislar, and White, (2017) when their regression model breached assumptions of heteroscedasticity and normality. However, Huber-White standard errors do not consider any bias that exists in the estimations. This can lead to misleading results (Freedman, 2006). Even though there is some critique levelled towards Huber-White standard errors it is still a good option to use when heteroscedasticity has occurred (Mehmetoglu & Jakobsen, 2017).

Because the confidence intervals and significance levels could be compromised, median regression was performed. Median regression is relatively unknown but offers several benefits when dealing with the problems present in this dataset. The strength of this method is that it is much more robust when dealing with outliers and asymmetrical data as the analysis is based on the median (Huang, Zhang, & Chen, 2017). The dataset that is the basis for our analysis is skewed towards the right. The reason for this is most likely the sample consists of individuals that are interested in solar power and the environment. As mentioned in Yu, Lu, and Stander (2003), median regression is a good alternative to use for skewed data. Similarly,

Huang et al. (2017) recommend using quantile regression as a complementary method to ordinary multiple regression, especially when there are violated assumptions.

4. Results

The results of these analyses will be used to answer the six hypotheses presented in the introduction. The two main sections (section 4.1 and section 4.2) are each split into two subsections, where the first subsection presents the results of multiple regressions and the second presents the results from median regressions.

4.1 Theory of planned behaviour and sociodemographic variables

4.1.1 Multiple regressions

The results of multiple regression (Table 3) show that perceived behavioural control (PBC) has a significant seemingly negative predicted effect on the intention to become a pilot customer (model 1). The effect is seemingly negative as the scale is inverse where low scores indicate high PBC. The effect of PBC is moderate. Moreover, subjective norms and attitudes have a marginally significant positive predicted effect on the intention to become a pilot customer. The effect of attitudes and subjective norms on intention were weak. However, the model itself had a moderate effect (model 1).

Controlling for socio-demographic variables (model 2), PBC remains a significant predictor of intention. Attitudes remains a marginally significant predictor and subjective norm become significant at conventional levels (p <.05; Table 3). Gender is shown to be a significant predictor. Being male has a positive effect on the intention to become a pilot customer compared to female. Education is a significant predictor of intention. Compared to higher education for up to four years, having a secondary- and high school education is a significant positive predictor of intention, whereas education of more than four years is not a significant predictor. Finally, owning a villa has a marginally significant positive predicted effect on the intention to become a pilot customer as compared to living in semi-detached housing. Income and age were not a significant predictor of intention. A slight increase in explained variance is seen in model 2, Table 3.

Table 3

TPB predicting intention to adopt solar panels – robust multiple regression (model 1 & model 2)

Variables	R^2	β	t	p	95% Conf. Interval
Model 1	.22				
Attitudes		.07	1.89	.060†	.01, .09
Subjective norm		.07	1.87	.063†	-.01, .09
PBC		-.44	-9.00	<.001***	-.11, -.08
Model 2	.23				
Attitudes		.06	1.66	.097†	-.01, .07
Subjective norm		.09	2.13	.033**	.00, .10
PBC		-.42	-8.72	<.001***	-.11, -.07
Gender		.11	2.47	.014**	.05, .44
Age		.03	0.76	.450	-.004, .01
Education					
Secondary- and high school		.10	2.58	.010**	.05, .34
Higher edu. +4 yr.		-.01	-0.25	.802	-.19, .15
Housing					
Villa		.10	1.77	.077†	-.02, .43
Apartment		.06	1.00	.317	-.15, .46
Income					
Less than 700.000		-03	-0.64	.523	-.24, .12
More than 1. mil.		-.05	-1.03	.305	-.22, 07

Note. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. $N = 513$ (model 1), $N = 492$ (model 2). Estimation method: Multiple regression with Eicker-Huber-White standard errors. PBC = Perceived behavioural control (higher values indicate lower PBC). Sex: male = 0, female = 1. Standardized beta coefficients. Education is a categorical variable with higher edu. < 4 years as base category. Housing is a categorical variable with detached housing as base category. Income is a categorical variable with income between 700.000 to 1 mil. as base category.

4.1.2 Median regressions

The first median regression model (Table 4) shows that PBC is a significant predictor of intention (model 3), whereas attitudes and subjective norm are not significant. When adding sociodemographic variables (model 4), PBC remains a significant predictor. In addition, gender remains a significant predictor of intention. However, no other socio-demographic variables are significant. The effects of models 3 and 4 is bordering on a weak effect.

Table 4

TPB predicting intention to adopt solar panels – robust median regression (model 3 & model 4)

Variables	R^2	β	t	p	95% Conf. Interval
Model 3	.10				
Attitudes		.01	0.34	.737	-.03, .05
Subjective norm		.01	0.40	.692	-.05, .07
PBC		-.38	-5.06	<.001***	-.52, -.23
Model 4	.11				
Attitudes		.002	0.07	.948	-.05, .06
Subjective norm		.04	1.35	.179	-.02, .09
PBC		-.40	-5.63	<.001***	-.53, -.26
Gender		.18	2.27	.024**	.02, .34
Age		.01	0.43	.671	-.05, .07
Education					
Secondary- and high school		-.08	1.34	.181	-.04, -.19
Higher edu. + 4 yr.		-.03	-0.37	.711	-.19, .13
Housing					
Villa		.13	0.80	.426	-.19, .44
Apartment		.09	0.55	.585	-.24, .43
Income					
Less than 700.000		-.04	-0.61	.545	-.15, .08
More than 1. mil.		-.10	-1.63	.104	-.22, .02

Table 4 (continued)

Note. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. $N = 513$ (model 3), $N = 492$ (model 4). Estimation method: Quantile regression (.5) with Eicker-Huber-White standard errors. PBC = Perceived behavioural control (higher values indicate lower PBC). Sex: male = 0, female = 1. Education is a categorical variable with higher edu. < 4 years as base category. Housing is a categorical variable with detached housing as base category. Income is a categorical variable with income from 700.000 to 1 mil. as base category.

4.2 Extended theory of planned behaviour and socio-demographic variables

4.2.1 Multiple regressions

Multiple regression of extended TPB (Table 5) shows a significant predicted effect of the extension innovativeness (model 5), meaning that innovativeness influences the intention to become a pilot customer. Descriptive norms are not found to be a significant predictor of intention. In this model perceived behavioural control is highly significant and subjective norms and attitudes are only marginally significant. Compared to model 1, model 5 does not explain any additional variance.

When adding socio-demographic variables (model 6), the effect of subjective norms changes from marginally significant to significant. PBC and innovativeness remain significant predictors of intention. The gender of the participant is still a significant predictor of intention. Being a male will increase the intention to purchase solar panels compared to being female. Age remains not significant in extended TPB, as in the ordinary TPB model. Moreover, similar to model 2 having a secondary- and high school education, as compared to having four years or less of higher education, influence the intention to become a pilot customer. Living in a villa, compared to living in semi-detached housing, is only a marginally significant positive predictor of intention. model 6 saw a slight increase in explained variance compared to model two.

Table 5

Extended TPB predicting intention to adopt solar panels – robust multiple regression (model 5 & model 6)

Variables	R^2	β	t	p	95% Conf. Interval
Model 5	.22				
Attitudes		.06	1.72	.085†	-.01, .08
Subjective norm		.08	1.96	.051†	-.00, .10
PBC		-.42	-8.60	<.001***	-.11, -.07
Descriptive norm		-.03	-0.70	.483	-.08, .04
Innovativeness		.11	2.64	.009**	.02, 15
Model 6	.25				
Attitudes		.06	1.52	.130	-.01, .07
Subjective norm		.09	2.18	.030**	.01, .10
PBC		-.40	-8.24	<.001***	-.11, -.06
Descriptive norm		-.02	-0.57	.566	-.08, .05
Innovativeness		.11	2.55	.011**	.02, .15
Sex		.10	2.38	.018**	.04, 44
Age		.04	0.93	.353	-.00, .01
Education					
Secondary- and high school		.10	2.57	.010**	.04, .33
Higher edu. + 4 yr.		-.01	-0.29	.770	-.19, .14
Housing					
Villa		.10	1.73	.084†	-.03, .42
Apartment		.05	0.91	.366	-.17, .45
Income					
Less than 700.000		-.03	-0.67	.506	-.25, .12
More than 1. mil		-.05	-1.08	.281	-.23, 07

Note. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. $N = 513$ (model 5), $N = 492$ (model 6). Estimation method: Ordinary multiple regression with Eicker-Huber-White standard errors. PBC = Perceived behavioural control (higher values indicate lower PBC). Gender: male = 0, female = 1. Education is a categorical variable with higher edu. <4 years as base category. Housing is a categorical variable with detached housing as base category. Income is a categorical variable with income from 700.000 to 1 mil. as base category.

4.2.2 Median regressions

In the basic TPB model (Table 6) PBC is still a significant predictor of intention (model 7). Attitudes and subjective norms are not significant predictors of intention. Similar to multiple regression, innovativeness shows a significant predicted effect of intention, and descriptive norms a non-significant effect. Controlling for socio-demographic variables (model 8) did not influence the results as PBC and innovativeness are still significant. The only significant socio-demographic variable is gender. The rest of the variables are not significant (model 8). Model 7 and model 8 showed a slight increase in explained variance when compared to model 3 and model 4.

Table 6

Extended TPB predicting intention to adopt solar panels – robust median regression (model 7 & model 8)

Variables	R^2	β	t	p	95% Conf. Interval
Model 7	.11				
Attitudes		.01	0.52	.600	-.03, .05
Subjective norm		.02	1.24	.216	-.01, .05
Descriptive norm		-.003	-0.13	.900	-.04, .04
PBC		-.38	-5.63	<.001***	-.51, -.24
Innovativeness		.05	2.08	.038*	.002, .10
Model 8	.13				
Attitudes		.00	0.00	1.000	-.06, .06
Subjective norm		.03	1.11	.254	-.03, .10
Descriptive norm		.004	0.15	.881	-.07, .07
PBC		-.39	-5.58	<.001***	-.53, -.25
Innovativeness		.07	2.03	.043**	.002, .13
Gender		.16	2.16	.031**	.01, .31
Age		.004	0.11	.915	-.07, .08
Education					
Secondary- and high school		.09	1.27	.203	-.05, .22
Higher edu. + 4 yr		-.05	-0.55	.584	-.23, .13
Housing					

Table 6 (continued)

Villa	.09	0.52	.607	-.24, .42
Apartment	-.003	-0.02	.984	-.39, .38
Income				
Less than 700.000	-.05	-0.70	.485	-.20, 09
More than 1. mil	-.10	-1.41	.160	-.23, .04

Note. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. $N = 513$ (model 7), $N = 492$ (model 8). Estimation method: Quantile regression (.5) with Eicker-Huber-White standard errors. PBC = Perceived behavioural control (higher values indicate lower PBC). Sex: male = 0, female = 1. Education is a categorical variable with higher edu. <4 years as base category. Housing is a categorical variable with detached housing as base category. Income is a categorical variable with income from 700.000 to 1 mil. as base category.

5. Discussion

The aim of most studies on environmental behaviour is to provide information that can be helpful in reducing the negative environmental impact of human activities (Dieperink et al., 2004; Elgaaied-Gambier et al., 2018; Nayum et al., 2015). This was also the purpose of the present study focusing on psychological and socio-demographic factors that might be important to increase the adoption of private solar power systems in Norway. Such studies can contribute to a better understanding of how to best promote pro-environmental behaviour. The research question and hypotheses in the present study were examined in the framework of theory of planned behaviour (TPB) and an extended version of TPB. The limitations of the study, as well as implications for future research and possible TPB extensions, will also be discussed. Finally, the thesis will be rounded off with a short conclusion.

5.1 Theory of planned behaviour

5.1.1 Attitudes have a marginal effect on intention

The present study shows that attitudes may possibly have a small positive effect on intention, although this is at best a marginally significant effect (model 1, 2 in Table 3 and model 5 in Table 5). A positive effect, although marginally significant, is in line with previous research showing that attitudes are often a significant predictor for performing environmental behaviour (Barbarossa et al., 2015; Ha & Janda, 2012; Mohamed et al., 2016;

Wolske et al., 2017). For example, Mohamed et al. (2016) found that attitudes were a significant predictor for intention to adopt electric vehicles.

Since the p-value varied across models and was very high in certain cases (Table 4 and 6), we should be careful when interpreting the significant effect. Putting too much weight on the marginal significance would also increase the chance of a type 1 error, and moreover, the effect of attitudes is very low. A β of 0.07 is considered a small effect (Walker, 2008). It is also of note that attitudes are not significant in any of the median regressions which acts as a robustness check. The lack of a strong significant effect of attitude is surprising since attitudes are generally seen as a strong predictor in TPB (Armitage & Conner, 2001).

However, finding attitudes to be not significant is not unheard of. Examining condom use, attitudes were found to be a non-significant predictor (Carmack & Lewis-Moss, 2009). Even though attitudes have been critiqued, Ajzen and Fishbein (1977) explained that attitudes' ability to predict intention could be improved by a high correspondence between attitudinal and behavioural measures. The accord between the attitudinal questions and the intention of becoming a pilot customer in this questionnaire is not optimal. No questions specifically ask about attitudes to become a pilot customer and getting solar panels. Instead, several of the questions ask about the participant's attitudes towards solar panels in general. When examining the attitudes variable used in the analysis, only 16% have answered negative or neutral and, 84% of the participants had positive attitudes. Descriptive statistics (Appendix B, Table B1) also show that there is an overwhelming amount of positive responses in the questions that create the attitudes scale. The significance of attitudes could very well change in a sample with more diverse opinions.

5.1.2 Subjective norms have a weak effect on intention

The effect of subjective norms is marginally significant in some tests (Table 3; Table 5). However, when controlling for sociodemographic variables, subjective norms become significant at $p < 0.05$ (Table 3; Table 5).

The importance of subjective norms is supported by several papers that examine high-cost environmental behaviour (Barth, Jugert, & Fritsche, 2016; Korcaj et al., 2015). Being environmentally conscious has become more important in the last few decades. A survey by

TNS Gallup showed that in 2015, 34% of the population put climate change as one of the three biggest challenges facing Norway (Mila, 2015). The fact that there has been an increase in awareness could have led to stronger subjective norms.

The effect size of subjective norms varies from $\beta = 0.07$ to $\beta = 0.09$, meaning that the effect is still small regardless of the significance level. Moreover, the lack of significance in median regression indicates that the alternative hypothesis cannot be supported in all specifications. This is not surprising, as subjective norms are often regarded as one of the weaker predictors in TPB (Armitage & Conner, 2001). Bearing in mind the methodological challenges related to breached regression assumptions, it is important that a variable is significant in both ordinary multiple regression and in median regression for the results to be conclusive (see section 3.3.4.1).

One of the reasons why subjective norms do not show up as a significant predictor in median regression, as it did in multiple regression, could be that the participants do not feel strong enough social pressure to become a pilot customer. The behaviour that is being examined is very niche. In many social circles, it is seen as something positive to perform pro-environmental behaviour. However, some of the participants might not feel the required social pressure for subjective norms to work. Without the perceived social pressure subjective norms will not influence behaviour (Ajzen, 1991). Another factor is whether the participant believes that the pressure comes from a relevant source, a referent. If the pressure comes from somebody that the participant does not care about then, according to Ajzen (1991), the effect will not be as strong.

5.1.3 Perceived behavioural control influences intention

Perceived behavioural control (PBC) has a significant effect on the intention to become a pilot customer. PBC is significant across all models at $p < .001$ and shows a negative strong effect on intention. The negative effects could be explained by how the items were formulated: high scores on the Likert scale indicates that installing solar panels is perceived to be potentially problematic (i.e., high scores indicate lack of PBC, see Appendix B, Table B1). The participants were also asked how relevant the hypothesised problems regarding solar panels were. A negative score on these questions indicates that the participant does not believe something to be a problem.

A significant effect of PBC is in accordance with other papers on the topic of solar power adoption (Rai & Beck, 2015; Korcaj et al., 2014). PBC has been shown to be able to predict behaviour and intentions in a wide variety of behaviours (Armitage & Conner, 2001). This further supports the notion that the perceived difficulty of the behaviour is important for the adoption of solar panels and other environmental behaviours. The fact that many of our participants believe that getting solar panels won't be a problem (Appendix B, Table B1) is very positive for the adoption of residential solar panels. This also has implications for policymaking. A streamlined bureaucratic process could improve PBC and make the whole process seem less daunting.

It should be mentioned that Klöckner (2015) and Kalafatis et al. (1999) has stated that the idea that PBC has a direct effect on behaviour has been revised. It is now assumed that PBC has a moderating effect on behaviour (Klockner, 2015). However, these considerations are not directly relevant for the present thesis, as we are not including a measure of actual behaviour, only intention.

5.1.4 Some socio-demographic factors influence intention

There are several socio-demographic variables that influence the intention to become a pilot customer. Only one of the socio-demographic variables (gender) is significant across all models. This is an indication the gender might be the most important socio-demographic predictor for intention to become a pilot customer. Being a male, compared to being female, will increase the likelihood that one would become a pilot customer. Gender has been found to be related to environmental behaviour in different studies (Hiramatsu, Kurisu & Hanaki, 2016; Xiao & Hong, 2010). Hiramatsu et al. (2016) found that women were on average more environmentally conscious than men. The study by Xiao and Hong (2010) found that males' participation in public environmental behaviour were higher than females. However, when controlling for education there is no difference in public environmental behaviour. This paper does not support the findings in the thesis, where we have found gender differences in what could be construed as public environmental behaviour.

Somewhat surprisingly, secondary- and high school education compared to up to four years of university education, was a significant predictor of intention (model 2, Table 3 and

model 6, Table 5). One would expect that having a higher education would lead to being more open to new technology (Riddell & Song, 2017). Meyer (2015) showed that being more educated also is correlated with increased pro-environmental behaviour. It seems that education makes individuals more concerned with social welfare, and this increases the likelihood that one performs environmental behaviour (Meyer, 2015). It is important to underline that the effect was not found to be significant in median regression, indicating that the result is not conclusive. Jansson, Marell, and Nordlund (2010) also showed that education was a weak predictor of environmental behaviour. However, they emphasized that education, among other socio-demographic variables, increases the willingness to adopt environmental technology.

Finally, living in a villa as compared to semi-detached housing was a marginally significant positive predictor of intention to become a pilot customer. The explanation could simply be that living in a villa provides one with a more appropriate housing type for installing solar panels.

Age was not significant in any of the regression models (Table 3 – 6). Studies have found that age is related to environmental concern (Buttel, 1997). As presented by Buttel (1997) there are contradictive findings as to which age group expresses the most environmental concern.

Appendix B, Table B6 shows that nearly 50% of our participants have a household income of more than 1 mil. NOK. This is not representative of the average Norwegian household (Statistisk sentralbyrå, 2019). There is a lack of low-income participants. This might also contribute to the lack of a significant effect of income on the intention to become a pilot customer.

5.2 Extensions to theory of planned behaviour

5.2.1 Innovativeness has a positive effect on intention

Innovativeness is explained as a proclivity to choose a new technology and to be open to new ideas (Lu, Yao, & Yu, 2005). Innovativeness being significant in both ordinary multiple regressions ($p < 0.05$) and median regressions ($p < 0.05$; Table 3 – 6) supports that we can

accept the hypothesis (page 2) that being innovative has a positive effect on intention (model 5, 6, 7 and 8). Even though innovativeness was a significant predictor the effect is quite weak in all regression models (model 5, 6, 7 and 8).

Innovativeness being a significant predictor of intention is in line with other studies (Englis & Phillips, 2013). The present study focuses on the adoption of new environmental technology. It would be a reasonable assumption to make that the people showing interest, and chose to participate in the study, are interested in either environmentalism, new technology, or both. On the other hand, if this is correct, respondents that might score low on innovativeness, and also might have a low intention to adopt solar panels, are underrepresented in the study. This might explain the relatively low effect of innovativeness since the variation in innovativeness could be lower among the respondents than it is in the actual population.

Examining the descriptive statistics of the innovativeness (Appendix B, Table B1) related variables in the questionnaire can help us decide what type of adopters we can find in our sample. It is likely that our sample leans more towards innovators and early adopters. It would be very surprising if this sample consists of a large number of laggards (Rogers, 2003). When asked about whether the participants are sceptical about new ideas, 72% claimed not to be sceptical towards new ideas. Further 86% said that they are to some degree not sceptical towards new innovations and new ways of thinking (Appendix B, Table B1), this indicates that both innovators and early adopters could be well represented in this thesis (Rogers, 2003). Based on the significance of innovativeness it seems that accepting new technology could be important for the intention to become a pilot customer.

Wolske et al. (2017) found that seeing residential solar panels would increase the interest in solar panels. However, this effect was indirect. It did so by increasing the relative advantage and reducing the perceived risks related to residential solar panels (relative advantage and perceived risks are both components of diffusion of innovation (Rogers, 2003). Based on the paper by Wolske et al. (2017) and the findings in this thesis, there could be a link between innovativeness and descriptive norms. The problem is that solar panels are not that common in Norway (Appendix B, Table 1). This is where innovative individuals play an important role in making solar panels more common. By being innovators and early adopters, they can recruit the other categories, namely the early majority, the late majority

and hopefully also the laggards (Rogers, 2003). In this way, the innovators and early adopters could increase the intention to adopt solar panels of other members of the community.

5.2.2 Descriptive norms have no effect on intention

That descriptive norms had no effect on intention (Table 4 and 5) was surprising, especially since a significant effect of subjective norms was indicated, at least in some specifications. It would be intuitive that also observing behaviour would influence the intention to perform the behaviour. As mentioned descriptive norms have been suggested as an expansion to TPB (Rivis & Sheeran, 2003).

Descriptive norms are formed when a person observes the behaviour of others (Reno et al., 1993). One possible reason for descriptive norms not being significant could be that residential solar panels are not common enough in Norway to have an effect when the data were collected. The questionnaire shows that 85% answered either neutral or negatively regarded if they believed that solar panels are commonplace in Trondheim (Appendix B, Table B1). This indicates that most people do not believe that acquiring solar panels is normal and thus lowering the strength of the descriptive norm. When asking about how many of the participants had seen solar panels in Trondheim only 24.7% answered in a positive manner (Appendix B, Table B1). It is of note that the questions regarding belief about how common solar panels are, and if they have seen them, is on a Likert scale. This makes it harder to know what exactly the participants meant in this context.

To summarise, the use of extensions to TPB did add to the overall explanatory power of the analysis. Even though innovativeness did not add much in the form of explained variance, it gives an indication that identifying oneself as an innovative person is a factor that could explain intention.

5.3 Limitations and challenges

A major limitation of this study is related to the dependent variable, (intention). It only measures the intention to perform the behaviour. There is a gap between intention and behaviour and Sheeran & Webb (2016) showed that in fact, only about one-half of intended behaviour becomes actual behaviour. However, an earlier study by Sheeran (2002) found that

intentions could on average explain 28% of behaviour. Also, as mentioned in section 2.1.1, Godin & Kok (1996) found that intentions could explain 34% of health-related behaviour. There seems to be a disagreement in how much actual behaviour intention can explain, and there are most likely several different factors influencing behaviour. Fishbein and Ajzen (1975) present three specific conditions affecting the intention-behaviour relationship. The first is the degree to which the measure of intention and behavioural criteria correspond with their levels of specificity. The second condition is that the intentions are stable between when they are measured and when the behaviour is performed. Of special interest is the third condition looking at the degree to which the behaviour is volitional, i.e. how much control does a person have over the behaviour. In this study the question regarding the intention to perform behaviour and the behaviour is very similar to what the eventual behaviour would be: The participants are asked on a scale what their intention to become a pilot customer is, and this corresponds well with the possible prospective behaviour of actually adopting the technology (which, however, was not measured in our questionnaire). Unfortunately, we have no way to know the stability between the intention and the behaviour, as we do not have access to any data indicating how many became pilot customers. Based on the effect of PBC in the regression analysis it seems that the participants have a high degree of perceived control. Even though Fishbein and Ajzen's (1975) conditions seem to be met quite well we cannot be sure that the behaviour was in fact followed through.

Further, the questionnaire used in this thesis was not created with the exact analysis used in this thesis in mind. Even though all the TPB components are present in the questionnaire some components could have been measured with more items. This is most relevant for subjective norms and intention.

The data could be considered old since investment in new technology often sees a rapid increase in adoption during a few years. The data was collected in 2016, and since then there has been a big increase in the sale of solar panels in Norway. In 2017 the market for solar panels has grown by 59% (Bellini, 2018). It is probable that newer data would have influenced the results especially those related to descriptive norms. Seeing solar panels as more common than in previous years could lead to a change in descriptive norms.

Another limitation is that the data collection was not done randomly. The sampling method resulted in a group of participants that could be more interested in both the

environment and technology than compared to the average Norwegian. Using this type of sample from the population is something that needs to be considered when analysing the results e.g., with respect to the results' generalizability.

There is also an issue with participants dropping out of the questionnaire. 87 participants or about 12% dropped out of the questionnaire. There is a possibility that a high number of questions is related to the rate of dropping out. Shalqvist et al. (2011) found that shortening a relatively long questionnaire significantly increased the response rate. Their conclusion is that researchers should consider the trade-off between the value of additional questions and a larger sample.

5.4 Implications for future research

The results found in this study, and in similar studies, could give an idea of what psychological factors should be in focus when attempting to change behaviour to become more environmentally minded. Only focusing on influencing the attitudes or norms regarding a behaviour could have less effect than if one were to add PBC as well.

PBC is an important predictor in that it has an effect on both the intention to perform behaviour and behaviour itself (Ajzen, 1991). This could indicate that presenting behaviour as easy would increase the chance that it will be performed. An example of this is a commercial with Norwegian comedian Atle Antonsen (Grønt Punkt Norge, 2016). In this commercial, he talks about how hard recycling is in a sarcastic and comedic manner, implying that it is easy to do. Thus, studies could focus more on different methods to increase PBC when influencing pro-environmental behaviour.

An interesting topic for further research could be to compare different types of high-cost pro-environmental behaviour, and also see if they could be correlated. One could, for example, examine if there is a correlation between having an electric or hybrid vehicle and having an interest in solar panels or smarter home electric systems. It could also be interesting to see if there is a link between other types of pro-environmental behaviour and high-cost pro-environmental behaviour. Examples of areas of interest could be the choice of personal transport, recycling behaviour, food choice or another type of behaviour that could

be construed as low-cost. Spillover effects would also be of interest when comparing different types of pro-environmental behaviour. A study by Lauren, Smith, Louis, and Dean (2019) found that past environmental behaviour is associated with an increase in intention to perform other environmental behaviours.

Perhaps one of the more interesting avenues of further research could be to expand TPB with personality factors. This has been done in some domains of social psychology. Personality factors by themselves have been used in environmental psychology. An example of this is a study by Poškus and Žukauskienė (2017), who showed that certain personality types are more environmentally minded. They also found that different personality types approached environmental behaviour differently. Rivis, Sheeran, and Armitage (2011) added the big five personality traits as an expansion to TPB and showed that the traits were correlated with greater control of behaviour. Openness, agreeableness, neuroticism, and conscientiousness were related to higher levels of environmental concern. This finding is corroborated by Hirsh (2010). Additionally, Jacoby (1971) did find a relationship between less dogmatic people and being prone to innovation. This could indicate that there is a link between innovativeness and an open personality that would be interesting to investigate within the scope of environmental psychology. As mentioned in section 2.2, Conner and Armitage (1998) present several other possible expansions to TPB, for example, self-identity, that could improve the model.

To cover more aspects of Norwegian citizens interested in solar-panels an integrated model could be used. There is a wide array of different integrated models that would be appropriate for further research on this subject. One example of such an integrated model is the comprehensive action model (Klöckner & Blöbaum, 2010). This model contains a wide variety of predictors that are theorised to have an effect on intentions to perform a behaviour. Klöckner & Blöbaum, 2010 found that this model had greater explanatory power than other models. Another integrated model (Wolske et al., 2017) encompasses variables from value-belief-norm theory (Stern, 2000), TPB (Ajzen, 1991) and diffusion of innovation (Rogers, 2003). The authors found that their integrated model gave a clearer picture of interest in residential solar panels. This indicates that using a more complex model in future research could give a better picture of this pro-environmental behaviour.

6. Conclusion

The aim of this thesis was to assess the effect of different psychological and sociodemographic factors on the intention to become a pilot customer for a residential solar power system. In general, there are three variables that seem to influence the intention of becoming a pilot customer across models. The first one, PBC, represents the importance of perceived difficulty when performing high-cost environmental behaviour. It also tells us that most of the participants did not experience getting solar panels as an issue. Secondly, it is more likely that males would intend to become a pilot customer compared to females. Gender was the only consistently significant socio-demographic variable. Thirdly, innovativeness seems to be indicative of increased intention to become a pilot customer. Additionally, several other variables are either marginally significant, or significant in only some of the models. The findings could be used to find ways to promote the use of residential solar systems and other high-cost pro-environmental investments.

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Appendix A: Trønderenergi solar panel questionnaire

Appendix A shows the questions used in the questionnaire. There are 117 items in total and they are written exactly as they are presented in the questionnaire.

1. Hva var den viktigste grunnen til at du sendte inn en uforpliktende søknad til TrønderEnergi?
2. Jeg er interessert i ny teknologi.
3. Jeg er opptatt av å være miljøvennlig.
4. Jeg ønsker på sikt å spare utgifter til strøm.
5. Jeg vil investere i fremtidens energiforsyning.
6. Jeg vil øke verdien på huset mitt.
7. Noen jeg er kjent med inspirerte meg til å melde interessen.
8. Jeg vil bidra at bruk av solselleteknologi i Norge utvikler seg.
9. Jeg skulle ikke la den sjansen gå forbi meg.
10. Jeg synes at det kunne vært stilig å ha solsellepanel på taket sånn at andre kan se dem.
11. Jeg liker å bli sett på som en som tar den nyeste teknologien i bruk.
12. Søknaden til TrønderEnegi var uforpliktende. Hvor sikkert er du at du ville takke ja til å bli en av pilotkundene?
13. Du har muligens noen betenkninger imot å installere solsellepanel på huset ditt. Hvilke er det?
14. Solsellepanel øker behov for å fjerne snø fra taket.
15. Konstruksjonen kommer til å slite ut taket mitt.
16. Solsellepanel vil ikke være økonomisk lønnsomme.
17. Det blir mye støy når de skal installeres.
18. Det blir mye forstyrrelse av hverdagen at de skal vedlikeholdes gjennom Trønderenergi.
19. Strømforsyning i huset mitt blir mer ustabilt.
20. Det blir byråkratisk å få pengene for produksjonsoverskuddet mitt.
21. Solsellepanel øker behov for å fjerne snø fra taket.
22. Konstruksjonen kommer til å slite ut taket mitt.
23. Solsellepanel vil ikke være økonomisk lønnsomme.
24. Det blir mye støy når de skal installeres.

25. Det blir mye forstyrrelse av hverdagen at de skal vedlikeholdes gjennom Trønderenergi.
26. Strømforsyning i huset mitt blir mer ustabilt.
27. Det blir byråkratisk å få pengene for produksjonsoverskuddet mitt.
28. Solsellepanel øker behov for å fjerne snø fra taket.
29. Konstruksjonen kommer til å slite ut taket mitt.
30. Solsellepanel vil ikke være økonomisk lønnsomme.
31. Det blir mye støy når de skal installeres.
32. Det blir mye forstyrrelse av hverdagen at de skal vedlikeholdes gjennom Trønderenergi.
33. Strømforsyning i huset mitt blir mer ustabilt.
34. Det blir byråkratisk å få pengene for produksjonsoverskuddet mitt.
35. Helt generelt/ overordnet, mener du at å få solsellepanel på taket vil være - Verdiløst|Verdifullt
36. Helt generelt/ overordnet, mener du at å få solsellepanel på taket vil være - Ubehagelig|Behagelig
37. Helt generelt/ overordnet, mener du at å få solsellepanel på taket vil være - Skadelig|Fordelaktig
38. Helt generelt/ overordnet, mener du at å få solsellepanel på taket vil være - Dårlig|Bra
39. Sett solseller I Trondheimsregionen
40. Sett solseller I andre norske regioner
41. Sett solseller I andre land
42. Vanlig solseller - I Trondheimsregionen
43. Vanlig solseller - I andre norske regioner
44. Vanlig solseller - I andre land
45. Det finnes forskjellige modeller på markedet hvordan solpanel på private boliger kan finansieres, det følger en kort beskrivelse av fire modeller. Hvilket modell ville du foretrekke?
46. Elektrisk bil / hybrid bil
47. Varmepumpe til oppvarming av hus
48. Vaskemaskin med minst energimerke A++
49. Kjøleskap med minst energimerke A++
50. Fryser med minst energimerke A++
51. Støvsuger med minst energimerke A

52. TV med minst energimerke A+
53. Vinduer i huset mitt har u-verdi under 1.0 (f. eks. tre-lags vindu)
54. Ytreveger i huset mitt har minst 20 cm isolering
55. Taket i huset mitt har minst 15 cm isolering
56. El-sykkel
57. Sykle eller gå istedenfor å bruke bil.
58. Bruke kollektivtrafikk istedenfor å bruke bil.
59. Bruke tog/buss istedenfor fly på reiser innenfor Norge.
60. Spise vegetar istedenfor å spise kjøtt.
61. Handle/bytte brukte varer (klær, møbler, osv.) istedenfor å kjøpe nye.
62. Reparere ødelagte ting istedenfor å kjøpe nye.
63. Unngå å kaste mat.
64. Tradisjoner er viktig for meg. Jeg prøver å følge skikker nedarvet fra min religion eller familie.
65. Det er svært viktig for meg å hjelpe folk rundt meg. Jeg bryr meg om hvordan de har det.
66. Rettferdighet og likebehandling er viktige verdier. Jeg synes alle bør ha like muligheter i livet.
67. Jeg liker å stå fram med det jeg kan. Jeg vil at folk skal beundre det jeg gjør.
68. Folk bør bry seg mer om naturen rundt seg. Det er viktig for meg å ta vare på miljøet.
69. Jeg liker overraskelser og er alltid på 1kt etter nye ting å gjøre. Jeg synes det er viktig å gjøre mange ulike ting i livet.
70. Det er viktig for meg å ha det bra. Jeg liker å Â«skjemme meg bortÂ» av og til.
71. Det er viktig for meg å ha bra med penger. Jeg ønsker å ha god råd og kunne kjøpe dyre ting.
72. Jeg liker å prøve ut nye ideer.
73. Jeg improviserer ofte måter å løse et problem på når svaret ikke er opplagt.
74. Jeg erfarer at jeg ofte er skeptisk til nye ideer.
75. Mine venner og kolleger spør meg ofte om råd eller informasjon.
76. Jeg er skeptisk til nye oppfinnelser og nye måter å tenke på.
77. Jeg regner meg selv som kreativ og original i måten jeg tenker og oppfører meg på.
78. Jeg setter pris på å ta lederansvar i gruppen jeg tilhører.
79. Jeg er vanligvis forsiktig med å godta nye ideer.
80. Jeg må se andre bruke nye innovasjoner før jeg vurderer dem.

81. Jeg synes vanligvis at den tradisjonelle måten å leve og gjøre ting på er best.
82. Jeg føler at jeg har innflytelse blant venner og kolleger.
83. Jeg synes det er stimulerende å være original i måten jeg tenker og oppfører meg på.
84. På grunn av mine verdier/ prinsipper føler jeg meg forpliktet til å leve mest mulig miljøvennlig.
85. Det ville vært mot mine verdier å sløse med miljøressurser.
86. Folk som er viktig for meg synes jeg burde leve mest mulig miljøvennlig.
87. Folk som er viktig for meg støtter at jeg lever mest mulig miljøvennlig.
88. Jeg bekymrer meg for miljøproblemer forårsaket av levemåten vi Nordmenn har.
89. Reduksjon i bruk av miljøressurser er et viktig tema for meg.
90. Ettersom en person ikke kan ha noen påvirkning på løsningen av miljøproblemene, teller det ikke hva jeg gjør.
91. Jeg føler meg personlig hjelpeløs når det gjelder å ha noen påvirkning på et problem så stort som miljøet.
92. Menneskenes dyktighet og klokskap vil sikre at det ikke blir ulevelig på jorda.
93. Naturens balanse er stabil nok til å motstå påvirkningene fra moderne industriland.
94. Vi nærmer oss grensen for antallet mennesker jorda kan brødfø.
95. Den såkalte Â«økologiske krisenÂ» som menneskeheten hevdes å stå overfor har blitt sterkt overdrevet.
96. Det er meningen at menneskeheten skal herske over naturen.
97. Til tross for våre høyt utviklede evner er vi mennesker fremdeles underlagt naturen lover.
98. Jorda er som et romskip med meget begrenset plass og ressurser.
99. Hvis utviklingen fortsetter på sin nåværende kurs, vil vi snart oppleve en større økologisk katastrofe.
100. Planter og dyr har like stor rett som oss mennesker til å eksistere.
101. Naturens balanse er ømfintlig og svært lett å forstyrre.
102. Er du ... (question about gender)
103. Ditt fødselsår (åååå)
104. Antall personer i husholdningen
105. Hvor mange av dem er 13-18 år gammel?
106. Hvor mange av dem er under 12?
107. Hva er ditt høyeste fullført utdannelse?
108. Hva slags bolig bor du i?

109. Eier eller leier du/husholdningen boligen din?
110. Hvor stor er boligen/ leiligheten din? Vennligst oppgi boarealet på boligen/ leiligheten i kvadratmeter:
111. Når ble boligen din bygget? Vennligst oppgi byggeår for huset. Dersom du ikke vet nøyaktig byggeår må du gjerne gi oss ditt beste/ omtrentlige anslag.
112. Hvilken energimerke har boligen din i dag?
113. Hvor mye elektrisitet brukte husholdningen din omtrent i 2015, målt i kilowattimer? Antall kilowattimer (kWh) brukt i 2015:
114. Hva er husholdningens samlede bruttoinntekt (før skatt) pr. år?
115. Har du noen kommentarer du ønsker å dele med oss?
116. response_start_date
117. completed_

Appendix B: Variables and questions used in regression analysis. Distribution of answers

Table B1

The distribution of answers for each of the questions. The questions are sorted by variables.

Variables	Likert scale							
	-3	-2	-1	0	1	2	3	N
Intention								
The application to TrønderEnergi was noncommittal. How likely is it that you will say yes to become one of the pilot customers? (%)	0.53	0.35	0.71	7.95	7.60	28.80	54.06	566
Attitudes								
In general, do you think that getting solar panels on your roof would be – Worthless|Valuable (%)	4.70	2.26	1.57	8.36	17.07	28.92	37.11	574
In general, do you think that getting solar panels on your roof would be – Uncomfortable|Comfortable (%)	8.23	3.33	2.45	34.85	12.61	17.16	21.37	571
In general, do you think that getting solar panels on your roof would be – Damaging|Beneficial (%)	7.85	3.49	2.97	12.91	12.04	24.43	36.30	573
In general, do you think that getting solar panels on your roof would be – Bad|Good (%)	6.47	2.45	1.05	6.64	10.49	28.32	44.58	572
Subjective norm								
People that are important to me thinks I should live as environmentally friendly as possible (%)	4.57	7.56	8.44	41.83	23.02	9.84	4.75	569

Table B1 (continued)

PBC=(probXrel)								
(prob) Solar panels increase the need to remove snow from the roof (%)	15.13	15.13	12.17	22.96	17.74	11.30	5.57	575
(prob) The construction will wear out my roof (%)	42.43	25.57	9.74	13.04	7.48	1.22	0.52	572
(prob) Solar panels wont be economically beneficial (%)	15.73	15.56	16.08	29.20	14.16	6.47	2.80	572
(prob) There will be a lot of noise when they are installed (%)	39.30	20.70	10.26	20.70	5.91	2.09	1.04	575
(prob) There will be a lot of everyday disturbances when they are maintained through TrønderEnergi (%)	36.63	25.00	12.15	20.49	4.69	0.69	0.35	576
(prob) The power supply will be more unstable (%)	47.04	22.30	9.93	16.03	3.14	1.22	0.35	574
(prob) It will be bureaucratic to get the money from my production surplus (%)	21.43	15.51	12.54	31.18	11.85	5.40	2.09	574
(rel) Solar panels increase the need to remove snow from the roof (%)	22.13	13.76	10.98	20.91	17.07	10.63	4.53	574
(rel) The construction will wear out my roof (%)	26.61	13.22	10.09	18.43	12.52	10.43	8.70	575
(rel) Solar panels wont be economically beneficial (%)	13.07	8.71	12.72	25.09	17.42	14.29	8.71	574
(rel) There will be a lot of noise when they are installed (%)	56.97	19.16	6.97	14.11	2.09	0.70	0	574
(rel) There will be a lot of everyday disturbances when they are maintained through TrønderEnergi (%)	39.02	18.64	11.32	18.99	8.54	2.79	0.70	574
(rel) The power supply will be more unstable (%)	21.91	8.35	10.61	22.26	14.43	11.13	11.30	575
(rel) It will be bureaucratic to get the money from my production surplus (%)	23.44	12.33	15.45	26.04	12.85	7.12	2.78	576
Descriptive norms								
Seen solar panels in the Trondheim region (%)	31.87	18.74	9.63	15.06	21.37	2.80	0.53	574
Normal with solar panels – in the Trondheim region (%)	22.30	28.75	17.25	20.21	6.97	2.79	1.74	574
Seen solar panels in other Norwegian regions (%)	18.49	15.14	12.50	19.72	24.30	7.57	2.29	568
Normal with solar panels – in other Norwegian regions (%)	11.60	24.78	19.51	26.36	11.42	4.39	1.93	569
Seen solar panels in other countries (%)	4.72	2.80	2.62	11.54	20.98	29.02	28.32	572
Normal with solar panels in other countries (%)	1.05	3.49	4.71	17.63	23.39	27.75	21.99	573

Table B1 (continued)

Innovation								
I experience that I often am sceptical towards new ideas (%)	17.74	30.96	23.30	13.91	7.83	4.87	1.39	575
I am sceptical to new inventions and new ways of thought (%)	32.81	36.81	15.97	7.47	3.65	2.78	0.52	576
I am usually careful with accepting new ideas (%)	13.76	33.80	22.47	12.20	12.72	4.88	0.17	574
I have to see others use innovations before I consider them (%)	17.88	27.60	20.31	15.45	12.85	4.51	1.39	576
I usually believe that the traditional method to live and do things is the best (%)	6.78	22.78	23.30	27.30	12.52	4.87	2.43	575

Table B2

Distribution of gender

Variable	Male	Female
Gender(%)	84.36	15.64

Note. N = 569

Table B3

Mean, min and max, age of participants

Variable	Mean	SD	Min, max
Age (year)	49.35	10.73	25, 83

Note. N = 577

Table B4
The participants level of education

Variable	Level of education		
	Secondary- and high school	Higher edu. <4 yrs.	Higer edu. +4 yrs.
Education (%)	29.22	37.39	33.39

Note. N = 575

Table B5
Type of housing

Variable	Type of housing		
	Villa	Detached	Apartment
Housing (%)	76.74	13.02	10.24

Note. N = 576

Table B6
Distribution of income of participants

Variable	Level of Income NOK		
	Less than 700,000	700,000 to 1.000 000	more than 1.000 000
Income (%)	19.23	31.87	48.90

Note. N = 546

NTNU

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