

Master Thesis

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## Motivations and social practices of homeowners with PV panels in Belgium, Germany and The Netherlands

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## Summary

The European Union sets legally binding targets for all member states to achieve that 14% of the total energy consumption must be generated by renewable energy. Photovoltaic (PV) panels are becoming increasingly important in generating renewable electricity. Homeowners play a valuable role in adding extra capacity. A big difference in the amount of PV panels installed by homeowners is observed in Belgium, Germany and the Netherlands. The purpose of the research is to identify patterns in the motives and social practices of homeowners with PV panels in the mentioned countries. Two theoretical models are the basis for defining concepts and to formulate hypotheses. The model of Spaargaren is used for analysing consumption practices and the model of Hofstede is used for analysing cultural patterns. Data is collected with semi-structured interviews. The topics are about the process that led to an investment in PV panels and the experiences with PV panels. In each country eight homeowners are interviewed. The empirical findings show strong emphasis towards financial motives and considerations. However each country show specific patterns on the topics ecological, uncertainty avoidance, technical affinity and energy awareness. The found cultural related patterns support the formulated hypothesis. Uncertainty avoidance is strong in Belgium. Technical affinity with PV panels is strong in The Netherlands. German homeowners show a different awareness of energy consumption and routines on energy consumption after installing the PV panels than the two other countries. The relevant regulatory framework in each country is a prominent topic in the stories of the homeowners. Therefore it's recommended to design a regulatory framework that fits with the stage of adoption and the specific cultural patterns of the target group.

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# 1 Introduction

## 1.1 Background to the research problem

The European Union sets legally binding targets for all member states to achieve that 14% of the total energy consumption (i.e. heat and electricity) must be generated by renewable energy sources by the year 2020 (Directive 2009/28/EC). Another requirement is that each member country must have a national renewable action plan (NREAP). Big contributors for the generation of renewable electricity are biomass and wind energy. Electricity generated by photovoltaic (PV) installations becomes increasingly important in Europe. Based on the national renewable action plans the capacity generated by PV installations should surpass 80 GW by 2020 (Menna et al., 2011).

The growth of electricity generated by PV installations is impressive in Europe. In 2010 in total 13 GW of new PV installations were connected to the European Grid. For the first time Europe's photovoltaic sector installed more new capacity than any other renewable electricity source (Euroobserver-Systèmes Solaires, 2011). The biggest contributor is Germany with 7.4 GW. Belgium added 0.2 GW to the grid. The Netherlands contributed only 0.03 GW (Euroobserver-Systèmes Solaires, 2011).

The question is why electricity generated by PV installations is relatively low in the Netherlands compared with the neighbouring countries Germany and Belgium. Citizen-consumers play an important role in adding capacity by placing PV panels on their roofs. For example German homeowners installed nearly 100,000 systems (700 MW) in 2010 (based on figures of the German Federal Network Agency). What are the reasons that citizen-consumers in the Netherlands are not placing so much PV-panels on their roofs compared with Germany and Belgium? We can no longer speak of a 'captive' consumer. Nowadays citizen-consumers can freely choose between energy providers and homeowners can choose to produce their own energy. New consumer roles have emerged in the domain of energy consumption and production over the last decades (Van Vliet, 2002).

My thesis examines the behaviour of homeowners with PV panels in the three mentioned countries. The target group are citizen-consumers that own a house and can independently decide to invest in a PV installation. Hence these consumers are not part of an overarching project. What is the typical behaviour of homeowners in making decisions about an investment in a PV installation? What is the role of the relevant regulatory framework in the deliberation process? Are there cultural differences observable between the homeowners that decided to install PV panels? How do these homeowners behave with respect to energy issues after installing the PV panels? To examine this behaviour a qualitative study is carried out that consists of semi-structured interviews amongst homeowners.

## 1.2 Research objective

The objective of this research is to get insight in the motivation and social practices of homeowners that are related with the investment and ownership of PV panels. More precisely I want to get insight in the following topics.

1. The deliberation process that leads to the decision to invest in PV panels.
2. The social practices of homeowners in relationship with the ownership of PV panels.

I compare homeowners with PV panels in Belgium, Germany and the Netherlands. I hope to contribute to more knowledge about relations between motivational goals, lifestyles and social practices in households. In addition the results of this research could be helpful for designing a policy for stimulating the investment in PV panels.

### 1.2.1 General research question

*Which patterns can be observed in the motivations and social practices of homeowners with respect to their investment decision and ownership of PV panels?*

### **1.2.2 Sub questions**

What are the reasons mentioned by homeowners to invest in PV panels in Belgium, Germany and The Netherlands?

Which routines do homeowners demonstrate with respect to the consumption of electricity after installing the PV panels?

What is the regulatory framework with respect to solar energy in Belgium, Germany and The Netherlands?

What are the cultural differences between homeowners in Belgium, Germany and The Netherlands?

### **1.2.3 Method**

The main method of data collection was semi-structured interviews with mostly open questions.

The following steps and activities were carried out:

- Selection of research method
- Description of target group
- Strategy to select and invite candidates for interviews
- Interviews
- Analysis of the data

#### Selection of research method

The motivation to use the method of semi-structured interviews with open questions is based on the nature of the information that is needed to answer the research question. The information is derived from homeowner's motives, considerations and knowledge about PV panels in a broad sense. The method of semi-structured interviews with open questions is well suited for this type of information. It gives the interviewed homeowners the necessary space in verbalizing their behaviour, experiences and opinions about PV panels in their own language.

#### Description of target group

The target group are homeowners in Belgium, Germany and The Netherlands that took own initiative to invest in PV panels. They are not a part of an overarching project.

#### Strategy to select and invite candidates for interviews

The possible candidates that were invited for the interviews were randomly selected. Randomly means that not deliberately candidates that fit the description were excluded or included in the selection of invited homeowners. Multiple strategies were used to find candidates. First my own network was used to find possible candidates. In this network family, friends, neighbours and fellow students were asked to provide names and email addresses of people that own PV panels. The second strategy was to contact suppliers of PV panels and ask them for names. The third strategy was to use a European database with names of homeowners that own PV panels. For practical reasons clusters of homeowners in specific regions were selected in Belgium and Germany. The selection was based on a maximum distance of 300 km from the region Utrecht. My own network and a list of names of a supplier were most successful in finding Dutch candidates. In Belgium my own network and the European database were equally successful. In Germany the European database was the most successful strategy.

The collected names and addresses were filed. All selected candidates received a letter with an explanation and purpose of the research and were asked to respond if they are willing to cooperate in the research. An example of this invitation letter is in appendix 3. Candidates that gave a positive response were approached to make an appointment. All the appointments were

planned in a specific period for each country (December for the Netherlands, January for Belgium and February for Germany). Each candidate received a confirmation of the appointment.

### Interviews

#### **Construction of the questionnaire**

The interviewer used a questionnaire during the interviews. The constructing of the questionnaire was done after defining the goal and concepts. The used concepts are operationalised into topics. Attention points and aspects that belong to a specific topic were defined. Open-ended questions were formulated and logically ordered. After the constructing of the questionnaire a test interview was held with a volunteer that owns PV panels. The results of the test interview gave input for some adjustments in the questionnaire. The questionnaire is placed in appendix 2.

#### **The interviews**

Beforehand permission was asked to record the interview. Furthermore, it was explicitly stated that all information is anonymously processed.

Each interview was held on the preferred location of the homeowner. Preferably the interview took place at the residence of the homeowner. Each interview is recorded. During the interviews notes were written down and the questionnaire is used to guide and check if all necessary information is obtained.

All recorded interviews are written into transcripts. Interviews that are held in the English language have English written transcripts. All the other interviews are written in the Dutch language. An overview of the interviews is placed in appendix 4.

### Analysis of the data

The constructed questionnaire functioned as input for the construction of the code table. All interviews are coded with the code table. The code table is placed in appendix 5. In an iterative process the code table is adjusted. To test the reliability of the code table interview 1 and interview 2 are coded by two different persons and compared on consistent results.

The coded transcripts of the interviews are converted into frequency tables per examined country. The responses are coded and categorized in the defined concepts and dimensions. In the frequency tables the response counts are given relative weight by comparing a score on a particular object with the average score. The counts of coded responses are listed per interview in the frequency tables in appendix 1.

On the basis of an in-depth analysis of the coded interviews and the frequency table the findings are reported. These findings were examined and confronted with the formulated hypothesis. Differences in findings between countries were identified and analysed. Conclusions are drawn and recommendations formulated.

### **1.3 Structure of thesis**

The thesis is divided into a theoretical, an empirical and a concluding chapter. In chapter 2 the theoretical framework is described. First two theoretical models are introduced and concepts from this model are described and explained. The first model is suitable for analysing consumption practices in a domestic setting. The second model is the theoretical basis for analysing cultural patterns in countries. After the introduction of the models country specific findings with citizens' perceptions, opinions and attitudes towards energy, climate change and environment are reported. Furthermore two specific surveys about the opinion of consumers on PV panels are discussed. On the basis of the two models and findings in the examined surveys hypotheses are formulated.

The empirical findings are reported in chapter 3. A general overview of observed patterns are described followed by a description of specific patterns per country. In the last section of this chapter a comparison is made between the countries and the findings are held against the formulated hypotheses. In the chapter 4 conclusions and recommendations are formulated. I reflect on the method, used theoretical models and empirical findings in the final chapter 5.



## 2 Selected theoretical models, country specific findings in literature and research hypotheses

### Introduction

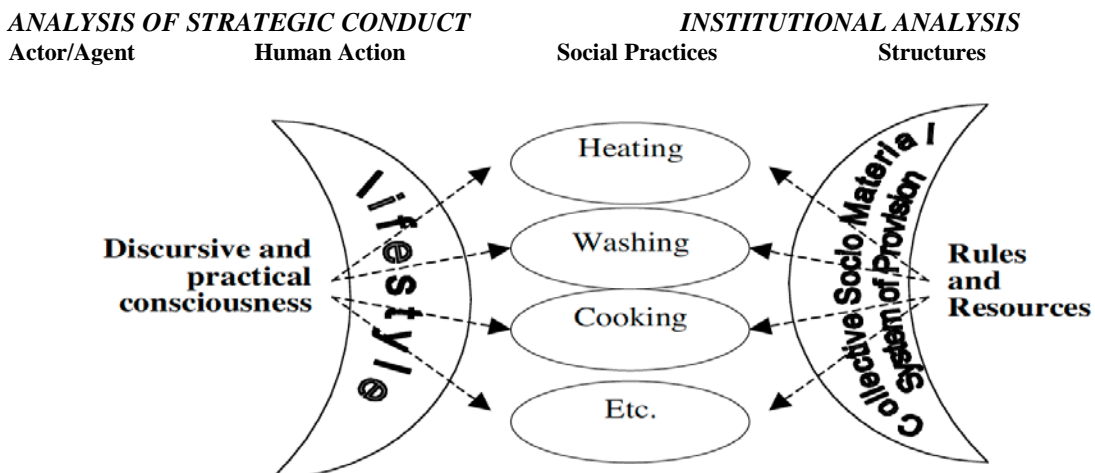
There are a lot of models available that try to explain the behaviour and change in behaviour of consumers in their consumption practices. Some models emphasise economical factors, like expected gains. Other models have a focus on social factors such as beliefs, values, habits, norms and ability (Jackson, 2005). I selected two models that are elaborated in the next section. The first model is from Spaargaren and based on the structuration theory of Giddens. The second model I describe is from Hofstede that uses six dimensions to explain cultural differences between countries. The first model of Spaargaren will be used to analyse social practices of individual consumer households. The second model of Hofstede will be used to analyse the responses of homeowners on cultural aspects. In relation with cultural aspects Eurobarometers that measure citizens' opinions and attitudes toward energy, climate change and the environment are analysed. Subsequently surveys about consumer opinions and attitudes toward PV panels in two other countries are analysed. The last addressed topic is the regulatory framework with different subsidy schemes for each examined country. At the end of each section a hypothesis or more hypotheses are formulated.

### 2.1 Model for studying consumption practices

For change in consumer behaviour with respect to sustainable consumption decisions I selected an integrative model for consumer behaviour. This model with consumption as a set of social practices proposed by Spaargaren and Van Vliet (Spaargaren and Van Vliet, 2000) will be the theoretical basis for analysing behaviour on the level of individual consumer households. The manner homeowners behave with respect to energy consumption and supply depends on different social practices. Persons in a household act in all kind of social practices like heating, taking a shower or making a decision about investments. These practices are performed under different conditions within a certain time frame and place. The advantage of the proposed model is that it takes this different social practices and conditions into account. Therefore this model is well suited as a theoretical basis to analyse the energy related consumption practices of homeowners that have installed PV panels on their roofs.

The following figure presents the conceptual model for studying consumption practices. I will use the concepts in this model to make a relationship between the lifestyles of homeowners, the behaviour of homeowners with respect to their energy issues and the structures that are involved. I will first describe the concepts of this model. Then I will use the model to formulate hypotheses about expected consumption practices of individual homeowners that possess PV panels.

**Figure 1: A conceptual Model for Studying Consumption Practices (Spaargaren, 2000)**



Giddens' structuration theory is an important source for the concepts presented in the model. Human agents participate in social practices that are situated in a certain time and place. The human agent uses resources and has to follow specific rules that belong to a specific social practice. The rules and resources together are defined as the structure necessary to reproduce a particular social practice (Van Vliet, 2002). Human agents power to control the course of action depends on the flexibility a structure offers. This is an important notion in the model. It implies that a human agent can be confined in his actions by the structure. Another important notion in the structuration theory is the concept of the 'duality of structure'. The 'duality of structure' is the concept that a human agent can only participate in a social practice using the structure as a medium and that at the same time this structure is enforced and influenced by the actions of this human agent and other human agents (Van Vliet, 2002). The concept of 'duality of structure' in consumption practices and socio-material systems will be explained in the next section. After that section the theory about ecological modernization and the implications for domestic related considerations will be discussed.

### **2.1.1 The 'duality of structure' in consumption**

With the structuration theory of Giddens in mind Per Otnes described this concept as follows: "domestic consumption can be summarised as a process of 'being served by, and serving, a number of essentially collective socio-material systems'" (Otnes, 1988). Homeowners are served by the collective system in their social practices. For example the electricity grid serves activities such as lighting the house, using the washing machine, paying the bills with an on-line banking system, watching television, etc. At the same time the collective socio-material system in charge of the supply of electricity is reinforced by all these actions of the homeowner. A collective system of provision is already functioning when you buy a house. When you sell the house probably the same system is still 'serving' your old house. It seems that the house and system have established a coalition without consulting the owner of the house. This thought is to illustrate that a large part of the material and energy-flows used during the lifetime of a house are supplied by collective socio-material systems without explicit deliberations of the users of these flows. You are just being served. However the impact of these collective socio-material systems on resources is considerable. Therefore the characteristics of these systems are relevant for the possibilities a homeowner have to influence his desired sustainable lifestyle. People can be frustrated or stimulated in efforts to make their lifestyles more sustainable. For example when a energy company is willing to pay an attractive price for the electricity delivered to the grid from the PV panels this will probably stimulate the homeowner in his investment decision. Also the devices provided by the energy company to monitor a homeowners' energy consumption could be stimulating to put more effort in managing the energy consumption. The main message for me of the concept of the duality of structure is that citizen-consumers together can actively steer a structure by making a more deliberate choice for a sustainable lifestyle and choose providers that offer a sustainable alternative.

### **2.1.2 Ecological modernization in a domestic setting**

The sociological theory of ecological modernization will be briefly introduced. At the heart of this theory is the view that, environmental criteria - besides cultural, economic or political criteria- have an independent place to judge actions of individuals and institutions (Van Vliet, 2002). When an institute or individual is in a selection process of alternative actions an increased attention for ecological considerations is seen as a sign of ecological modernization. In analogy of institutional terms like environmental management we can use this term for citizen-consumers. When a citizen-consumer makes a consciousness effort to reduce the impacts on the environment caused by the characteristics of a lifestyle we speak of environmental management. This effort is based on the acknowledgement of an environmental utilisation space covering the total impact of a lifestyle. The idea is that a citizen-consumer has a choice in managing his environmental impact within technological or political limits. For example a homeowner can use energy based on renewable or non-renewable resources. He can take preventive measures to save energy or is spilling energy with all kind of electrical devices. In his effort to reduce the environmental impact of the different lifestyle sectors the homeowner seeks an optimum in the available environmental utilisation space. He has the desire to reach a reasonable fit between economical, cultural and ecological considerations to continue a lifestyle. So a sustainable lifestyle contains a deliberate trade off between the benefits and costs in economical, social and ecological terms. When a person is buying a new car not only the involved status, comfort, safety and financial aspects are important but also the energy label, the used technology for the engine and the recycling programme.

Notions and concepts from Giddens' structuration theory and the theory of ecological modernization are used in the model for studying consumption practices. I will use concepts from this model and other theories to investigate the behaviour of homeowners in three countries. My analysis will focus on motivations and social practices of homeowners. For this analysis the following concepts need further elaboration:

- The concept of a lifestyle;
- The concept of cultural standards;
- The concept of time-space structure in domestic social practices;
- The concept of a system of provision perspective.

### **2.1.3 Lifestyles and homeowners**

Human agents act in all kind social practices, like watching television, taking a shower, illuminating the house or preparing a meal. A homeowner has also specific activities like home maintenance, redecorating the house, invest in a new kitchen or PV panels. By acting as a homeowner in these social practices you can observe a pattern. Persons tend to behave in a consistent manner and have a desire to enforce their perceived identity. Giddens' definition of a lifestyle is: "A lifestyle can be defined as a more or less integrated set of practices which an individual embraces, not only because such practices fulfil utilitarian needs, but because they give material form to a particular narrative of self identity" (Giddens, 1991).

However a homeowner can demonstrate actions that considerable differ from each other given a particular context. Giddens explains that behaviour through the existence of different lifestyle sectors. "A lifestyle sector concerns a time-space 'slice' of an individual's overall activities, within a reasonably consistent and ordered set of practices is adopted and enacted" (Giddens, 1991). For example a homeowner can be very keen on measures to save energy and at the same time be stuck with a mortgage with a high interest rate. The homeowner activities involved in the decision process about a mortgage differ considerable with the activities that are involved in saving energy. These homeowner activities take place in different lifestyle sectors. Some activities of homeowners are performed every day like illuminating the house and watching television. These routine actions are probably done without deliberation. A homeowner will probably deliberate extensively in the process of deciding to buy a new kitchen, invest in PV panels or change the conditions of the mortgage. In the model the amount of deliberation involved in a social practice is divided in a practical consciousness and a discursive consciousness. The idea of the concept lifestyle is that an individual wants to express his perceived identity and to be credible will align his actions to be in harmony with this identity. However many social practices take place in lifestyle sectors that does need much discursive consciousness and are embedded in a practical mode of behaviour. In the conceptual model the concept lifestyle and the notion of a practical and discursive consciousness are key ingredients to explain the behaviour of consumers in domestic social practices. This is the analysis of strategic conduct and placed at the left side of the model.

### **2.1.4 Cultural standards**

I discussed the concepts duality of structure and lifestyles. In relationship with lifestyles and duality of structure the concept of cultural standards proposed by Elizabeth Shove is interesting. She uses cultural standards when analysing domestic consumption. The cultural standards she describes are Comfort, Cleanliness and Convenience. People living in a household want to meet these standards that they perceive as common, normal or minimal required (Shove and Southerton, 1998). These desired standards are an expression of the lifestyle of the people living in a household. Thus here cultural standards are helpful in describing a lifestyle in a domestic setting. She also makes a clear distinction with respect to structural aspects, such as infrastructures (the grid), objects (television) and conventions, uses and practices. Here the system of provision makes it possible (or impossible!) to satisfy the cultural standards. What I find very useful is this analysis is that different cultural standards influence the behaviour with respect to domestic consumption and demands a certain structure. I will use this notion to analyse the behaviour of homeowners in cultural terms that are relevant for social practices with respect to domestic consumption. However the cultural factor is much broader than the described cultural standards. In the chapter about culture the cultural factor will be extensively discussed. At this stage the notion is that cultural standards play a role in how consumers experience a specific service or product.

### **2.1.5 Time-Space structure in domestic social practices**

Members of a household carry out different domestic social practices. Some practices are taking place on a regular basis with a fixed pattern in time. Examples are washing the clothes, buying the groceries, cleaning the house, etc. The proposed hypothesis by Douglas and Sherwood (1979) is that persons have the desire to increase their personal availability. The promised increase in a persons' personal availability then is an explanation of the success of a new innovation. The other side of the coin is that when an innovation decreases this 'freedom' the chance of broad acceptance is greatly reduced. This wish for increased personal availability and the discussed cultural standards of comfort, convenience and cleanliness are important notions for explaining the success or failure of a particular innovation. Therefore proposed sustainable innovations that influence domestic social practices should be aware of these factors. For example the success of a car sharing initiative can be compromised by perceived reduction in comfort, convenience and personal availability.

### **2.1.6 A system of provision perspective**

I mentioned the system of provision in the previous sections. In this section the right side of the model is discussed more systematically.

I start with the system-of-provision perspective that is relevant for particular patterns of consumption. The system of provision approach connects a particular pattern of production with a particular pattern of consumption. Commodities or services are structured, produced and delivered in a kind of prefixed manner with a historical 'story'. For example the water system has a very long history and a very distinctive manner in how it is delivered and used by households. Also the public system for transport is very distinctive with a long history and typical manner of organization. The strength of a system- of-provision approach is that it allows a more detailed analysis of consumption practices in relationship with an offered mode of access and mode of use. The analysis of the system of energy supply provides more insight in explaining social practices of homeowners with respect to energy consumption than a more general approach.

The mentioned structure on the right side of the model consists of rules and resources accompanied with a type of system-of-provision. These often collectively offered products and services all have their own dynamics and characteristics. Sometimes changes in the organization of a type-of-provision occur very slowly. On the other hand sometimes changes can go very fast if an innovation gets momentum. For example changes in the telecom system accelerated when a lot of consumers started to use mobile phones. The landscape in the telecom industry has totally changed. New infrastructures, other dominating companies, other rules and licenses and total other social practices in communicating did happen in a relatively short time frame. The relationship between changes in a lifestyle-sector and changes in the system of provision are closely related. The companies working in the energy sector are confronted with different 'rules of the game' and face totally different circumstances then a few decades ago. This caused changes in the collective system-of-provision for energy (i.e. more differentiation) and made it possible for citizen-consumers to choose green energy. Therefore the analysis of the existing rules and resources of a particular system of provision is important to explain the observed behaviour in domestic consumption. The regulatory framework of a country that deals with the ownership of PV panels can be an important factor to explain differences in behaviour of homeowners in the examined countries. In a separate section at the end of this chapter the regulatory frameworks for the examined countries are described.

The installation of PV panels is a shift from only consuming electricity into consuming and producing electricity. This involves a change in the interaction between the consumer and the system of provision. Because of this change I expect that homeowners are more aware of their energy consumption than before installing the PV panels. I expect that homeowners show other social practices related with energy.

The formulated hypothesis is:

- H1 Homeowners are showing a change in social practices that are related with energy after installing PV panels.

## 2.2 Model for analysing cultural patterns in countries

I start with a description of the concept culture and the definition of culture that I use for this research before introducing the selected model for analysing cultural differences between countries.

*"Culture is not an exotic notion studied by a select group of anthropologists in the South Seas. It is a mold in which we are all cast, and it controls our daily lives in many unsuspected ways."*

Edward T. Hall *The Silent Language* (1959)

Culture is a very broad concept. It encompasses the character of a total society. It includes factors as language, knowledge, laws, religions, food customs, music, art, technology, work patterns, products, and other artifacts that give a society its distinctive flavour (Schiffman, 1991).

In a sense culture can be described as a society's personality. In general terms culture consists of a set of norms and values shared with a group of people. The process of learning these norms and values is called enculturation.

The anthropologist Clifford Geertz views culture as *"a set of control mechanisms-plans, recipes, rules, instructions (what a computer call "programs") for the governing of behaviour (Geertz, 1973)." People depend on these control mechanisms of culture for ordering their behaviour.*

Hofstede defines culture in a similar way as *"the collective mental programming of the people in an environment. Culture is not a characteristic of individuals; it encompasses a number of people who were conditioned by the same education and life experience" (Hofstede, 1991).*

The above described definitions of culture makes clear that individuals are products of their culture and are conditioned to act in a particular manner. Moreover culture cannot be separated from the individual. Culture is not a set of abstract values that exists independently of individuals (de Mooij, 2011). These notions are useful to realise that culture is "in the heads" of people (Munroe and Munroe, 1997) and is not seen anymore as an external environmental factor. With the objective in mind to understand the behaviour of homeowners the following definition of culture is useful.

*Culture is the sum total of learned beliefs, values, and customs that serve to direct the consumer behaviour of members of a particular society (Schiffman and Kanuk, 1991).*

Beliefs consist of a very large number of mental or verbal statements that reflect a person's particular knowledge and assessment of something. Values are also beliefs. However values differ from other beliefs because they have some specific characteristics.

These characteristics are (Schiffman and Kanuk, 1991):

- They are relatively few in number;
- They serve as a guide for culturally appropriate behaviour;
- They are enduring or difficult to change;
- They are not tied to specific objects or situations;
- They are widely accepted by the members of society.

In contrast with beliefs and values customs are open modes of behaviour that represent culturally approved or acceptable ways of behaving in a specific situation. Customs consists of everyday or routine behaviour. Beliefs and values are guides for behaviour. Customs are usual and acceptable ways of behaving.

Rokeach defines value as:

*"A value is defined as an enduring belief that one mode of conduct or end-state of existence is preferable to an opposing mode of conduct or end-state of existence. A value system is an enduring organization of beliefs concerning preferable modes of conduct or end-states of existence along a continuum of relative importance (Rokeach, 1973)."*

In a value system, values are ordered in priority with respect to other values. In above definition values are preferences of one state of being over another. For example active versus passive or clean versus dirty (de Mooij, 2011).

Two aspect of values are distinguished:

1. Values as guiding principles in life → the desirable.
2. A value as a preference for one mode of behaviour over another → the desired.

The desirable refers to general norms in absolute terms of right and wrong. The desired is what people want. It relates to choice, to what is important and preferred. Hence desirable is about norms, ethics and ideology of a collective. The desired relates more to pragmatic issues. Rokeach states that he deliberately excluded the concept desirable from his definition. He refers to preferable states of being, not to moral principles.

In this research we compare behaviour of homeowners in three countries. A model that gives insight in the characteristics of a specific national culture is the model of Hofstede.

### **2.2.1 Model of Hofstede for analyzing cultural differences between countries**

I compare the behaviour of homeowners in three countries with regard to their ownership of PV panels. I seek cultural patterns in the motivations and considerations of homeowners in the examined countries. The model of Hofstede is suitable to analyse cultural patterns in a country.

The model of Hofstede uses dimensions to describe a national culture. These dimensions are found after analyzing a large number of variables (i.e. with the help of factor analysis). The dimensions Hofstede nowadays uses are:

1. power distance
2. individualism/ collectivism
3. masculinity/femininity
4. uncertainty avoidance
5. long-/short-term orientation

Power distance can be defined as “the extent to which less powerful members of a society accept and expect that power is distributed unequally”.

It influences the manner people perceive authority and how people react on authority. Japan scores high on the power distance index. Japanese experience behaviour that recognizes hierarchy as natural as breathing.

In individualistic cultures values are in the person. A person wants to be unique and want to differentiate from others. People look after themselves and their immediate family only. In collectivistic cultures, identity is based in the social network to which one belongs. Harmony with in-group members and avoiding loss of face is important. Most people (between 70% and 80%) live in a culture that is collectivistic of nature (de Mooij, 2011).

In masculine societies the most important values are achievement and success. In feminine societies caring for others and quality of life are important values. Being a winner is perceived positive in a masculine environment and negative in a feminine environment. A feminine society strives for consensus.

Uncertainty avoidance is the extent to which people feel threatened by uncertainty and ambiguity and try to avoid these situations. In cultures with a strong uncertainty avoidance rules and formality to structure live are required. People do not adopt new innovations easily. In countries that score low on uncertainty avoidance people do not want to have many rules and believe in generalists and common senses.

The fifth dimension of long-/short-term orientation was found after a research in cooperation with Michael Bond. The values were formulated by Chinese scholars and presented to students from 23 countries. Michael Bond called it “Confucian Work Dynamism”. Consequences of long-term orientation there is not one truth, there is perseverance, thrift and pursuit of peace of mind. Include in short term orientation are values of national pride, tradition, low thrift, self-enhancement, appeal to folk wisdom and witchcraft, and talent for theoretical abstract sciences. Cultures with a short-term orientation need absolute truth. For members of a culture with a long-term orientation this need is less relevant.

Another model worth mentioning is of Shalom Schwartz an Israeli psychologist. He developed seven value types and positioned them on bipolar value dimensions (Schwartz, 1992). The first bipolar value dimensions are openness to change against tradition. The second bipolar dimensions are self-enhancement against self-transcendence. Both models describe similar value orientations. Both models have the same perspective that values are at the core of culture and the notion of culture being located within national boundaries. Based on Hofstede dimensional model of national culture much cross-cultural research is carried out over the last decades. Many replications of Hofstede's study on different samples have shown that the original country ranking is still valid.

For 68 countries worldwide country scores are available on the five dimensions. Recent country scores on the described dimensions for Belgium, Germany and the Netherlands are given in the following table.

**Table 1: GNI per Capita at purchasing power parity 2008 (US\$) and country scores on dimensions.**

Country	GNI/cap	PDI	IDV	MAS	UAI	LTO
Belgium	34.760	65	75	54	94	82
Germany	35.940	35	67	66	65	83
Netherlands	41.670	38	80	14	53	67
Sweden	38.180	31	71	5	29	53
United Kingdom	36.180	35	89	66	35	51

Key: PDI = Power Distance, IDV = Individualism/Collectivism, MAS = Masculinity/Femininity, UAI = Uncertainty Avoidance, LTO = Long-Short-Term Orientation (de Mooij, 2011).

The differences in GNI per capita are not very big between the countries. These will likely not explain the difference in behaviour and adoption rate between countries. So what is the influence of the country scores with respect to adoption of innovative technologies, environmental awareness and intention and actual investment in 'green' products?

I will now describe the influence of the relevant dimensions on the attitudes of consumers towards the environment and on the consumption of green products.

People demonstrate a difference in attitudes towards the environment across countries. In the European Union countries who said that "economic growth must be a priority for our country, even if it affects the environment" correlated with low GNI per capita and high power distance. The associations about the concept environment vary between countries. Germans have a holistic perspective. Humans are part of an ecological system. In Britain, environmentalism deals with destruction of inner cities, war on waste and preservation of countryside. French people are primarily concerned with depletion of rain forests or problems coming from the use and production of products. The conclusion stated by Marieke de Mooij is that differences in associations are culture bound (de Mooij, 2011). I will report extensively about European citizens' associations with respect to climate change, energy and environment in the section with the title Eurobarometer.

In high power distance cultures people first think about pollution. In lower power distance cultures the first association is climate change. Loss in biodiversity, depletion of natural resources and consumption habits are worries of rich countries. In high uncertainty avoidance cultures, larger percentages of people agree that the environment can negatively affect their daily lives. However in countries with a low uncertainty avoidance culture people do more to reduce their environmental impact. In lower power distance cultures and low uncertainty avoidance cultures, more people say they intend to buy and actually buy more environmentally friendly products. A higher score on uncertainty avoidance gives a bigger gap between intention and actual behaviour (Greece 75%, Portugal 68%, Sweden 46% and Denmark 45%). In countries with a high score on individualism people feel well informed about the environment. Who is responsible for the environment depends on the score on uncertainty avoidance. The view that the government is responsible correlates highly with high uncertainty avoidance. In a country with a low score on masculine (i.e. feminine culture) people feel that they are responsible for the environment themselves.

Sweden scores low on power distance, uncertainty avoidance and masculine. Data show that people in Sweden are actually buying more green products than other countries in Europe. The scores of Belgium are relatively high on power distance and uncertainty avoidance. This implies that people from Belgium feel that the government is primarily responsible and that the gap between intention and actual consumption of green products is bigger. Germany scores relatively high on masculine compared with the Netherlands and Sweden. The Netherlands scores relatively high on femininity. Described country specific scores on dimensions and observations about buying green products lead to the following hypotheses.

- H2 Homeowners with PV panels in Belgium will more frequently mention aspects that are related with the reduction of uncertainty compared with the two other countries.
- H3 Germans will mention more rational economical reasons in their motivation to invest in PV panels than Dutch homeowners.
- H4 Homeowners with PV panels in the Netherlands will more frequently mention aspects that are related with the desire to have a green lifestyle.

### 2.3 Eurobarometer

A comparison of perception of citizens between Belgium, Germany and The Netherlands about energy, climate change and environment is useful in finding cultural patterns. Concerns about climate change, energy dependency and environment could explain the reasons why homeowners are willing to invest in PV panels. Therefore I chose to analyse three specific Eurobarometers with the topics energy, climate change and the environment. The different barometers are analysed on the average opinion of citizens in the EU 27 and the opinion of Germany, Belgium and the Netherlands.

#### Energy

In the Eurobarometer about energy citizens are interviewed about energy issues. Three questions were asked to the citizens of the EU-27.

The first question is about possible difficulties in energy supply.

The question about this energy supply is:

*Q1 In winter 2008, some European Union Member States were faced with significant energy supply problems, in particular an interruption in gas deliveries. As a citizen, would you say that you would be better protected when facing an energy supply risk if...?*

Options:

- (OUR COUNTRY) adopted and implemented measures in a coordinated way with the other EU countries
- DK (don't know);
- (OUR COUNTRY) adopted and implemented measures individually.

The average score in the EU27 is 60% for coordinated action, 8% don't know and 32% for individual measures. Belgium and The Netherlands score above this average with respectively 71% and 72% for coordinated action. Germany scores below average with 58% for coordinated action (Eurobarometer 74.3 on Energy, 2011).

The second question is about solidarity.

*Q 2 Please tell me whether you totally agree, tend to agree, tend to disagree or totally disagree with each of the following statements concerning the question of energy supplies within the EU? It is desirable that (OUR COUNTRY) provides assistance to another EU Member State facing significant energy supply problems in the name of European solidarity between Member States.*

The average score for the EU27 is that 79% totally agree, 6% don't know and 15% totally disagree. Germany, Belgium and The Netherlands all score above the average with respectively 81%, 85% and 83%.

The third question is about priorities for greater energy cooperation.

*Q3 The European Parliament wants increased energy cooperation between the European Union*



Member States. With this in mind, do you think that the main priority should be given to...? (One possible answer only)

**Table 2: Belgium, Germany, The Netherlands and the EU27 scores on priorities energy policy (Eurobarometer 74.3 on Energy, 2011)**

Priority	EU27	Belgium	Germany	Netherlands
Stability energy prices	29%	37%	29%	15%
Developing renewable energies	27%	24%	24%	48%
Guaranteeing energy supplies	20%	23%	31%	17%
Energy saving goods & services	16%	14%	12%	18%
All at the same time	4%			
Don't Know	4%			

Noteworthy is that The Netherlands score very high on the development of renewable energies and that Germany scores high on guaranteeing energy supplies. For Belgium citizens' stability of prices is given the biggest priority.

### Climate change

The perception of citizens towards climate change is measured in the Eurobarometer 372 (source). The first question was about the most serious problem facing the world as a whole.

Question: Which of the following do you consider to be the single most serious problem facing the world as a whole?

**Table 3: Belgium, Germany, The Netherlands and the EU27 scores on most serious problem (Special Eurobarometer 372, 2011)**

Most serious problem mentioned in 2011	EU27	Belgium	Germany	Netherlands
Poverty, hunger and lack of drinking water	28%	29%	28%	31%
Climate change	20%	24%	25%	18%
The economic situation	16%	8%	6%	6%
International terrorism	11%	7%	10%	7%
Availability of energy	7%	8%	11%	7%
The increasing global population	5%	11%	8%	17%
Spread of infectious diseases	4%	3%	5%	5%
Armed conflicts	4%	4%	3%	4%
Proliferation of nuclear weapons	3%	4%	3%	3%
Other	0%	1%	0%	1%
Don't know	2%	1%	1%	1%

Question: Which of the following do you consider to be the single most serious problem facing the world as a whole? **Any others?**

**Table 4: Belgium, Germany, The Netherlands and the EU27 scores on most serious problem (Special Eurobarometer 372, 2011)**

Most serious problem mentioned in 2011	EU27	Belgium	Germany	Netherlands
Poverty, hunger and lack of drinking water	64%	68%	69%	69%
Climate change	51%	59%	66%	53%
The economic situation	45%	36%	27%	32%
International terrorism	38%	35%	42%	32%
Availability of energy	28%	33%	45%	33%
The increasing global population	21%	32%	32%	39%
Spread of infectious diseases	27%	25%	29%	32%
Armed conflicts	28%	26%	29%	30%
Proliferation of nuclear weapons	18%	22%	18%	15%
Other	1%	1%	1%	2%
Don't know	2%	1%	1%	1%

Belgium and Germany score higher than average on the most serious problem facing the world as a whole. The Netherlands score below average on climate change. The availability of energy

for Germany scores relatively high compared with the average score. For The Netherlands the score on the increasing global population is relatively high. In 2009 the score on climate change for EU-27 was 17%.

The following question is about how serious the problem of climate change is.

Question: And how serious a problem do you think climate change is at this moment? Please use a scale from 1 to 10, where '1' would mean that it is "not at all a serious problem" and '10' would mean that it is "an extremely serious problem".

**Table 5: Belgium, Germany, The Netherlands and the EU27 scores on most serious problem (Special Eurobarometer 372, 2011)**

How serious problem 2009 and 2011	EU27	Belgium	Germany	Netherlands
2009	7.1	7.1	7.3	6.3
2011	7.4	7.1	7.3	6.5

For Belgium and Germany climate change is seen as a more serious problem than in The Netherlands.

The next question was about responsibility for tackling climate change.

Question 3: In your opinion, who within the EU is responsible for tackling climate change?

**Table 6: Belgium, Germany, The Netherlands and the EU27 scores responsibility for tackling climate change (Special Eurobarometer 372, 2011)**

Responsible for tackling climate change *	EU27	Belgium	Germany	Netherlands
National Governments	47%	42%	50%	25%
The European Union	35%	54%	48%	28%
Business and industry	35%	47%	57%	25%
Collective responsibility of all actors	23%	18%	16%	42%
You personally	21%	34%	36%	20%
Regional and local authorities	17%	9%	23%	4%
Other	1%	0%	0%	1%
None	1%	1%	2%	2%
Don't know	5%	5%	2%	1%

\* Citizens were allowed to give more than one answer.

Citizens of Belgium mentioned The European Union most frequently as institute that is responsible tackling climate change. For Germany business and industry and for The Netherlands collective responsibility are mentioned most frequently. The relative low percentage 20% for The Netherlands on personal responsibility is notable. Belgium and Germany score relatively high on personal action. Citizens of The Netherlands mention most frequently (42%) that responsibility for tackling climate change is a collective responsibility of all actors. These answers could indicate how citizens best could be involved in taking measures (e.g. install PV panels on your roof) to prevent climate change.

Questions 4 and 5 are about personal action:

- Have you personally taken any action to fight climate change over the past six months?
- Which of the following actions have you taken, if any?

**Table 7: EU27, Belgium, Germany and The Netherlands scores on personal action (Special Eurobarometer 372, 2011)**

	EU27	Belgium	Germany	Netherlands
Action taken to fight climate change in the last six months.	53%	54%	63%	59%
You have bought a new car and its low fuel consumption was an important factor in your choice.	10%	19%	16%	13%
You regularly use environmentally friendly alternatives to using your private car such as walking, biking, taking public transport or car-sharing.	26%	36%	43%	49%
You have insulated your home better to reduce your	18%	32%	16%	23%

energy consumption.				
You have bought a low-energy home.	3%	6%	2%	7%
When buying a new household appliance e.g. washing machine, fridge or TV, you choose it mainly because it was more energy efficient than other models.	30%	43%	40%	44%
You have switched to an energy supplier or tariff supplying a greater share of energy from renewable sources than your previous one.	7%	15%	14%	19%
You have installed equipment to generate renewable electricity yourself in your home, e.g. solar panels, heat pump or wind turbine.	4%	9%	6%	6%
You buy locally produced and seasonal food whenever possible	36%	50%	46%	31%
You avoid taking short-haul flights whenever possible	9%	16%	23%	10%
You try to reduce your waste and you regularly separate it for recycling	66%	80%	79%	73%
You try to cut down on your consumption of disposable items whenever possible, e.g. plastic bags from the supermarket, excessive packaging	46%	62%	59%	54%

Citizens in Belgium, Germany and The Netherlands are relatively active in switching energy supplier, using alternative environmental friendly transport and buying energy efficient household equipment. Overall these three countries are more active than the average in the EU-27.

Question: Taxation should be based more on the way we use energy.

**Table 8: EU27, Belgium, Germany and The Netherlands scores on taxation use energy (Special Eurobarometer 372, 2011)**

Taxation should be based more on the way we use energy.	EU27	Belgium	Germany	Netherlands
Totally agree	24%	26%	29%	27%
Tend to agree	44%	46%	40%	46%
Tend to disagree	14%	19%	16%	15%
Totally disagree	7%	6%	8%	7%
Don't know	11%	3%	7%	5%

The majority of countries in the EU-27 agree with the statement that taxation should be based on the way we use energy. Belgium, Germany and The Netherlands have similar scores and don't deviate substantially with the average in the EU-27.

Question: Fighting climate change and using energy more efficiently can boost the economy and jobs in the EU.

**Table 9: EU27, Belgium, Germany and The Netherlands scores on attitudes to the green economy (Special Eurobarometer 372, 2011)**

Fighting climate change and using energy more efficiently can boost the economy and jobs in the EU.	EU27	Belgium	Germany	Netherlands
Totally agree	78%	86%	79%	71%
Totally disagree	13%	11%	14%	22%
Don't know	9%	3%	7%	7%

Citizens of the EU-27 are positive about the 'green' economy. Belgium and Germany are above average. The Netherlands' score is below average. However still 71% of the Dutch citizens totally agree.

## Environment

In the Eurobarometer 75.2 the results about the attitudes of citizens towards the environment are reported. Citizens were interviewed in 2011.

The following subjects are covered in the Eurobarometer 75.2:

1. The environment and the EU economy.
2. The environment and you.
3. The environment and policy makers.
4. Keeping you informed.

1. The environment and the EU economy.

**Table 10: EU27, Belgium, Germany and The Netherlands scores on environment and economy (Special Eurobarometer 365-EB75.2, 2011)**

The efficient use of natural resources can boost economic growth in the EU.	EU27	Belgium	Germany	Netherlands
Totally agree	83%	88%	77%	87%
Totally disagree	10%	10%	15%	9%
Don't know	7%	2%	8%	4%

**Table 11: EU 27, Belgium, Germany and The Netherlands scores on environment and economy (Special Eurobarometer 365-EB75.2, 2011)**

The protection of the environment can boost economic growth in the EU.	EU27	Belgium	Germany	Netherlands
Totally agree	77%	80%	70%	67%
Totally disagree	16%	18%	23%	26%
Don't know	7%	2%	7%	7%

**Table 12: EU 27, Belgium, Germany and The Netherlands scores on environment and economy (Special Eurobarometer 365-EB75.2, 2011)**

EU funding should be allocated more to support environmentally friendly activities and developments.	EU27	Belgium	Germany	Netherlands
Totally agree	89%	88%	91%	80%
Totally disagree	7%	10%	6%	15%
Don't know	4%	2%	3%	5%

The majority of citizens agree that the economy can benefit from efficient use of natural resources and the protection of the environment. Also citizens agree that EU funding should be allocated more to support environmentally friendly activities and developments. The Netherlands score a little below average. These results are in line with the results on attitudes towards the positive effect of fighting climate change on the economy.

2. The environment and you.

**Table 13: EU 27, Belgium, Germany and The Netherlands associations with environment (Special Eurobarometer 365-EB75.2, 2011)**

When people talk about "the environment" which of the following do you think of first? And then?	EU27	Belgium	Germany	Netherlands
Protecting nature.	47%	51%	61%	32%
The state of the environment our children will inherit.	41%	56%	56%	45%
Climate change	40%	40%	50%	40%
Pollution in towns and cities.	39%	39%	28%	30%
Man-made disasters such as oil spills and industrial accidents.	33%	34%	53%	33%
The quality of life where you live.	33%	34%	35%	23%
Using up natural resources.	31%	37%	34%	37%
Green and pleasant landscapes.	28%	23%	24%	17%
Earthquakes, floods and other natural disasters.	26%	22%	29%	9%

For Germany the protecting of nature is dominant in the associations. For Belgium and The Netherlands the association 'the state of the environment our children will inherit' is mentioned most frequently.

### 3. The environment and policy makers.

**Table 14: EU 27, Belgium, Germany and The Netherlands scores decisions about protecting the environment (Special Eurobarometer 365-EB75.2, 2011)**

When it comes to protecting the environment, do you think that decisions should be made by the national government or made jointly within the EU?	EU27	Belgium	Germany	Netherlands
Totally agree	64%	72%	73%	72%
Totally disagree	32%	27%	24%	26%
Don't know	4%	1%	3%	2%

Most citizens in the EU27 agree that decisions should be taken on EU level. Belgium, Germany and The Netherlands all score above average.

**Table 15: EU 27, Belgium, Germany and The Netherlands scores effective way(s) of tackling environmental problems (Special Eurobarometer 365-EB75.2, 2011)**

In your opinion, which of the following would be the most effective way(s) of tackling environmental problems?	EU27	Belgium	Germany	Netherlands
Introducing heavier fines for offenders.	36%	35%	39%	24%
Providing more information on environmental issues.	26%	22%	20%	17%
Ensuring higher financial incentives (e.g. tax breaks, subsidies) to industry and to citizens who protect the environment.	26%	25%	31%	52%
Using natural resources more efficiently.	26%	34%	25%	37%
Ensuring better enforcement of existing environmental legislation.	25%	32%	30%	23%
Introducing stricter environmental legislation.	23%	24%	23%	17%
Introducing or increasing taxation on environmentally damaging activities.	15%	14%	19%	20%

Dutch citizens mention ensuring higher financial incentives most frequently. This is substantially above average. For Belgium and Germany introducing heavier fines for offenders is mentioned most frequently. Using natural resources more efficiently scores relatively high for Belgium and The Netherlands. Notable is that Dutch citizens belief that giving a positive incentive is more effective than giving a heavier fine for offenders. This is an interesting difference with Belgium and Germany. It seems that citizens in German and Belgium more law-abiding than in The Netherlands. This observation is consistent with the higher score of Germany and Belgium on masculinity than in The Netherlands. Power and authority related values are important in masculine cultures.

The analysed Eurobarometers show that citizens from Belgium, Germany and the Netherlands think differently about a number of topics. Opinions and attitudes for example differ on priorities in energy policy, the seriousness of climate change and the party responsible for tackling climate change. The differences between countries indicate that the defined cultural dimensions play a role in the considerations, beliefs and attitudes of people towards energy, climate change and the environment. Are these cultural patterns also visible in the motives and considerations of homeowners towards PV panels? In the following section two surveys are discussed that specifically address homeowners' attitudes and opinions towards PV panels.

## 2.4 Adoption of PV panels in United Kingdom and Sweden

The analysis of the Eurobarometers indicates that European citizens' opinions and attitudes are culturally bound. The next analysed surveys are specific about homeowners' opinions and attitudes towards PV panels. The findings give insight in homeowners' attitudes towards solar power technologies. One of the findings was that people have a variety of constructs with respect to PV panels (Faier and Neame, 2006). For example people mention environmental concern as a reason to invest in PV panels. However many other drivers are named by respondents in interviews and questionnaires. People demonstrate different attitudes towards environment across countries. Also the gap between the intention to "buy green" and actual consumer behaviour show differences across countries. The conclusions and findings of the surveys will be discussed in the next sections. I will use the findings to formulate hypotheses about behaviour with respect to the investment and use of PV panels. In one survey constructs with respect to solar technology were formulated on the basis of a literature research and interviews with owners of solar installations. These constructs were used to construct a questionnaire for a survey in the United Kingdom. Surveys were sent to early adopters (35 valid responses) and early majority (420 valid responses). The two groups score significantly different on a large number of constructs.

In the following table the mean scores on constructs of early adopters and early majority are reported. Only the scores that show a significant difference between the two groups are mentioned. For example the difference of mean scores on the constructs natural, reduces carbon emissions and reduces pollution are not significant and not mentioned in the table.

**Table 16: significant differences in scores between early adopter and early majority (Faier and Neame, 2006)**

Construct	Early adopter Survey mean score	Early Majority Survey mean score	Early Adopters group response	Early Majority Group response
Safe form of power generation	1.60	2.27	Positive	Positive
Complete solution	4.38	5.59	Positive	Positive
Home improvement	3.12	4.46	Positive	Positive
Could develop in the future	1.98	2.88	Positive	Positive
Will be more widespread in the future	2.07	3.66	Positive	Positive
Solar power is compatible with modern living	2.05	3.49	Positive	Positive
The systems are hidden away	5.24	6.97	Positive	Don't know
Simple to install in a property	5.32	7.23	Positive	Don't know
Maintenance free	4.98	6.43	Positive	Don't know
Does not affect the visual landscape	4.95	6.40	Positive	Don't know
Affordable technology	6.15	7.23	Don't know	Don't know
Attractive	6.49	8.24	Don't know	Negative
There is a high level of grant	7.31	8.50	Don't know	Negative
Solar has a short payback	10.86	9.90	Negative	Negative

Apparently the early adopters are on average more positive about PV panels then the early majority. However they are more negative about the payback time of the investment in PV technologies.



**Table 17: presents a graphical illustration of the spread of responses of the two groups (Faiers and Neame, 2006).**

Positive statement	1	2	3	4	5	6	7	8	9	10	11	12	13	Negative statement
Description	Positive					Don't know	Negative							
Clean	<div></div>	<div></div>												Dirty
Reduces carbon emissions	<div></div>	<div></div>	<div></div>											Increases carbon emissions
Reduces pollution	<div></div>	<div></div>	<div></div>											Increases pollution
Safe form of power generation	<div></div>	<div></div>												Not a safe form of power generation
Could develop in the future	<div></div>	<div></div>		<div></div>	<div></div>									Probably won't develop in the future
Solar power is compatible with modern living	<div></div>		<div></div>	<div></div>										Solar power is not compatible with modern living
Will be more widespread in the future	<div></div>			<div></div>										Unlikely to become more popular
Generates savings			<div></div>	<div></div>	<div></div>									Does not generate savings
Home Improvement	<div></div>	<div></div>		<div></div>	<div></div>									Waste of money
Provides a visual statement of beliefs		<div></div>	<div></div>	<div></div>										Not a highly visible technology
Acts all of the time			<div></div>	<div></div>	<div></div>									Seasonal
Natural		<div></div>	<div></div>	<div></div>	<div></div>									Man-made
Solar systems provide a comprehensive solution for hot water and electricity		<div></div>	<div></div>	<div></div>	<div></div>	<div></div>								Normal heating and mains power provides an adequate solution
Solar systems are an appreciating asset			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>							Solar is a depreciating asset
The positioning of solar panels does not affect the visual landscape		<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>							The positioning of solar panels does affect the visual landscape
Maintenance free			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>							Solar systems needs more maintenance than existing heating systems
Might help sell a house any faster			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>							Does not help sell a house any faster
Adds value to a property			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>						Does not add value to a property
The systems are hidden away			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>						The systems are intrusive
Affordable technology				<div></div>	<div></div>	<div></div>	<div></div>	<div></div>						Unaffordable technology
Simple to install in a property			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>						Difficult to install in a property
Attractive				<div></div>	<div></div>	<div></div>	<div></div>	<div></div>						Unattractive
There is a high level of grant available						<div></div>	<div></div>	<div></div>						There is a low level of grant available
Solar has a short payback									<div></div>	<div></div>	<div></div>			Solar has a long payback

**Key: early adopters (light shade) early majority (dark shade)**

The conclusion of Faiers and Neame is that early adopters are most positive to solar power systems, and most of all to the environmental aspects of the technology. However, on aesthetic, operational and financial issues, the responses indicated less positive attitudes by the 'pragmatic' majority (Faiers and Neame, 2006). Another finding is that the 'chasm' (source Moore. 1990) exists between early adopters and the early majority with respect to the adoption of domestic solar systems. The biggest barrier for adaption is the financial aspect that is involved with the system.

Another survey performed by Palm and Tengvard examined household adoption of PV's and Wind Turbines in Sweden. Twenty respondents, of who seventeen live in a private home, were interviewed (semi-structured in-depth interviews). Also retailers of PV systems were interviewed. The retailers saw cost as the major factor that keep households from adopting their products (Palm and Tengvard, 2011). On the basis of the answers of the respondents the following main intentions were identified.

Motives for adoption:

- Concern for the environment and lifestyle harmonization.
- Own production as a way to act and to set an example for others.
- As a way to protest against energy companies or the "Big Brother" society.
- Own production as a way to become independent (mentioned by respondents living in rural areas).
- Financial reasons. Respondents expected a rise in future electricity prices and a change in legislation.
- Technological reasons. Many households saw generating energy as a 'fun' concept. To enjoy watching electricity meter and see the amount of kilowatts produced by themselves.

Barriers to adoption:

- High investment costs and low production efficiency. Respondents mentioned the high upfront costs, low produced kilowatt-hours per year and the long payback period.
- Grid companies and regulations as a hindrance.
- Technology and installation. The technology itself was viewed as a hindrance.
- The installation process.

The overall conclusion is that households that adopted the equipment gave the householders a "better conscience"; moreover the investment has a symbolic function. The visible ownership of PV panels or wind turbines is a way to express an ecological lifestyle to neighbours and friends. By these households the decision has nothing to do with economical rationality (Palm and Tengvard, 2011).

Benjamin Sovacool sees cultural barriers to renewable energy and energy efficiency in the United States. According to his analysis based on interviews with a broad group of stakeholders in the United States culture and institutions are powerful obstacles facing renewable energy and energy saving. According to Benjamin Sovacool: *"American consumers believe they are entitled to cheap and abundant forms of electricity. It is a battle over competing values and cultural attitudes concerning social welfare, profits, the natural world, and conceptions of abundance, consumption, freedom, control, and trust (Sovacool, 2009)"*.

The studies demonstrate different attitudes, intentions and behaviour towards renewable energy and PV installations. It seems that some differences in valuation of constructs are culturally bound. Moreover within countries you can observe a difference in behaviour between early adopters and early majority with respect to adoption of PV systems. Hence it's interesting to make hypotheses about the adoption of PV panels by homeowners between the countries.

The following two hypotheses are formulated:

- H5 In Germany and Belgium the group of homeowners with PV panels for the greatest part can be classified as early majority.
- H6 In the Netherlands the group of homeowners with PV panels for the greatest part can be classified as early adopters.



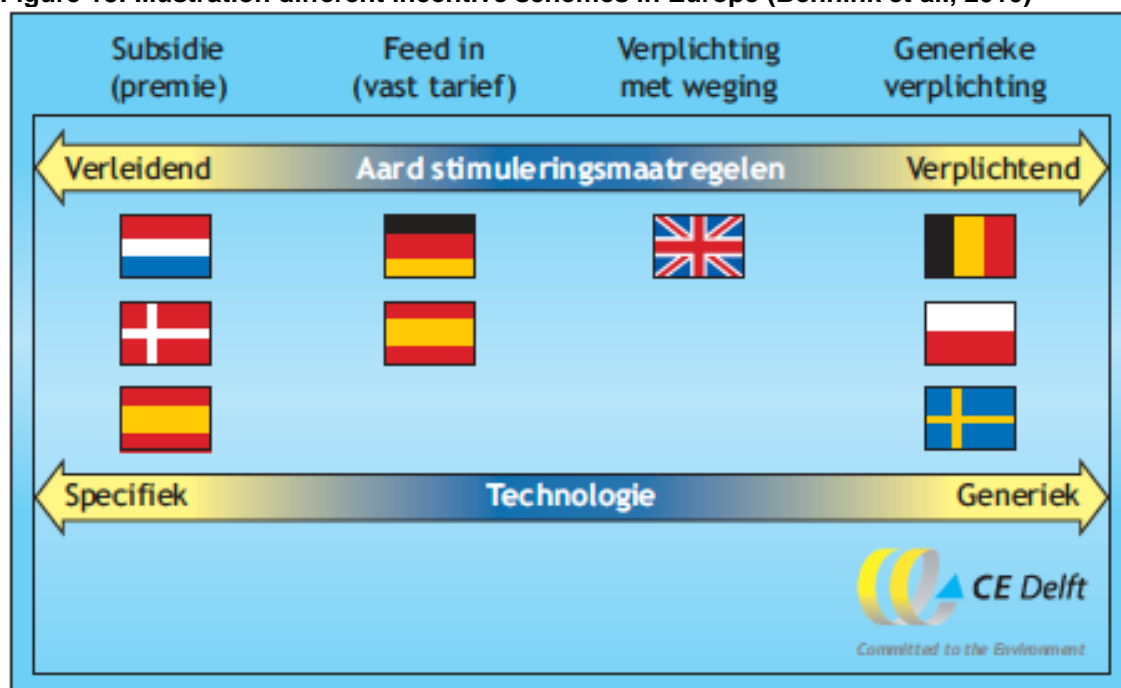
## 2.5 The regulatory framework of PV systems in Germany, Belgium and The Netherlands

The EU sets legally binding targets for all member states to achieve that 14% of the total energy consumption must be generated by renewable energy sources by the year 2020 (Directive 2009/28/EC). Another requirement is that each member country must have a national renewable action plan (NREAP). The plans will reflect national circumstances such as renewable energy sources available in each country. Hence each country is allowed to formulate a regulatory framework that fits with the country specific situation.

The European countries use different incentive schemes to stimulate investments in renewable energy. Roughly the instruments used in these schemes can be categorized into:

1. Subsidy scheme.
2. Supply commitment (systems that oblige energy companies to produce electricity with a minimum share of renewable energy).

**Figure 18: Illustration different incentive schemes in Europe (Bennink et al., 2010)**



Germany and the Netherlands have a subsidy scheme.

**Table 19: Description subsidy scheme in Germany and The Netherlands (Bennink et al., 2010)**

Country	Tariff or premium	Duration of subsidy	Budget and financing
Germany	Fixed, degressive, tariff	20 years (sometimes 15 or 30 years)	Increase on price of electricity. Expenses: € 8,5 billion in 2008
The Netherlands	Premium	SDE: 12 or 15 years.	The state budget. Expenses: € 10 million in 2008, € 336 million in 2015.

In case of premium compensation is given above the price of electricity to compensate for the unprofitable investment in PV panels. Hence the premium will be adjusted till so far the price of electricity will be higher or lower. In case of a fixed tariff the (degressive) height of the subsidy is fixed during the period and there are no adjustments based on changes in prices of electricity.

For each country the different schemes are described.

## Regulatory framework Germany

The German government stimulates the investment in PV installations with feed-in tariffs and other incentives that were introduced by the Renewable Energy Act in 2000. Another incentive is for example a reduction on income tax for a part of the investment in PV panels. In Germany the system is completely based on fixed degressive tariffs. The tariffs are degressive to stimulate producers to produce more efficient systems. Beforehand every investor exactly knows for a new project how the tariff will be in the next twenty years. Depending on the date that the PV installation started to produce electricity the feed-in-tariff is determined. To stimulate the consumption of self-produced energy the consumer receives a tariff for each self consumed kWh (since 2009). Naturally this self-consumed electricity is not delivered into the energy grid. Only for the electricity delivered into the energy grid the homeowner receives the feed-in-tariff.

**Table 20: Feed-in-tariff for roof-mounted PV panels.**

Feed-in-tariff (€cent/kWh)	2007	2008	2009	2010	2010	2010	2011	2012
Roof up till 30kWp	49.21	46.75	43.01	39.14	34.05	33.03	28.74	24.43
Roof > 30 kWp till 100	46.82	44.48	40.91	37.23	32.39	31.42	27.33	23.23
Roof > 100 kWp till 1 MWp	46.30	43.99	39.58	35.23	30.65	29.73	25.86	21.98
Roof > 1 MWp	46.30	43.99	33.00	29.37	25.55	24.79	21.56	18.33
Self-use ≤ 30%			25.01	22.76	17.76	16.65	12.36	8.05
30 - 100					16.01	15.04	10.95	6.85
100 - 500					14.27	13.35	9.48	5.60
Self-use ≥ 30%			25.01	22.76	22.05	21.03	16.74	12.43
30 - 100					20.39	19.42	15.33	11.23
100 - 500					18.65	17.73	13.86	9.98

**Table 21: A numerical example for a homeowner with a 5-kilowatt peak (KWp)<sup>1</sup> PV installation. The production is 4.000 kilowatt in 2011.**

	0% consumption	25% consumption (tariff 8.05 ct/kWh)	50% consumption (tariff 8.05 ct/kWh till 30% and 12.43 ct/kWh from 30 till 50%)
Production electricity	4,000 kWh	4,000 kWh	4,000 kWh
Feed-in	4,000 kWh	3,000 kWh	2,000 kWh
Fee 28.74 ct/kWh	€ 977.20	€ 732.90	€ 488.60
Consumption	-	1,000 kWh	2,000 kWh
Fee for consumption		€ 80.50	€ 96.60 (till 30%) € 99.44 (from 30 till 50%)
Saved electricity from grid 20ct/kWh	-	€ 200. -	€ 400. -
<b>Total</b>	<b>€977.20</b>	<b>€1,013.40</b>	<b>€1,084.64</b>

The advantage of the German system is that in the situation of increasing prices of electricity the total price for renewable energy will not change. The total price is already fixed over a certain period. Hence there is no direct relationship with price changes in the energy market (e.g. changes in oil prices).

## Regulatory framework The Netherlands

In the Netherlands the system was a premium system from 2009 until 2011. This was a part of the stimulation program for renewable energy from the Dutch government. The purpose of this premium was to cover the difference between the production costs of a kWh generated by a PV system and the average price to produce electricity. If the actual yearly price of electricity is higher then calculated beforehand the premium will be lower. Hence the premium that a

<sup>1</sup> Kilowatt peak stands for peak power. This value specifies the output power achieved by a solar module under full solar radiation (under set Standard Test Conditions). Solar radiation of 1,000 watts per square meter is used to define standard conditions.

Most manufacturers also refer to peak power as "nominal power". Since it is based on measurements under optimum conditions, the peak power is not the same as the power under actual radiation conditions. In practice, this will be approximately 15-20% lower due to the considerable heating of the solar cells.

homeowner receives fluctuates with the market price of electricity. Before 2009 in The Netherlands you could receive a subsidy for the installed installation. After a technical inspection of the PV installation by an independent party the homeowner received an amount of money from a department of the government. The rules and height of subsidies changed a several times in the last decade. The subsidies for PV installations with a capacity lower than 15KWp are terminated since 2012.

Another regulation is that every homeowner with a PV installation can deliver his produced electricity into the grid against commercial prices. The energy company is obliged to give the same price from this electricity as the commercial consumption price. The maximum amount of produced electricity that receives this price is 5,000 KWh. This system of netting, which means that consumed energy in a household is reduced with produced energy is only possible for relative small PV installations.

In 2012 the Dutch government started with a new stimulation program for renewable energy. This new program is called SDE+. Only professional PV installations with a capacity bigger than 15 KWp can receive a subsidy. These bigger installations have a separate connection with the grid. These installations cannot use the netting regulation of 5.000 KWh. This subsidy is only applicable for companies and is called energy-investment deduction. A company is allowed to close a mortgage on this PV installation and deduct the interest. This arrangement falls under a lager program with subsidies for biomass, wind and other techniques for renewable energy. The total budget for all the subsidies for 2012 is 1,7 billion euro.

### **Regulatory framework Belgium**

In Belgium the system is based on supply commitments. This supply commitment is applicable for the energy providers not for the energy producers. Hence industries that use a lot of energy and that produce their own energy is not obliged to produce a part of their energy needs with renewable methods. An energy provider is obliged to buy green certificates from homeowners that produce electricity from PV panels. There is a minimum price for a green certificate in Belgium. In 2012 this minimum price is 250 € for each produced 1000 KWh. The minimum price for green certificates is fixed for twenty years. In 2010 the minimum price was 350 €. The system of decreasing minimum prices is similar with Germany. Due to the improved technology the price per KWh produced reduces gradually. Therefore the minimum price is adjusted each year. The energy providers pay a higher price than the 'market' price. These extra costs are financed by the energy providers through an addition on the price for electricity for their customers. In this method green certificates stimulate the more expensive method of producing electricity with PV panels. Similar to The Netherlands in Belgium households are allowed to use netting. This means that produced energy is cancelled out with consumed energy. The homeowner only pays the net consumption after reduction of the electricity produced with the PV panels.

**Table 22: The minimum price for green certificates in Belgium from 2006 till 2016.**

Date start production	Amount in Euro per certificate	Duration
2006-2009	450	20
2010	350	20
2011 January – June	330	20
2011 July – September	300	20
2011 October – December	270	20
2012	250	20
2013	190	15
2014	150	15
2015	110	15
From 2016	90	15

Source: <http://www.vlaanderen.be> accessed 17-02-2012

Notable is that in Belgium and Germany the incentives are fixed for a certain period and regulations are consisted over the last decade. In the Netherlands there are at the moment no subsidies anymore for the installation of new PV panels by homeowners. In the past regulations are often adjusted in The Netherlands. The effect of these different incentive schemes will probably be noticeable in the speed of adoption of PV panels in the examined countries.

My hypothesis about the expected influence of the regulatory framework on adoption of PV panels:

*H7 The difference in regulatory frameworks is an important factor in explaining the difference in speed of adoption of PV panels in the examined countries.*

## **2.6 Hypotheses with respect to adoption and ownership of PV panels**

The notions and concepts of the two examined theoretical models are the theoretical basis for analysing the behaviour of homeowners with PV panels. During the elaboration of these models and discussing specific findings in surveys hypothesis are formulated. All the formulated hypothesis in this chapter are given in the following list:

- H1 Homeowners are showing a change in social practices that are related with energy after installing PV panels.
- H2 Homeowners with PV panels in Belgium will more frequently mention aspects that are related with the reduction of uncertainty compared with the two other countries.
- H3 Germans will mention more rational economical reasons in their motivation to invest in PV panels than Dutch homeowners.
- H4 Homeowners with PV panels in the Netherlands will more frequently mention aspects that are related with the desire to have a green lifestyle.
- H5 In Germany and Belgium the group of homeowners with PV panels for the greatest part can be classified as early majority.
- H6 In the Netherlands the group of homeowners with PV panels for the greatest part can be classified as early adopters.
- H7 The difference in regulatory frameworks is an important factor in explaining the difference in speed of adoption of PV panels in the examined countries.

### 3 Empirical findings

#### Introduction

On the basis of the analysis of the interviews the empirical findings are reported. First a general overview is provided of the findings. Then specific findings are described per country. In the final section a comparison is made between the countries. Furthermore the formulated hypotheses are held against the findings.

#### **3.1 General overview findings**

Although every respondent has his own personal narrative general patterns are found after analysing the interviews. Per topic these general patterns are described. The topics are ordered on frequency of the responses (from high to low).

#### Financial motives and considerations

In general respondents mention many items that are related with the financial benefits that a PV installation deliver or will deliver in the future. Respondents frequently express economical considerations such as the expected rise of prices of electricity and the pay back period of a PV system. Also aspects of the regulatory framework that supports the investment in a particular country are often mentioned. A financial motivation is provided often on the question about the reasons why a homeowner decided to invest in PV panels. In some cases it was the only thing that really matters. However in most cases a combination with other frequently (i.e. above average) mentioned reasons and considerations are observed. In fact all respondents gave some kind of reflection on the financial implications of an investment in PV panels. The dominance of this factor varies between the respondents.

Quotes of respondents<sup>2</sup>:

*"They calculated it in such a way that it was a shame not to go ahead. Pure for the money."* Respondent 6

*"The calculation showed that the payback period of the investment is 4-4½ year. After 4½ it's pure profit. That's interesting."* Respondent 4

*"First reason was really to have a good return on investment. To become more independent of the increase of price of electricity."* Respondent 11

*"The main motive for me was the financial revenues. Certainly. The second reason was to become independent. De price of electricity will certainly rise. I want to be independent of that by using my own electricity."* Respondent 12

*"To put it plain simple. The investment was about 35.000 euro. If you don't receive anything back on that. But the received money was about 30.500 euro in subsidies. Let's say an investment of four and a half thousand. I don't know if I earned it back in five, six or eight years. Just a substantial advantage each year."* Respondent 17

*"My motivation. I'm an economist. Money is important for me. My motivation was not to lose money with this investment. But it was not to earn money and to make a big gain."* Respondent 3

*"On the one hand to save money. And something for the environment. To some extent reduce pollution."* Respondent 23

#### Uncertainty avoidance

Respondents that mentioned financial motives and considerations are also frequently concerned with reducing the risk of the investment. They give a lot of attention to quality, guarantees, reputation of the supplier and financial security. Hence the respondents want to be sure that the invested money in the PV panels will give the projected return in the future. These respondents are preoccupied with uncertainty avoidance.

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<sup>2</sup> The author translated all responses that are not spoken in the English language.

## Quotes of respondents:

*"It's very important that you have criteria. The duration of the project. Five years or twenty years? Somewhere the supplier, website or somebody writing or telling you It's for 20 years or It's for 24 years. So you have to be confident about the duration, the warranty, etc."* Respondent 3

*"Because of the uncertainty. I wanted to have a supplier that would share the risk. So I compared the guarantees. Also the procedure for the installation. Most of them will tell you. Okay we will come. We put it on your roof. Make sure it works and then we go. But okay how can you measure it works properly. The nominal capacity. Everybody was saying don't worry after one year you will see. No, no, no please how decidedly measure."* Respondent 2

*"Yes, 10 years product warranty. And a guarantee that after 25 years that the power of the modules will not be decreased with more than 20 %. Also a guarantee on the inverter. And they give a free insurance in the first two years."* Respondent 11

*"So and Wilders [the supplier of the PV installation], that turned out afterwards, has knowledge about PV panels, from the systems and he has knowledge about electrical systems. That's what you need!"* Respondent 18

## Regulatory framework

The expressed financial and security considerations are often related with the relevant regulatory framework. In each country features of the regulatory framework are named frequently in the considerations. Especially appealing aspects of the applicable regulatory framework that reduces the financial risk were often highlighted. Homeowners were triggered to act when they realised that a scheme could change in the future. Some respondents formulated the motivation to invest in the typical terms used in a specific regulatory framework. Hence the regulatory framework framed the message.

*"At that moment there was still a price of € 450 per green certificate per 1000 kWh. In 2010 it was just € 350. It really started to get momentum in Flanders. Many were being installed. I reach with my installation 5 certificates in two years."* Respondent 6

*"With the financial crisis we receive a very low interest on our savings. One and a half, two percent is not a return. So combined with the subsidy scheme it became clear that with such a thing on your roof you could get a 6% return. And the value of your house will increase. That's an important reason."* Respondent 10

*"I believe that it was the first administration Balkenende. There was also a kind of economical downfall. That they had to take austerity measures. That implied that the subsidy would come to an end. Then I went after it like a mad man. I think that I called everybody possible source for information each morning during four weeks."* Respondent 18

## Ecological considerations

Another finding is that the environmental factor is mentioned frequently in the considerations or motivational reasons of the homeowners. After examining the responses a mixed result is noticeable in the findings about ecological considerations amongst the respondents. Half of the respondents frequently touch ecological topics in their answers. The other half didn't mention any or barely any ecological topics in their stories. Some have a rather broad concept of the phrase ecological. These people were professionally involved with sustainable topics. Other respondents were more concerned about climate change and care for future generations. Also environmentally friendly behaviour was named. Some respondents didn't mention any ecological considerations in relationship with their PV panels. Overall the respondents demonstrated a variety of environmental awareness in their answers.

## Quotes about these ecological considerations:

*"And I was sure it would certainly reduce the production of the consumption of the electricity. But not sure that it would be also be a positive balance for the climate change. The production was not clearly ready to be carbon less. So I think and still think when you have an economical incentive you reach some results. If you only count on the environmental motivation of the people you can hardly have a lot of people joining. But you can certainly have some."* Respondent 2

*"Sustainable development. The future of the planet. What can I do when I hear every day there is a problem with the future. I'm an economist. So it must be something that works. And what can I do? I can plant trees. I can spare fuels and so on. And I can buy a smaller car. I can go by bicycle and so on. Bon, and here it's in this philosophy."* Respondent 3

*"Not only on the price. But also about the feeling. I want that a company is not partly doing business in Photovoltaic. I want to have a good feeling about the company. They must be 100% convinced about their green direction."* Respondent 9

*"Ecology. Because we have a farmhouse. We live ecological. We try not to drive to many kilometres. We save energy. It was logical to install a PV installation."* Respondent 16

*"That group off. Working in the aerospace and the feeling that you have something to compensate. To do something against global warning. I have a brother that has been living with an ozone layer in Australia all those years. They were rather involved with the environment. Having children. The next generation. You cannot continue to consume endlessly."* Respondent 20

### Adoption

Based on the answers of the respondents an indication about the adoption stage of PV panels in a country is found. The answers of the respondents suggest that PV panels are fairly common in Belgium and Germany. Apparently the regulatory framework has played a role in the speed of adoption. The mentioned booming business and delivery problems indicate a rapid growing amount of PV installations. Also the example of neighbours, friends or colleagues that already have an installation and promote the installation by other people indicates a stage of adaption. Also postulated negative statements about a specific regulatory framework give hints about the adoption in a country.

#### Quotes about adoption:

*"Aware actually when we started to look around and saw that the neighbours were timbering a lot on their roofs. In our region where I live you witnessed a rapid increase. It was impossible to miss it."* Respondent 1

*"We did have a boom in Germany. Companies didn't have any time. Stressed times. The calmness came at a later stadium. Some installations collapsed with roof and all. That didn't happen one."* Respondent 14

*"When I was working for the company I visited a few projects in Germany, also some in Scandinavia. In Germany I observed integrated solar shades blinds with PV in the buildings. Then you really have an advantage. Because these solar shades adjust with the solar angle. The same principle is necessary for efficient PV. Then you have the best of both worlds. I didn't observe that in The Netherlands at all. At least in the period I was involved with it."* Respondent 19

*"Are you surprised? In our case it was one big disaster. Subsidy on, subsidy off. You have to regulate that properly. At least for a longer period, ten until twenty years. Then all kind of small firms can make a decent profit. Now it's each time. What will happen this time?"* Respondent 21

### Technical affinity

An interesting finding is that the majority of the respondents showed a technical affinity towards PV panels. From all the respondents more than 50% have a technical profession. Two respondents without a technical profession showed interest for the technology of PV panels. These respondents name technical considerations in a positive relationship with PV panels. It seems that the factor technical affinity tells something about the adoption of PV panels. PV panels are for homeowners a relative new technology. We could reason that the homeowners with a technical affinity can more easily understand the technicality of PV panels and can produce a clear image of the PV Panels on their roofs. They are easier familiar with new techniques and feel more comfortable to invest in these PV Panels than people that have not a technical affinity. Therefore the concept of PV panels is easier adopted by the 'technical' minded people. We could also regard this technical mind as an expression of a certain lifestyle. The technicality of PV panels fits with this lifestyle. Under heading lifestyle social practices this finding is further discussed.

#### Quotes about technical affinity:

*"An enjoyable activity. I have my own website that I update with information about PV panels. To encourage other people. Where different users can compare locally. That's purely a hobby. I put a lot of effort into it. They are allowed to look at my data. An update is made every two hours. Also a photo reportage about the installation of PV panels."* Respondent 8

*"I'm interested in technology anyway. I'm active with electronics. I have a model railroad for trains. Anything that has to do with technology interests me."* Respondent 15

*"Because it's a project! It's fun. Technical. I know that it will have some benefits. Probably I will have a profitable return in ten years. I don't know."* Respondent 21

#### Lifestyle and social practices

In the reaction of the respondents often life style related aspects were mentioned. People reported about their lifestyle and desire to fit PV panels into their lives. Also in the responses frequently an indication was given that social practices were adjusted after installing PV panels. Some routines were adjusted. For example the routines in doing the laundry or watching the electricity meter more frequently. Monitoring the electricity meter more closely and taking measures to reduce electricity consumption are practices of good bookkeeping and a thrifty household. With respect to lifestyle also the profession and hobby of a respondent is a factor related with PV panels. For some respondents the hobby aspect of PV panels is appealing. They install the PV panels themselves and have technical devices to measure the production with an automatic uplink to a website. For other respondents the ecological motivation was a part of an existing 'green' lifestyle. It naturally fits with this lifestyle. These respondents demonstrated the biggest effort to reduce the consumption of electricity. They also named other environmental friendly behaviour. On the other hand respondents also expressed that a change should fit with an existing lifestyle. Some respondents named comfort and a good life to indicate that greening a lifestyle has its limits.

#### Quotes about lifestyle social practices:

*"And then. If we do a part of solar electricity using PV. We use it at home. We don't it to cover all the electricity we consume. It's a part. So in the same time, new lights and to be careful using electricity. Preferable using the laundry machine during the day. Use electricity when you produce it."* Respondent 5

*"I need to tell. I'm not deep green. I just drove with my diesel to this location. But what is within our power we will cooperate. Let's say to leave a minimum amount of mess behind on this planet as possible. Then we will do it. But okay I'm also honest. I have also done a diving trip on Bonaire. And I know that flying is not exactly the most beneficial way. That's something I also do. Though when it fits into our life, a heat pump, PV panels and I have a blue motion car and it's affordable."* Respondent 1

*"We try to avoid to us the car. Save energy in the house. Recycling. Don't buy things you don't need. When we buy a new fridge or wash machine we look for A++."* Respondent 16

*"Good for your image. Pleasurable to talk about. You are part of a group of people actually doing something. A reduction of environmental pollution. That's something you can show. You become smarter with your energy. The consumption of energy is more visible. The consumption of energy is not anonymous anymore."* Respondent 20

*"To burden the environment not more than necessary with a good life. There are also other ways to reach it. But then it becomes troublesome. A clear environmental motive. I want to do as much as possible against the CO<sub>2</sub> problem. The principle of sustainability. That counts."* Respondent 22

### **3.2 Typical patterns Belgium**

To some extent respondents expressed similar motives and considerations in each country. On the other hand specific patterns were especially visible in a specific country. On the basis of the homeowners responses these typical patterns are described for Belgium.



### Financial motives and considerations

The homeowners in Belgium give answers that put an emphasis on financial items and items of reducing risk. On average the amount of responses related with financial en uncertainty items is the highest in Belgium.

Respondents often tell that the investment in PV panels is financially attractive. However they are very concerned with reducing the risk of the investment. They give a lot attention to quality, guarantees, reputation of the supplier and financial security. The homeowners often tell about tax reductions, local subsidies and green certificates. Moreover the Belgium homeowners inform themselves extensively before deciding to invest in PV panels. Hence the respondents in Belgium want to be sure that the invested money in the PV panels will give the projected return in the future. Quotes that are expressing these aspects are mentioned below:

Typical quotes:

*"In Brussels three years ago it was a very good idea to do that. Because when you place PV panels on your roof you have money returned from the community. About a ½ part of the investment. You are allowed to deduct the investment with your tax return in the same year."* Respondent 5

*"Most people in our neighbourhood did place them for the money. For the subsidy scheme of the Belgium federal government. So most people did it purely for the money. I encountered hardly any people that had other motives."* Respondent 1

### Reducing risk

The regulatory framework in Belgium gives homeowners a financial security. Beforehand the homeowners exactly know how much they will receive for their green certificates. This regulatory framework is a factor that helps to reduce the risk of the investment. The Belgium homeowners gave much attention to this aspect. Other aspects that reduce risk and were expressed in the interviews are the guarantees on PV panels and inverters, quality of the PV panels and the reputation of the supplier.

Typical quotes:

*"I have a supplier offered guarantee for a worryless functioning system. I pay for this guarantee € 80 per year. Twenty years."* Respondent 7

*"Brands of Panels. Typed into the forums. Read tests. I have been working on that for months. It was fun, very interesting. Though I didn't see them around a lot. That made me a little suspicious. I was searching for a catch. I use a lot of time to make a decision. Surely, you invest an amount of money. Then you must be certain that it will pay off."* Respondent 8

It can be concluded that the respondents are preoccupied with financial security and therefore often give answers that are related with reducing risk.

For the topics ecological considerations, adoption and technical affinity the Belgium respondents do not score above average. These patterns do not stand out compared with the financial and uncertainty related responses.

### Lifestyle and social practices

In Belgium the change in energy awareness after installing PV panels is remarkable. Almost all respondents did give answers related with an increase in energy awareness. On the basis of the responses in several cases changes of routines were reported after installing PV panels.

Quotes about changes in awareness:

*"I have become more aware of my electricity consumption. I don't know what happens if you feed more into the electricity than you use. That's not totally clear for me yet."* Respondent 6

*"I definitely think it hit a point there. Most of them do never leave a light on. We removed the refrigerator to the garage. Because it was cooler there and so on. Ideas have come before and after."* Respondent 2

Overall observation is that in Belgium the regulatory framework plays an important role in boosting the confidence of Belgium homeowners to invest in PV panels. The system of green certificates for produced kWh and the system of monitoring is also stimulating for increased energy awareness. Ecological considerations and technical affinity play a role in the narratives of the homeowners. Although less attention is given to this subjects.

### **3.3 Typical patterns Germany**

In Germany the frequency of responses are equally distributed over the different subjects. However the difference between respondents is big. About 50% emphasise financial and certainty aspects. About 50% emphasise environmental aspects. Two respondents showed an emphasis on technical aspects. Other aspects were hardly mentioned. This indicates a preoccupation or negligence for a particular topic.

#### Financial security/ regulatory framework

In Germany respondents frequently named the feed-in-tariff as a reason to invest in PV panels. The fixed tariff for twenty years gives the homeowner confidence about his investment. Another mentioned reason to invest in PV panels was to become independent of the expected increase of price of electricity. Also PV panels as an alternative investment for savings was mentioned. Notable for Germany is that some respondents consider the investment as a source of pension.

Relevant quote:

*"I will quit my job in seven years. Then I will retire. Then the loans are paid back and will use the revenues for my pension."* Respondent 13

#### Adoption

In the reactions the regulatory framework in Germany plays an important role. The mentioned booming business and delivery problems indicate a rapid growing amount of PV installations. Also the example of neighbours, friends or colleagues that already have an installation and promote the installation by other people indicates a stage of adaption.

*"A colleague already owned an installation for several years. I spoke with him. He was very enthusiastic about it. He could also show how much it has produced for him."* Respondent 15

*"Four, five years ago. When they started to communicate actively about the subsidy scheme in Germany. Then you witnessed a steadily increase of PV panels on the roofs. Farmers that used fallow land for PV."* Respondent 10

#### Technical affinity and ecological considerations

With respect to technical affinity two respondents showed great interest in the technicalities of PV panels. Two other respondents paid a lot of attention to the ecological element of PV panels.

#### Lifestyle and social practices

In Germany respondents were most outspoken about the environment. For some respondents the ecological motivation was a part of an existing 'green' lifestyle. It naturally fits with this lifestyle. These respondents demonstrated the biggest effort to reduce the consumption of electricity. They also named other environmental friendly behaviour.

Notable for Germany is that some respondents said that their consumption didn't change. Moreover in some cases it did increase. Their energy awareness was not or negatively affected by installing the PV panels. A possible explanation is that the produced electricity in Germany is often not used for consumption. It feeds the net directly. The meters for consumption and production are separated. Hence the people experience no difference in their consumption of electricity after installing the PV panels. In the Netherlands and Belgium there is only one meter that monitors the consumption and production of electricity. People can watch their meter going in the opposite direction on a sunny day.

Quotes about neutral or negative changes in energy awareness:

*"I. Are you more aware of the energy you use? No, perhaps even less. Because it's free."*  
Respondent 11

*"No, I try to save a little energy. With lamps etc. The comfort is more important for me than saving. My behaviour didn't change once I started to produce my own electricity."* Respondent 13

*"I'm not more aware. I didn't start to consume less."* Respondent 14

### 3.4 Typical patterns Netherlands

Most respondents have an outspoken opinion about the regulatory framework. Another typical pattern is that technical affinity with PV panels is a characteristic shared amongst 75% of the respondents.

#### Financial security and regulatory framework

Especially under the early adopters the regulatory framework plays an important role. This group of respondents invested in the years that the subsidies were introduced by the government. In their narrative about the process that lead to an investment in PV panels the generous subsidy scheme that was applicable at that moment is frequently mentioned. In their motives getting a subsidy was appealing. It must be noted that the subsidy schema at that moment was a lump sum arrangement. Homeowners received the subsidy in one payment. About 90% of the investment was covered by these subsidies. In the Netherlands new subsidy rounds were introduced with each time a cap on the total budget. Hence people were afraid to miss the attractive arrangement and felt a sense of urgency to get the subsidy. Indeed some respondents reported that they didn't succeed in getting the subsidy and postponed the investment in PV panels.

The finding is that the regulatory framework is important in the considerations of the Dutch respondents. It almost was a 'quest' to get the subsidy. The run on the several subsidy rounds caused some peaks in the placement of PV panels. However these were temporary events. This temporal character can be found in the answers of the respondents. Therefore it's reasonable to suggest that the regulatory framework did influence the speed of adoption of PV panels.

#### Quotes about the regulatory framework

*"Frankly that is negative. Because the subsidy ended. My own consideration was that I should wait before these things are more developed."* Respondent 18

*"I did apply for a subsidy from the government a several times. I believe that I was not selected two times. So that was not working. Then two years an offer came along from Urgenda. At that moment I thought. Now it's a good time to come into action."* Respondent 22

*"In so far the price it became reasonable affordable. The subsidy schemes at that moment what I read about it were lousy. Je must apply and hope to be selected for a subsidy."* Respondent 24

#### Adoption

Under the heading financial security and regulatory framework I argued that the system of subsidy rounds with a budget cap did influence the speed of adaption of PV panels. The responses of homeowners indicate that the subsidy scheme was the reason to invest in PV installations. Expected changes in the subsidy schemes and the cap on existing schemes did cause a temporally run on the demand of PV installations. Some respondents expressed a negative opinion about the changes in the subsidy schemes in The Netherlands.

*"I thought it was an initiative from the government related with the Kyoto protocol. As a government you were supposed to launch stimulation programs. It seemed a little bit like an obligation to do something. We have to tackle a directive from the Kyoto protocol. We have to spent ten million on PV panels. Hardly this will put The Netherlands on the map for environmental performance. The same for the province or the energy company, we could find some information on a hidden page of a website. You really have to search for it. Not actively promoted. It was difficult to find somebody that knew something. You can apply for the subsidy. The rest is up to you. Only distribute the money."* Respondent 20

*"Are you surprised? In our case it was one big disaster. Subsidy on, subsidy off. You have to regulate that properly. At least for a longer period, ten until twenty years. Then all kind of small firms can make a decent profit. Now it's each time. What will happen this time?"* Respondent 21

*"The disadvantage of the projects from the government was that you receive a conditional subsidy on your panels. This meant that an possible increase of the price of electricity caused a reduction in your subsidy."* Respondent 22

### Technical affinity

Another aspect that tells something about the adaption is the high degree of technical affinity with PV panels amongst the Dutch respondents. Especially in the Dutch group a high amount of homeowners have a technical profession. Four of the homeowners did install the PV panels themselves. For some of them the technical motivation was an important factor in the considerations to invest in PV panels. Under the Dutch respondents this technical affinity is most frequently found. This could imply that these respondents belong to a group of early adopters with an open mind towards technical innovations.

Quotes about technical affinity:

*"It's important that you first examine the PV panels technology. At some point I got the hang of it. In measuring the power of the sets. 1 set with two modules and 1 set of three modules. That makes two inverters. He, I only can reach a maximum power of 500 watt. But the 600 watt stands for the maximum input and not for the output. I have panels with a power of 600 watt but the inverter can only handle a maximum of 498 watt. With PV panels you have also to deal with tolerances of +5% or -5%. You need an inverter with a sufficient buffer."* Respondent 24

*"My background is electronics. You come across different types of generating energy. It always had my interest. That is now already ten, fifteen years ago."* Respondent 23

### Lifestyle and social practices

Noteworthy to mention is that some respondents and respondents expressed that a change should fit with an existing lifestyle. Some respondents named comfort and a good life to indicate that greening a lifestyle has its limits.

Quotes about lifestyle fitting considerations:

*"To burden the environment not more than necessary with a good life. There are also other ways to reach it. But then it becomes troublesome. A clear environmental motive. I want to do as much as possible against the CO<sub>2</sub> problem. The principle of sustainability. That counts."* Respondent 22

*"For example driving the car. The choice for comfort is easily made. My bus experiences can be counted on the fingers of one hand."* Respondent 23

### 3.5. Comparison of the findings

The observed patterns are found after analysing the responses of the homeowners. The discussed patterns are to a varying extent noticeable in all the three countries. When we compare the countries observed patterns are more prominent in one of the countries. Moreover sometimes a deviant finding is observed from the reported patterns. In this chapter I will also compare the findings with the formulated hypotheses.

The following frequency table is helpful in analysing differences in responses between the countries.

**Table 23: frequency table**

Frequency table responses						
Total			BE tot	GER tot	NL tot	Totaal
Dimension	Indicator	Code				
MAS	Price	TIPr	8	3	4	15
	Performance	TIPe	5	3	5	13
	Service	TISe	2	1	9	12
	Financial motives	MF	16	13	12	41
	Financial considerations	CF	25	10	13	48
<b>Tot MAS</b>			<b>56</b>	<b>30</b>	<b>43</b>	<b>129</b>
UAI	Quality	TIQ	10	5	2	17
	Guaranty	TIG	7	5	2	14
	Regulatory framework/ financial security/ subsidies	TISu	12	10	11	33
	Reputation	TIR	7	9	10	26
	Certainty considerations	CU	7	1	0	8
<b>Tot UAI</b>			<b>43</b>	<b>30</b>	<b>25</b>	<b>98</b>
FEM	Origin PV panels	TIO	2	1	0	3
	Ecological motives	MG	7	5	7	19
	Environment friendly behaviour	EF	2	3	5	10
	Promoting PV panels	ER	3	2	1	6
	Ecological considerations	CE	18	19	17	54
	Family/generational motives	MO	2	0	2	4
<b>Tot FEM</b>			<b>34</b>	<b>30</b>	<b>32</b>	<b>96</b>
IND	Technical motives	MT	5	0	6	11
	Technical considerations	CT	6	14	17	37
	Independence motives	ME	4	2	1	7
	Practical motives	MP	1	3	0	4
	Technical profession	FP	4	3	6	13
	Installation by homeowner	ET	2	1	4	7
<b>Tot IND</b>			<b>22</b>	<b>23</b>	<b>34</b>	<b>79</b>
<b>Total</b>	MAS+UAI+FEM+IND		<b>155</b>	<b>113</b>	<b>134</b>	<b>402</b>
<b>Average</b>	MAS+UAI+FEM+IND		<b>38,75</b>	<b>28,25</b>	<b>33,5</b>	<b>100,5</b>
<b>Dimension above average country</b>						
	MAS above average	+ = above	+	+	+	+
	UAI above average	- = below	+	+	-	-
	FEM above average		-	+	-	-
	IND above average		-	-	+	-
<b>Number of respondents above average</b>						
	MAS above average		7	3	4	<b>14</b>
	UAI above average		4	2	2	<b>8</b>
	FEM above average		3	3	4	<b>10</b>
	IND above average		1	3	4	<b>8</b>
Practise	Monitoring	EM	8	8	11	27
	Energy awareness	EB	17	4	14	35
<b>Tot PRAC</b>			<b>25</b>	<b>12</b>	<b>25</b>	<b>62</b>
	Experience PV positive	EP+	7	8	7	22
	Experience PV negative	EP-	2	0	2	4

Dimensions: MAS = masculinity, UAI = uncertainty avoidance, FEM = femininity, IND = individuality. For each country counts on specific codes are reported. Counts on each code are totalised per dimension. The average is calculated by the sum of total counts of dimensions divided by four. The reported number of respondents above average is based on country specific tables placed in appendix 1.

The frequency table gives insight in the relative importance of a specific dimension. Frequency tables that contain responses per interview are reported in appendix 1.

Some observations after examining the frequency tables (including tables appendix 1):

- Financial motives and considerations are most frequent in Belgium. Also when the average scores are compared.
- In each country the regulatory framework is named frequently in the considerations.
- Belgium respondents mention quality, guaranty and certainty considerations most frequent. In Belgium the amount of respondents that are preoccupied with the reduction of uncertainty is high compared with the other countries.
- Ecological motives and considerations don't seem to differ a lot between the countries. In all countries some respondents emphasize this subject. Other respondents don't mention any or hardly any ecological considerations. These respondents score relatively high on frequency of financial considerations (visible in the specific country table in appendix 1).
- The technical affinity with PV panels is noticed in the responses in all countries. Especially in the Netherlands this finding is evident.
- Respondents mentioned practices related with electricity consumption and monitoring that did change after installing the PV panels. In Germany we observe a much lower frequency on this item.
- All respondents are positive about their investment in PV panels. A minority gave some negative responses.

When we examine the dimensions above average overall the dimension masculinity and uncertainty avoidance are prominent. Remarkable is that the dimension femininity is above average in Germany. In the Netherlands the dimension individuality is above average. After examining the number of respondents corresponding with a dimension above average we can see how much respondents are responsible for a score above average in the total frequencies. For example only two correspondents in Germany score above average on uncertainty avoidance and therefore heavily influence the total score. This is also the case with femininity.

After comparing the countries by examining the frequency tables and in-depth analysis of the interviews the following remarks per topic.

#### Regulatory framework

In each country the regulatory framework is named frequently in the considerations. However in Germany the respondents are more positive about the financial security of the scheme. In Germany and Belgium the payments are nicely distributed over a period of twenty years. Moreover the tariffs are fixed. In the Netherlands after the first wave of subsidy rounds the opinions are more negative about the regulatory framework. Hence the responses differ to some extent. The financial reasoning certainly plays an important role in the considerations of all the respondents. For some it's in the only reason to invest in PV panels. For others also other motives are a factor in the decision process.

#### Uncertainty avoidance

In Belgium considerations about uncertainty related topics were expressed most frequently. The homeowners want to avoid risk in their investment. Belgium respondents most frequently mention the guaranteed green certificates for produced electricity, the quality of PV panels and guarantees on the PV installation. The reputation of the supplier is named in all the three countries. It's reasonable to suggest that the Belgium respondents are more involved into avoiding uncertainty than the German and Dutch respondents.

#### Ecological motives

In all the countries the respondents mention frequently ecological motives and considerations. However in all the countries a big difference was noticeable amongst the respondents. Some frequently touch ecological topics in their narratives. Other respondents didn't mention any or barely any ecological related topics. Some have a rather nuanced opinion about the ecological benefits of PV panels. Other respondents were more concerned about climate change and care

for future generations. Also environmentally friendly behaviour was named. It seems that people with a green lifestyle can more easily connect ecological reasoning with the investment in PV panels. They also express that they don't want to make a big profit with their investment; just don't lose money. People that only named financial motives and considerations talk more easily about the subsidy scheme, tax returns and produced electricity. They don't use (or are not familiar with) the vocabulary to speak in ecological terms. The suggestion is that the familiarity with the subject is noticeable in the answers. This familiarity seems also to depend on the education and profession of the respondent.

### Adoption

Responses indicate that PV panels are more common in Belgium and Germany. The respondent more frequently mention that they have noticed the PV panels on the roofs in the region. Also the background of the respondents indicate that in The Netherlands the adoption was still in an innovator or early adopter stage at the moment they installed the PV panels. In the Netherlands the technical background of respondents is most prominent.

### Technical affinity

Many respondents have a technical affinity with PV panels (especially in the Netherlands). It tells something about lifestyle and social practices. The 'hobby' aspect of PV panels indicates that persons with a technical affinity adapt a new technology more easily. The technicality of a PV panels fits with the social practices of this group of people. After comparing the countries this finding is found in responses in all the three countries.

### Social practices and monitoring

When we compare energy awareness between the countries Germany shows a deviant trend. Some German respondents said that their consumption of energy didn't change or did increase after installing the PV panels. A possible explanation is that the produced electricity in Germany is often not used for consumption. It feeds the net directly. The meters for consumption and production are separated. Hence the people experience no difference in their consumption of electricity after installing the PV panels. In the Netherlands and Belgium one meter record the consumption and production of electricity. People can watch their meter going in the opposite direction on a sunny day. This type of meter shows a direct relation with consumption and production of electricity in a household.

### Hypotheses

At the end of the theoretical chapter hypotheses were formulated. These hypotheses will be held against the reported empirical findings.

H1 Homeowners are showing a change in social practices that are related with energy after installing PV panels.

This hypothesis is supported with the findings. A majority of respondents mention examples of changed routines after installing the PV panels.

H2 Homeowners with PV panels in Belgium will more frequently mention aspects that are related with the reduction of uncertainty compared with the two other countries.

The hypothesis is supported with the findings. The amount of respondents that score above average on uncertainty avoidance is larger in Belgium than in Germany and The Netherlands. The difference with the Netherlands is most evident. The difference with Germany is less obvious. However the tendency for preoccupation with reducing uncertainty is most prominent in the responses of Belgium homeowners.

H3 Germans will mention more rational economical reasons in their motivation to invest in PV panels than Dutch homeowners.

On the basis of the frequency table this hypothesis is not supported. In both countries responses that deal with rational economical reasons are above average. In total the amount of respondents

that scores above average on this subject is even higher in The Netherlands. However overall the differences are small.

- H4 Homeowners with PV panels in the Netherlands will more frequently mention aspects that are related with the desire to have a green lifestyle.

The hypothesis is not supported by empirical findings. Although Dutch respondents frequently mention ecological motives and considerations in their stories no remarkable differences are found compared with Germany and Belgium. In fact Germany has the relative highest score on this topic. Compared with frequency of financial motives and considerations in The Netherlands the frequency of ecological related items is actually lower.

- H5 In Germany and Belgium the group of homeowners with PV panels for the greatest part can be classified as early majority.

Findings support the hypothesis. The responses indicate that PV panels are more common in German and Belgium than in the Netherlands. The homeowners express elements in their stories that can be seen as typical for the early majority. The initiative to consider the investment in PV panels started after a combination of recommendations from family and neighbours, increased visibility of PV panels on roofs, an established regulatory framework and a mature network of suppliers. Hence they are not the people that immediately are triggered by new products but follow if the system of provision gives enough confidence. The observation that PV panels are not adopted yet by the late majority classifies them as early majority. The observed emphasis on the reduction of uncertainty is also a sign that this group desires a good functioning system without many risks.

- H6 In the Netherlands the group of homeowners with PV panels for the greatest part can be classified as early adopters.

The conclusion is that the findings support the hypothesis. In the Netherlands the PV panels are not so common as in Germany and Belgium. During the interviews it became clear that this group shows a technical affinity with the PV panels. In their responses curiosity and openness for new techniques were found. This technical affinity is most evident in The Netherlands. Another observation is a less supportive system of provision. Some negative opinions about this system of provision were articulated by some of the respondents. Also some of the respondents told that they were the first in the neighbourhood that installed new PV panels. Compared with Germany and Belgium the group was not preoccupied with uncertainty avoidance. Together with the less streamlined system of provision this indicates that this group is willing to take a leap of faith. Another corresponding finding is that this group were successful in receiving subsidy. To receive a subsidy in the Dutch system you must act promptly and be keen on the possibility to get a subsidy. These Dutch homeowners can be regarded as more agile on this terrain than groups belonging to the majority and late majority. Above traits derived from the responses fits with traits of the group early adopters.

- H7 The difference in regulatory frameworks is an important factor in explaining the difference in speed of adoption of PV panels in the examined countries.

The responses are in correspondence with the hypothesis. In all countries responses are found that tell something about the regulatory framework and the adoption of PV panels. In the first place people motivated often the decision to invest in PV panels by naming features of the relevant regulatory framework. On the other hand some people expressed negative opinions about the regulatory framework. Especially some Dutch respondents were negative about the regular changes in the Dutch subsidy system. They explicitly mentioned this subsidy system to explain the difference in adoption between Germany and The Netherlands.



## 4 Conclusions and recommendations

This research was conducted to answer the general research question:

*Which patterns can be observed in the motivations and social practices of homeowners with respect to their investment decision and ownership of PV panels?*

The following conclusions are drawn after analysing the empirical findings and confronting these findings against the formulated hypotheses.

First conclusions about motivations are formulated, then conclusions about social practices, followed by a conclusion about cultural dimensions.

### Motivation homeowners

Homeowners give a variety of reasons to motivate their investment decision. However in all examined countries dominant are financial reasons and considerations. Uncertainty avoidance also plays an important role in the responses of the homeowners. Overall their first concern is to get the assurance that the investment in PV panels will deliver the expected financial benefits and that the installation will function properly. This factor emerged from the interviews as a basic condition to go ahead with an investment.

Conclusion: Homeowners first concern is to reduce the financial risk of an investment in PV panels: Basic conditions for investment are the expected financial benefits and the confidence in a proper working PV installation.

Uncertainty avoidance differs between countries. In Belgium the preoccupation to reduce risks is most prominent. German homeowners also mention many elements related with uncertainty avoidance. Remarkable is that the preoccupation with uncertainty avoidance is not observed in the responses of Dutch homeowners. In correspondence with the hypothesis this indicates that uncertainty avoidance is a country culturally bound characteristic. The group of homeowners that stresses the reduction of risk are for example best served with a regulatory framework that guarantees fixed payments for produced electricity. This group is qualified as the early majority.

These above findings lead to the following conclusion:

- A regulatory framework that supports the financial motivation and reduces uncertainty is an explanation for the observed success of adoption of PV panels amongst the early majority in Belgium and Germany.

Most homeowners have more motives and considerations to invest in PV panels than only financial reasons. Ecological and technical reasons are also mentioned. Motives and considerations depend on the lifestyle of homeowners and are visible in the social practices of the homeowners.

### Social practices homeowners

Depending on a certain lifestyle and related social practices we can see a connection with the reasons and considerations mentioned by the homeowners. Homeowners with a technical affinity and technical background have technical hobbies and frame the PV panels in technical terms that fit with their interests. Thrifty homeowners speak about financial benefits and measures that reduce the consumption of electricity. Finally people with a green lifestyle easily can connect the investment with PV panels with green arguments. They possess the kind of language to speak in ecological terms. The career of the homeowners also fits with this notion. Career, lifestyle, interests, beliefs and life experience of homeowners give colour to a story.

Conclusion: Stories about PV panels are loaded with a vocabulary that fits with the background of the homeowner.

Nevertheless the stories are in correspondence with the actual routines. Thrifty people have a routine of good bookkeeping and showed me records of production and consumption. Technical

people showed me proudly their installed PV installation. Green people pointed out environmental friendly routines like producing their own biological food and taking alternative transportation.

Conclusion: PV panels are embedded in an existing lifestyle with corresponding social practices and routines.

A common trait of all these groups is that they were capable of transferring personal lifestyle preferences into action. This action started after a process of deliberation. Enthusiastic stories of neighbours and colleagues triggered sometimes the interest in PV panels. Visibility of PV panels on the roofs, a good functioning network of suppliers with good proposals and a supportive regulatory framework did stimulate homeowners to act. Positive confirmation is key.

Conclusion: Homeowners that invested in PV panels received positive confirmation. To be attractive for a large group of people you need to smooth the whole process.

This brings us to the next questions. Are routines in households changed after installing PV panels? Can you speak of an increase in energy awareness?

Conclusions:

- Routines are changed after installing PV panels. Homeowners gave frequently examples of changed routines and measures to reduce energy consumption.
- Homeowners show increased energy awareness after installing the PV panels.

Remarkable is the reported deviation by four of the German homeowners. They gave responses that indicated unchanged routines and a decrease in interest for the consumption of electricity. The provided explanation is the deviant monitoring system in Germany. Meters monitoring consumption and production are separated.

Conclusion: A monitoring system with one meter for consumption and production is more stimulating to make an effort to reduce the consumption of electricity than separate meters.

### Cultural dimensions

I formulated hypotheses based on the scores of the countries on the defined dimensions of Hofstede. I expected to find a relative high score on uncertainty avoidance for Belgium homeowners, a relative high score on masculinity for German homeowners and a relative high score on femininity for the Dutch homeowners.

Belgium homeowners indeed show a tendency for uncertainty avoidance. German homeowners didn't score high on masculinity. Dutch homeowners didn't score high on femininity. Interesting is the high score of Dutch homeowners on technical affinity. This is in correspondence with the high score of the Netherlands on the dimension individuality. Individuality has traits that are related with technical affinity. These traits are creativity, curiosity and independency. Furthermore the scores of Germany on the dimensions individualism, masculinity and uncertainty avoidance are practically the same. Germany homeowners did show equal scores on the different dimensions. Overall I conclude that cultural patterns are found in the responses of the homeowners that are in correspondence with the country scores on the dimensions.

### **Recommendations**

#### Regulatory framework

In the motivations and considerations about PV panels the regulatory framework was an important factor. A regulatory framework must serve the most important concern of people. People don't want to lose money. Also a regulatory framework should fit with the cultural characteristics of the target group. In the design of a regulatory framework both elements should be included. Use a message that fits with each phase of the adoption process. For each phase in the adoption process you should carefully describe the cultural patterns of the target group. On the basis of the empirical findings about cultural patterns and adoption I propose:

- In the first phase of adoption use a message that is appealing for the people with a technical affinity.
- In the second phase use a message that is appealing for the people with ecological concerns.
- In the third phase use a message that is appealing for people that want to avoid uncertainty.

### Monitoring

PV installations should be accompanied with a monitoring system that consists of one meter. This meter gives immediate feedback on the production and consumption of electricity. Then homeowners are able to monitor the effect of their actions that have the objective to reduce the consumption of electricity. The positive reinforcement of their actions by watching the meter becomes an enjoyable routine.

### Further research

I observed in the empirical findings specific cultural patterns in each country. For example in the responses of Dutch homeowners I observed traits that fit with the dimension individuality. Belgium homeowners showed traits that fit with the dimension uncertainty avoidance. These observations are indications that cultural patterns play a role in the adoption process of PV panels. However the amount of samples is limited. Additional research with a bigger sample size is needed to collect data that produces findings that are more representative for larger groups of homeowners with PV panels.

## **5 Discussion on method, theory and empirical findings**

### Method

The semi-structured interviews were useful in collecting the qualitative data. The interviews produced material that was suitable to give an answer on the general research question and sub questions. The method produced valid data for the examined group. The internal validity is good. The external validity is weak. With 24 interviews the sample size is limited. The empirical findings are to a limited extent representative for a larger group of homeowners. Though the research was explorative. I sought patterns in motivations and social practices. The emphasis was on the context of homeowners with PV panels and not on a single explaining factor.

### Theory

Two theoretical models were used to define concepts and formulate hypotheses. They also served as a basis for the analysis of the interviews. Selected literature was used to analyse findings in surveys and to formulate hypotheses.

The theoretical model to analyse consumption practices of Spaargaren was suitable in analysing the consumption practices of homeowners. The model clearly makes a distinction between human agents with a discursive and practical consciousness, lifestyle segments, social practices and the system of provision. With this model I was able to explain the empirical findings. For example homeowners sometimes gave answers that at first glance conflicted with each other. For example they gave examples of environmental friendly behaviour in a domestic setting and at the same time they used their diesel fuelled car intensively for their work and took a plane to a distant country for their hobbies. The model distinguishes social practices in lifestyle segments, such as work, home and hobbies. Also the theoretical model proved useful in explaining different behaviour in energy related practices after installing the PV panels. The interaction between system of provision and consumer practices was recognisable in the findings. The first example is the monitoring system and the second example is the regulatory framework.

The theoretical model of Hofstede provided a good framework to make it possible to identify the relevant cultural elements in a story. The defined dimensions provided a good basis to construct a code table and analyse the interviews on cultural patterns. The observed uncertainty avoidance

in Belgium and technical affinity with traits of individuality in the Netherlands are in correspondence with the country scores on the dimensions.

The Eurobarometer surveys gave an interesting insight in citizen's opinions and attitudes towards energy, environment and climate change. It supported the theory of Hofstede that attitudes and opinions on these subjects are culturally bound for a specific country. Though for the formulation of hypotheses it was not useful. I did not formulate any hypothesis on the basis of the analysis of the surveys. For the analysis of homeowners with PV panels it was not necessary to include this analysis.

The analysis of the two surveys in United Kingdom and Sweden that specifically dealt with homeowners' attitudes and opinions towards PV panels proved to be useful. It gave insight in the constructs that homeowners use in their stories. The observation that early adopters and early majority assess PV panels differently was helpful in making hypotheses.

Overall the selected theoretical models and surveys were useful for analysing the material.

### Empirical findings

Compared with the examined literature the empirical findings show similarities. That attitudes and opinions are culturally bound is observed in the Eurobarometers. Also the observed differences of homeowners' attitudes and opinions towards PV panels are found in the analysed survey that took place in the United Kingdom. Remarkable is that the observed dominant economical rationality was not found in the Swedish survey of Palm and Tengvard. Their conclusion was that the decision to invest in PV panels has nothing to do with economical rationality. It gave the householders a "better conscience". The investment has a symbolic function. A possible explanation is that the adoption process in Sweden is in another adoption phase and that the examined cultural group show feminine traits. This is in line with the high score of Sweden on femininity. The observation about technical affinity and PV panels was not reported in the examined literature. The effect of a supportive monitoring system was mentioned in the survey about PV panels in Sweden. The deviant behaviour of four German homeowners in energy awareness is typical for this research. The high score of Belgium homeowners on uncertainty avoidance is in correspondence with the country score on this dimension. The typical findings about technical affinity and unchanged energy awareness of four German homeowners are interesting and could be subject for additional research with a larger sample.

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## Appendix 1: Frequency tables

Frequency table Belgium			BE	BE	BE	BE	BE	BE	BE	BE	BE tot
Dimension	Indicator	Code	Int 1	Int 2	Int 3	Int 4	Int 5	Int 6	Int 7	Int 8	
MAS	Price	TIPr	1	1		1	1	1	2	1	8
	Performance	TIPe					2		2	1	5
	Service	TISe							2		2
	Financial motives	MF	6	1		2	2	2	2	1	16
	Financial considerations	CF	4	3	2	3	1	5	4	3	25
<b>Tot MAS</b>			<b>11</b>	<b>5</b>	<b>2</b>	<b>6</b>	<b>6</b>	<b>8</b>	<b>12</b>	<b>6</b>	<b>56</b>
UAI	Quality	TIQ	3		4			1		2	10
	Guaranty	TIG		1	2				2	2	7
	Regulatory framework/ financial security/ subsidies	TISu			2	2	1	3	3	1	12
	Reputation	TIR	2						3	2	7
	Certainty considerations	CU		1	4			1	1		7
<b>Tot UAI</b>			<b>5</b>	<b>2</b>	<b>12</b>	<b>2</b>	<b>1</b>	<b>5</b>	<b>9</b>	<b>7</b>	<b>43</b>
FEM	Origin PV panels	TIO	1	1							2
	Ecological motives	MG	2		1	2	2				7
	Environment friendly behaviour	EF	2							2	4
	Promoting PV panels	ER			2					1	3
	Ecological considerations	CE		3	1	2	11			1	18
	Family/generational motives	MO		2							2
<b>Tot FEM</b>			<b>5</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>13</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>36</b>
IND	Technical motives	MT	2	2						1	5
	Technical considerations	CT	2				1	1		2	6
	Independence motives	ME	1	3							4
	Practical motives	MP	1								1
	Technical profession	FP					1	1	1	1	4
	Installation by homeowner	ET						1		1	2
<b>Tot IND</b>			<b>6</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>5</b>	<b>22</b>
<b>Total</b>	MAS+UAI+FEM+IND		<b>27</b>	<b>18</b>	<b>18</b>	<b>12</b>	<b>22</b>	<b>16</b>	<b>22</b>	<b>22</b>	<b>157</b>
<b>Average</b>	MAS+UAI+FEM+IND		<b>6,75</b>	<b>4,5</b>	<b>4,5</b>	<b>3</b>	<b>5,5</b>	<b>4</b>	<b>5,5</b>	<b>5,5</b>	<b>39,3</b>
	MAS above average	1= above	1	1	0	1	1	1	1	1	7
	UAI above average	0= not above	0	0	1	0	0	1	1	1	4
	FEM above average		0	1	0	1	1	0	0	0	3
	IND above average		0	1	0	0	0	0	0	0	1
Practise	Monitoring	EM		2	1	1	1	1	2		8
	Energy awareness	EB	2	3		2	5	4	1		17
<b>Tot PRAC</b>			<b>2</b>	<b>5</b>	<b>1</b>	<b>3</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>0</b>	<b>25</b>
	Experience PV positive	EP+	1	2	1	1		1		1	7
	Experience PV negative	EP-				2					2

Dimensions: MAS = masculinity, UAI = uncertainty avoidance, FEM = femininity, IND = individuality. For each interview counts on specific codes are reported. Counts on each code are totalised per dimension. The average is calculated by the sum of total counts of dimensions divided by four. When the average score is above average the dimension counts as one. When the average is below average the dimension counts as zero. The total number of respondents that score above average on a dimension is calculated in the last column.

Frequency table Germany			GER	GER	GER	GER	GER	GER	GER	GER	GER tot
Dimension	Indicator	Code	Int 9	Int 10	Int 11	Int 12	Int 13	Int 14	Int 15	Int 16	
MAS	Price	TIPr					1		2		3
	Performance	TIPe			1		1			1	3
	Service	TISe			1						1
	Financial motives	MF	2	4	2	1	2	1	1		13
	Financial considerations	CF		4	1	1	2		1	1	10
<b>Tot MAS</b>			<b>2</b>	<b>8</b>	<b>5</b>	<b>2</b>	<b>6</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>30</b>
UAI	Quality	TIQ		2	1			1	1		5
	Guaranty	TIG		2	2				1		5
	Regulatory framework/ financial security/ subsidies	TISu		1	3	3	1		1	1	10
	Reputation	TIR	1	4	2					2	9
	Certainty considerations	CU		1							1
<b>Tot UAI</b>			<b>1</b>	<b>10</b>	<b>8</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>30</b>
FEM	Origin PV panels	TIO	1								1
	Ecological motives	MG	2					1	1	1	5
	Environment friendly behaviour	EF								3	3
	Promoting PV panels	ER							2		2
	Ecological considerations	CE	3	4		2	1	3	3	3	19
<b>Tot FEM</b>	Family/generational motives	MO									0
			<b>6</b>	<b>4</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>4</b>	<b>6</b>	<b>7</b>	<b>30</b>
IND	Technical motives	MT									0
	Technical considerations	CT	1			1		8	4		14
	Independence motives	ME				2					2
	Practical motives	MP						2		1	3
	Technical profession	FP	1			1			1		3
<b>Tot IND</b>	Installation by homeowner	ET				1					1
			<b>2</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>10</b>	<b>5</b>	<b>1</b>	<b>23</b>
<b>Total</b>			<b>11</b>	<b>22</b>	<b>13</b>	<b>12</b>	<b>8</b>	<b>16</b>	<b>18</b>	<b>13</b>	<b>113</b>
<b>Average</b>			<b>2,75</b>	<b>5,5</b>	<b>3,25</b>	<b>3</b>	<b>2</b>	<b>4</b>	<b>4,5</b>	<b>3,25</b>	<b>28,25</b>
	MAS above average	1= above	0	1	1	0	1	0	0	0	3
	UAI above average	0= not above	0	1	1	0	0	0	0	0	2
	FEM above average		1	0	0	0	0	0	1	1	3
	IND above average		0	0	0	1	0	1	1	0	3
Practise	Monitoring	EM	1	1	1	1	1	1	1	1	8
	Energy awareness	EB	1			1			2		4
<b>Tot PRAC</b>			<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>12</b>
	Experience PV positive	EP+	1	1	1	1	1	1	1	1	8
	Experience PV negative	EP-									0

Dimensions: MAS = masculinity, UAI = uncertainty avoidance, FEM = femininity, IND = individuality. For each interview counts on specific codes are reported. Counts on each code are totalised per dimension. The average is calculated by the sum of total counts of dimensions divided by four. When the average score is above average the dimension counts as one. When the average is below average the dimension counts as zero. The total number of respondents that score above average on a dimension is calculated in the last column.

Frequency table The Netherlands			NL	NL	NL	NL	NL	NL	NL	NL	NL tot
Dimension	Indicator	Code	Int 17	Int 18	Int 19	Int 20	Int 21	Int 22	Int 23	Int 24	
MAS	Price	TIPr	1	1					1	1	4
	Performance	TIPe	1	1	1		1			1	5
	Service	TISe	2	1		3				3	9
	Financial motives	MF	3	1	1	1	1	1	2	2	12
	Financial considerations	CF	2			4		2	1	4	13
<b>Tot MAS</b>			<b>9</b>	<b>4</b>	<b>2</b>	<b>8</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>11</b>	<b>43</b>
UAI	Quality	TIQ							1	1	2
	Guaranty	TIG						1	1		2
	Regulatory framework/ financial security/ subsidies	TISu	2	2	2	4			1		11
	Reputation	TIR	3	2	2	1		1	1		10
	Certainty considerations	CU									0
<b>Tot UAI</b>			<b>5</b>	<b>4</b>	<b>4</b>	<b>5</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>1</b>	<b>25</b>
FEM	Origin PV panels	TIO									0
	Ecological motives	MG		1	1	1		2	1	1	7
	Environment friendly behaviour	EF						3	2		5
	Promoting PV panels	ER				1					1
	Ecological considerations	CE			7	3		4	3		17
	Family/generational motives	MO				2					2
<b>Tot FEM</b>			<b>0</b>	<b>1</b>	<b>8</b>	<b>7</b>	<b>0</b>	<b>9</b>	<b>6</b>	<b>1</b>	<b>32</b>
IND	Technical motives	MT		1		3	2				6
	Technical considerations	CT		1	1	1	4	2	5	3	17
	Independence motives	ME					1				1
	Practical motives	MP									0
	Technical profession	FP		1	1		1	1	1	1	6
	Installation by homeowner	ET		1		1	1			1	4
<b>Tot IND</b>			<b>0</b>	<b>4</b>	<b>2</b>	<b>5</b>	<b>9</b>	<b>3</b>	<b>6</b>	<b>5</b>	<b>34</b>
<b>Total</b>	MAS+UAI+FEM+IND		<b>14</b>	<b>13</b>	<b>16</b>	<b>25</b>	<b>11</b>	<b>17</b>	<b>20</b>	<b>18</b>	<b>134</b>
<b>Average</b>	MAS+UAI+FEM+IND		<b>3,5</b>	<b>3,25</b>	<b>4</b>	<b>6,25</b>	<b>2,75</b>	<b>4,25</b>	<b>5</b>	<b>4,5</b>	<b>33,5</b>
	MAS above average	1= above	1	1	0	1	0	0	0	1	4
	UAI above average	0= not above	1	1	0	0	0	0	0	0	2
	FEM above average		0	0	1	1	0	1	1	0	4
	IND above average		0	1	0	0	1	0	1	1	4
Practise	Monitoring	EM	1	1	1	2	2	1	2	1	11
	Energy awareness	EB			3	1	1	2	3	4	14
<b>Tot PRAC</b>			<b>1</b>	<b>1</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>5</b>	<b>5</b>	<b>25</b>
	Experience PV positive	EP+		1	1	1	1	1	1	1	7
	Experience PV negative	EP-	1		1						2

Dimensions: MAS = masculinity, UAI = uncertainty avoidance, FEM = femininity, IND = individuality. For each interview counts on specific codes are reported. Counts on each code are totalised per dimension. The average is calculated by the sum of total counts of dimensions divided by four. When the average score is above average the dimension counts as one. When the average is below average the dimension counts as zero. The total number of respondents that score above average on a dimension is calculated in the last column.



## **Appendix 2: Questionnaire**

### **Topic 1.**

First contact with PV panels.

Aspects:

- Source (social network, friends, government, energy company).
- Framing of PV panels (money saving, good investment, alternative for saving account, environmental care).
- Relevant aspects for one of the dimensions (reduction uncertainty, trust).
- Own initiative (self-direction, curious, independent, rely on own opinion).

#### Question

When did you first become aware of the possibilities of using PV for your house?

### **Topic 2**

Gathering information about PV panels.

Aspects:

- Character of information mentioned (financial driven, practical technical issues, environmental, social).
- Framing of information. Which key words are emphasised (money saving, alternative investment, reputation of provider, possibility to produce own energy, provider, pay back period, subsidies, feed-in tariff, permits).
- Which dimension do you hear? Keywords: performance of the PV panels, comparing alternatives, expressing a strong own opinion.

#### Question

How did you inform yourself before deciding to invest in PV panels?

### **Topic 3**

Motivational goal to invest in PV panels (core of the interview).

Aspects:

- Which motives are mentioned first (financial, environmental, technical/practical)?
- Which signal words are mentioned frequently (to make a difference, good investment, pay back period of PV panels, subsidy, feed-in tariff, own responsibility, to enjoy producing electricity, profitable, desire to be independent, desire to help, desire to protect nature, desire to talk about technical aspects)?
- Relative importance of mentioned reasons?

#### Question

What were the reasons for you to invest in PV panels?

#### Probe questions:

- Can you tell more about reason X?
- Without reason X would you still consider to invest in PV?
- You mentioned also reason X? What is more important reason X or reason Y.
- Can you explain why this reason is important for you?

### **Topic 4**

Experience with PV panels

Aspects:

- Which experiences are emphasized?

- Which value type is most served with the daily use of PV panels
  - feeling that you do something for nature
  - the amount of Kwh of electricity produced
  - enjoy watching the meter go in the other direction
  - feeling to be independent.

#### Question

What are your experiences in using the PV panels?

Did the PV panels meet your expectations?

### **Appendix 3: invitation for interview**

Dear Sir/Madam,

Are you a homeowner who took the initiative to install photovoltaic panels?

Are you willing to cooperate with a research that has the objective to stimulate solar energy?

My name is Arjen Schaap, student at the WUR (Wageningen University). I carry out a research that examines the reasons why homeowners invest in PV panels in Belgium, Germany and the Netherlands. The objective of the research is to get more understanding in the motivations of people like you, who belong yet to a select group of people that own PV panels. This knowledge is valuable to guide policies that stimulate solar energy amongst a broader group of homeowners.

The target group for the research are homeowners who took the initiative themselves to invest in PV panels. This means that the PV panels are not placed on the basis of a project developed by an organization (e.g. energy companies or municipality).

..... provided me with the information that you own PV panels. Therefore I would like to invite you for an interview.

Some examples of questions during the interview are:

- Are you supported in the process that led to the purchase of the PV panels? If so, how?
- What were your reasons to invest in PV panels?

Practical issues:

- The interviews will take place in the months November and December.
- The duration of the interview is approximately an hour.
- The location of the interview is preferably at your home place.
- For practical reasons the interview will be recorded.
- All gathered information is processed anonymously. The research is under supervision the Environmental Policy Group (WUR).

Your contribution to this research is highly appreciated!

Please let me know if you wish to cooperate with this research. After your reply I will contact you by email to make an appointment.

Best regards,

Arjen Schaap

Mobile: 0031651609618

Email: [arjen.schaap@xs4all.nl](mailto:arjen.schaap@xs4all.nl)

#### Appendix 4: overview interviews

<b>Interviews</b>	<b>Date interview</b>	<b>Country</b>	<b>Marital status</b>	<b>Birthdate</b>	<b>Education</b>	<b>Gender</b>
Respondent 1	05-12-11	Belgium	Married	13-11-74	HBO	Male
Respondent 2	07-12-11	Belgium	Married	08-03-58	Academic	Male
Respondent 3	14-12-11	Belgium	Married	01-07-59	Academic	Male
Respondent 4	14-12-11	Belgium	Married	14-08-60	HBO	Male
Respondent 5	05-02-12	Belgium	Married	12-03-58	Academic	Male
Respondent 6	03-02-12	Belgium	Unmarried	14-11-58	HBO	Male
Respondent 7	07-02-12	Belgium	Unmarried	13-01-64	MBO	Male
Respondent 8	07-02-12	Belgium	Married	23-05-62	HBO	Male
Respondent 9	27-01-12	Germany	Married	15-12-62	Academic	Male
Respondent 10	04-02-12	Germany	Married	01-12-59	Academic	Male
Respondent 11	14-12-11	Germany	Married	17-09-75	Academic	Male
Respondent 12	09-02-12	Germany	Widower	03-07-70	MBO	Male
Respondent 13	09-02-12	Germany	Married	10-02-59	HBO	Male
Respondent 14	10-02-12	Germany	Unmarried	03-05-61	HBO	Male
Respondent 15	10-02-12	Germany	Married	10-04-47	HBO	Male
Respondent 16	25-02-12	Germany	Married	13-05-65	Academic	Female
Respondent 17	07-12-11	Netherlands	Married	01-07-44	MBO	Male
Respondent 18	09-12-12	Netherlands	Married	11-10-37	HBO	Male
Respondent 19	20-12-11	Netherlands	Married	27-12-43	Academic	Male
Respondent 20	22-12-11	Netherlands	Married	12-08-60	HBO	Male
Respondent 21	23-12-11	Netherlands	Married	20-10-63	HBO	Male
Respondent 22	18-01-12	Netherlands	Married	17-07-42	HBO	Male
Respondent 23	23-12-11	Netherlands	Unmarried	12-09-70	HBO	Male
Respondent 24	30-01-12	Netherlands	Married	02-10-67	MBO	Male

## Appendix 5: code table for coding interviews

### Code table for interviews.

Topic 1 First contact				
Category/indicator	Example response	Code	Theoretical model Spaargaren individual level	Theoretical model Hofstede county level
Profession	In my work I was responsible for building projects.	FP	Profession is relevant for a person's set of beliefs, routines and practices that influences action.	Masculine profession emphasis on self-enhancement, power and achievement.  A 'creative technical' profession fits with individuality, self-direction, curiosity and openness to change.
Friends/family/neighbours/colleagues.	Visible on roofs neighbours. My sister installed PV panels.	FF	Social interaction relevant for discursive and practical consciousness and action. Relationships are embedded in moral codes, traditions and expectations.	Collectivism. Family is very important. Close inner circle of trust. Individuality more open for opinion form 'outsiders'. Traditions, values expectations and moral codes are culturally bound.
Media	Internet/paper/television	FM	Discursive & practical consciousness.	Trust in media culturally bound. Uncertainty avoidance.
Governmental	Meeting municipality	FG	Discursive & practical consciousness and rules & resources. Information stimulating or discouraging.	Trust & power. Uncertainty avoidance low or high.
Energy company	Brochure energy company	FE	Rules & resources. Socio material system of provision. Information stimulating or discouraging.	Power. Masculinity. Monopolies in the country?
House	New boiler/new roof/new house	FH	Rules & resources. Possibility to change existing situation.	N.A.
Topic 2 Gathering information				
Source information	Example response	Code	Theoretical model Spaargaren individual level	Theoretical model Hofstede county level
Media	Internet / brochure	IM	Discursive & practical consciousness in interaction with information system (certain rules & resources).	Power. Masculinity. Is the media accessible, independent, open and transparent?
Friends/family/neighbours/colleagues	Friends tell their experiences	IF	Social interaction relevant for discursive and practical consciousness and action. Relationships are embedded in moral codes, traditions and expectations.	Collectivism. Family is very important. Close inner circle of trust. Individuality more open for opinion form 'outsiders'. Traditions, values expectations and moral codes are culturally bound.
Professional	Trade fair (beurs) / proposal company / meeting company / consultant company	IP	Discursive & Practical consciousness. System of provision. The interaction between consumers and firms, governmental bodies and energy companies. Is the information mentioned convincing, trustworthy, transparent and complete?	Masculinity. Power relations and interests of involved parties influence the trustworthiness and transparency of the information.
Government	Meeting municipality	IG		
Energy company	Contact with energy company.	IE		

<b>Type of information compared</b>			All the information that is compared is relevant for the discursive and practical consciousness of the homeowners. Are existing beliefs and routines adjusted? Is the information reinforcing existing patterns of beliefs and routines? Are the homeowners especially interested in information that is consisted with their lifestyles? Are homeowners enabled to act?	Uncertainty Avoidance (UAI). A high emphasis on guarantees, safety, quality of panels, etc. indicates uncertainty avoidance.
Price	TIP			
Quality	TIQ			
Origin panels	TIO			
Guarantees	TIG			
Reputation supplier	TIR			
Proximity supplier	TIP			
Subsidies/ incentives/ regulatory framework	TIS		Rules & resources. How do the support schemes influences the actions of the homeowners? Reinforcement or discouraging.	Individuality (IDV) A high emphasis on technical details indicates individuality.
<b>Topic 3 Motives to invest in PV panels</b>				
<b>Category/indicator</b>	<b>Example response</b>	<b>Code</b>	<b>Theoretical model Spaargaren individual level</b>	<b>Theoretical model Hofstede county level</b>
Financial	Pay back period / increasing prices of electricity / subsidies/ profitable/ lower energy bill.	MF	Homeowners have the desire to be economical beneficial. In discursive and practical consciousness economical considerations dominate. Social practices are related with a thrifty household and good bookkeeping. Rules & resources that contribute to a profitable lifestyle are sought and preferred (e.g. a subsidy on PV panel). Ecological considerations are not important in decisions.	Masculinity. Financial aspects are emphasised. Cutting down household expenditures (i.e. a thrifty household). Independency of increasing electricity prices. Good bookkeeping.
Green / sustainable / ecological	Reduce impact on environment. Renewable energy.	MG	Expressing lifestyle. Homeowners have the desire to have a green lifestyle. Beliefs, routines and behaviour/actions and used system of provision are in line with an ecological awareness. There is a serious trade off between ecological and economical considerations.	Femininity. Ecological considerations are mentioned.
Technical affinity	Interesting technique/ project. Curious about technical details.	MT	Practical consciousness. Relates with skills and interests obtained in social practices in hobby and profession.	Individuality. Expressing own individuality. Profession or hobby. Is interested in technical aspects.
Practical	New boiler/ new house/ new roof.	MP	Social practice. House maintenance related practices. Home improvement.	N.A.
Concept of producing own electricity.	Be independent / own production/ enjoy meter going backwards.	ME	Expressing lifestyle.	Individuality. Stimulation. Fun concept.
<b>Topic 4 Experience with PV panels</b>				
<b>Category/indicator</b>	<b>Example response</b>	<b>Code</b>	<b>Theoretical model Spaargaren individual level</b>	<b>Theoretical model Hofstede county level</b>
With PV Installation.	Produces KWh as expected. Problems with inverter. Montage on roof.	EP	Certain routines adjusted. Social practices related with energy issues? Good bookkeeping practices (i.e. measuring production and consumption). Washing habits changed. Other electrical devices that are replaced or cut off? Does the interest in PV panels have something to do with the hobby of a homeowner? Is the concept of producing own electricity an	Individuality. Is the homeowner's hobby or professional interest expressed with the activity of producing own electricity?
Habit to watch the meter and systematically keep a track record.	Record with production and consumption electricity.	EM		
More aware of consumption energy.	Buy energy efficient equipment. Cut off lights and devices when they are not	EB		Masculinity. Is the financial aspect emphasised? Cutting down household

	used. Use the washing machine at a moment that the sun is shining.		enjoyable activity?	expenditures (i.e. a thrifty household). Independency of increasing electricity prices. Good bookkeeping.  Femininity. Other ecological related activities. Recycling, only buying environmental friendly products. Habits with transport.
<b>Other found indicators not listed above</b>				
Considerations / ideas / thoughts/ beliefs / reflection.	Financial / economical	CF	Discursive and practical consciousness in relationship with existing rules and resources. Mentioned opinions and beliefs.	Masculinity. Achievement. Self-enhancement.
	Ecological / sustainable	CE		Femininity. Care for environment. Benevolence. Self-transcendence.
	Technical / practical / esthetical	CT		Individuality. Curious. Self-direction
	Political / incentives / regulatory framework	CP		Uncertainty avoidance. Countries with high uncertainty avoidance prefer a strong government with stringent regulations.
Awareness family		AF		Collectivism