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Consumer Attitudes towards the Benefits provided by Smart Grid – a Case Study of Smart Grid in Sweden

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Abstract

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Title: Consumer Attitudes towards the Benefits provided by Smart Grid – a Case Study of Smart Grid in Sweden

Strategic Question: How to increase consumer awareness towards more flexible purchase of electricity?

Research Question: What are the consumer attitudes towards the possible benefits that Smart Grid provides?

Problem: Nowadays the purchase of electricity is not interactive enough; it works as a one-way transaction meaning that power suppliers provide them with electricity in exchange for money. And in today’s situation consumers can easily change between electricity power utilities by using comparison internet base websites to conduct and find the cheapest solution that suite them best. The technology of the Smart Grid, will take the purchase of electricity to a whole new level. It will also be able to provide useful information such as real-time prices and the current consumption level in SEK for every consumer. However this innovation is not recognized by the consumers due to the lack of knowledge and understanding in this area.

With this study, the authors will investigate the consumer behavior with a special focus on the consumer’s attitude towards the benefits of Smart Grid – in Sweden market.

Purpose: The purpose of this study is to investigate and analyze the consumer attitude towards the benefits that Smart Grid provides.

Method: This study is mainly based on quantitative research by using a survey method. The model of the Theory of Reasoned Action has been applied. The collection of the data comes from two sources, primary and secondary.

Conclusion: Consumers are more sensitive to the price than to the environment. It can be concluded that the consumers have a neutral attitude with a penchant to a positive attitude concerning the Smart Grid concept. Even though the information is not lacking the consumers want to have a better understanding of this new technology that will replace the old one. Consumers don’t want to have more information about the Smart Grid, but they are willing to acquire a better understanding of the process considering the new grid.

Key words: Consumer Behavior, Consumer Attitude, Demand Response, Green Electricity, Renewable Energy, Smart Grid, Smart Meter
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Argiris Christakopoulos & Georgios Makrygiannis
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1. Introduction

Our fast growing modern society depends on a huge amount of electricity usage, which it means that the demand of electricity is increasing rapidly (Dijkhuizen et al., 2011). It drives us to care more about environmental and energy sustainability. Wallin (2010) stated that the reduction of the impact of energy consumption is a priority problem and a great challenge that affects all countries in the world and needs to be tackling from a perspective that will lead to optimizations and savings. The idea of enabling green, clean and a more efficient way of utilize electricity is already at a stage where utility companies or energy providers (including government) are investing heavily upon it (Liotta et al., 2012).

For over one hundred years the traditional grid has served the utility industry well and now it has reached its expiration lifespan and will not be able to support the increasing demands that are needed in order to be able to reduce the electricity consumption (ABB Sweden, 2012; Blumsack & Fernandez, 2011). Those old grids are characterized by centralized power generations and one way directional power flow. While on the other hand the new grid called Smart Grid is the new future grid that will provide the next generations application of making electricity work smarter. It enabling a multi-directional power flow that will make consumers to be a part of the smart grid and become producers of electricity (Dijkhuizen et al. 2011). Smart Grid enables greener way of providing and generating electricity to consumers by combinations of newer, more efficient electrical grids with net metering, which allows consumers to see their energy consumption in real time, and to make adjustments to save power and money (Rivas, 2010). Firstly, the use of Smart Grid would enable an easier interaction between conventional and renewable power sources, given the enhanced flexibility this new system provides. It will enable consumers to increase their interaction, participation and involvement in the purchase of electricity and the new technology is meant to boost the capacity of electricity through making more power sources accessible for the society to gain energy. Secondly, it can also increase the reliability to reduce blackouts or other disturbances that may lead to power failure. Thirdly, it will increase efficient usage of electricity in order to cut CO₂ emissions (ABB Sweden, 2012). CO₂ emissions have a direct relation with the electricity consumption because it rises from different generation sources of electricity which are generated through non-renewable energy sources such as nuclear and coal. So by encourage consumers to increase their energy efficiency and reducing the overall consumption of electricity it will reduce CO₂ emissions (Barbour et al., 2000). This new era will enforce the economy to create more jobs and strengthen the market of electricity. And last but not least to provide more secure environment sustainability that will reduce CO₂ even more by generating green electricity via solar panels, wind generators and other sources that can provide green electricity (ABB Sweden, 2012). All of this is possible through the implementation of Smart Grid that forces all the power sources to work together as a smart network.

Consumer recognition of the benefits of the Smart Grid has already started to play an important role in its sustainability. The inefficient communication of Smart Grid has made the consumers to focus on the negative side of the Smart Grid instead of the benefits. Therefore, utilities need to emphasize more on the success they’ve had and bring forward the true image of Smart Grid (Andersen, 2011). According to Andersen (2011) the Smart Grid will enabling consumers with
tool energy management to manage energy consumption in order to give better control and utilize energy more efficient. However the lack of awareness about the Smart Grid term has raised anxiety in the utilities mind that consumers lack of understanding the new electricity era (Ablondi, 2010). The innovation process of Smart Grid is accelerating at a high pace while the consumers are lagging behind. The problem is that the expected impact from the smart grid implementation will not be high as expected given that lack of consumer involvement (Ablondi, 2010; SGCC, 2011).

The attitude and awareness of the consumer towards this Smart Grid concept needs to start to evolve and make consumers be a part of it. In this Thesis the authors are going to investigate the attitude that consumers have towards the Smart Grid benefits. This study based on the model of “Theory of Reasoned Action” (TRA) by Ajzen et al. (1975) along with its theories which is proven to be the bases to evaluate the target attitude of the consumers and in this case it has been applied on the Smart Grid benefits. A numerous studies have been made in the field of understanding consumers’ attitude upon Smart Grid and its benefits. A company called Green Research, in December 2010, did a research study about the following key questions regarding consumers’ attitude towards Smart Grid;

- What benefits of the smart grid and smart meters appeal most to consumers?
- What are consumers’ major concerns about the technology?
- How can utilities most effectively address those concerns?

The research was made using both focus groups and questionnaire. The focus group consisted of 16 participants and they were selected by fulfilling the selected requirements that were chosen for the research. The questionnaire was distributed online to 1,007 consumers. All the participants for both of the approaches (questionnaire and focus group in U.S.) were above 18 years old and paid electricity bill. The study revealed that the participants from the focus group were interested to receive more information about the technology. Another important fact that rose from this study is that the more knowledge the consumers received about Smart Grid the more anxious they were to found out more. This shows a positive indicator towards Smart Grid. In general the participants had a positive reaction towards the Smart Grid and smart meter. The participants became very enthusiastic when they found out that they can be environmental friendly and at the same time be price sensitive (Green research, 2010).

In another research made by Parks Associates (Ablondi, 2010) a research and consulting company, they state that consumers’ attitudes are still in a formative stage concerning the Smart Grid concept. The term Smart Grid is not yet known in the U.S. consumers mind. Their study indicates that consumers are interested in learning how to cut electricity costs and that most of them are willing to pay in order to save money and electricity.

Pike Research (2011) did also a similar study. The study was executed through a web-based survey and reach out to 1,050 U.S. consumers. The consumers that participated in this survey were based on demographically balance sample in U.S. And the results turn out to be very favorable for the concept of the Smart Grid, 47 percent of the consumers were interested in home energy management products and services. A big portion of the respondents (45 percent)
had a positive attitude towards having smart appliances in their household in order to manage their energy consumption more efficiently.

Smart Grid Consumer Collaborative (SGCC), a non-profit organization, did a web-based survey and reached out to 1,003 consumers. This study was aiming to find out the consumer attitude towards the Smart Grid concept. The results showed that the majority of the consumers have not heard about the terms Smart Grid and smart meter before. However, the results of the study showed that the majority of the respondents at the end of the survey indicated that they had a positive attitude towards the Smart Grid. So the more knowledge consumers have on the Smart Grid concept, the more favorable attitude they get towards it (SGCC, 2011). However, these researches come mostly from consulting and market research firms and do not have a scientific background.

1.1 Background

European energy and climate policy (20/20/20)

In June 2010, the European Council adopted a new strategy for the EU energy and climate. The aim of this strategy was at promoting employment, as well as smart and sustainable growth. Energy, efficient use of resources like renewable energy and innovation are the main key areas in this new strategy (Swedish Energy Agency, 2011). This new strategy is called 20/20/20, because the European Commission has states some targets. These targets are:

- A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels
- 20% of EU energy consumption to come from renewable resources
- A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency (European Commission, 2010).

These targets are all to be achieved by the end of the year 2020. However, the energy efficiency target is not, as yet, legally binding. In November 2010, the European Commission presented a draft energy strategy. This new strategy has more competitive, sustainable and secure energy. This kind of energy supply is a key area in the process of converting to a sustainable society. The energy strategy proposes measures within five priority areas for the next years:

1. improving energy efficiency,
2. an integrated market,
3. competitive prices and a secure energy supply,
4. technological leadership,
5. the external dimension of energy policy

In the European Union (EU), the share of the renewable energy by 2020 must correspond to 20% of its total energy use. Considering this, a national burden-sharing agreement has been decided for each member state, which for Sweden entails a renewable energy share of 49%. Sweden has further raised this goal so that its renewable energy share should be at least 50% of the total energy use. As well the share of the renewable energy in the EU, when is coming to the transport sector, has to constitute at least 10%, by 2020, of the total motor fuel
consumption. Sweden’s target for renewable energy in the transport sector is the same as that of the EU. However, within the EU, greenhouse gas emissions shall be reduced by at least 20% by the year 2020 compared with emissions in 1990. This target may be increased later by a decision on a 30% emissions reduction, provided that a broader, international agreement can be reached. In Sweden the greenhouse gas emissions are to be reduced by 40% by the year 2020 compared with 1990 (Swedish Energy Agency, 2011).

In Sweden the vision for 2050 is that; Sweden should have no net emissions of greenhouse gases into the atmosphere. This decision is a supplement to the environmental quality target for limited climate impact. Ways of reaching these targets include government proposals to modify taxes and implement more stringent economic policy instruments. Green investments in developing countries as well as EU-wide decisions have also been highlighted as important means towards achieving these targets (Swedish Energy Agency, 2011).

1.2 Problem formulation

According to Liotta (2012) “recently awareness of where our energy is produced is increasing, and topics such as energy efficiency are on every one’s mind, either because of monetary reasons, or out of concern for the environment”. More than 40 percent of the world’s electricity consumption is coming from the coal fuels. This fact combined with the growing need for electricity drives the companies in the electrical industry to change the current grid (ABB Review, 2010).

Nowadays the purchase of electricity is not interactive enough, it works as a one-way transaction meaning that power suppliers provide consumers with electricity in exchange for money. And in today’s situation consumers can easily change between electricity power utilities by using comparison internet base websites to conduct and find the cheapest solution that suite them best. However, the technology of the Smart Grid, will take the purchase and usage of electricity to a whole new level. Smart Grid is growing in importance of being the next innovation in the way of distribute and utilize electricity and provide a higher stand for an enforced environmental sustainability. More and more industrial companies and utilities are aware of that and therefore they invest in the development of the Smart Grid technology. This means that with the help of smart metering the consumer will be more involved in the purchase of electricity process and increase their participation in this activity. Smart metering enables the consumer to have a full control of their consumption of electricity by measure it through the device. It will also be able to provide useful information such as real-time prices and the current consumption level in SEK for every consumer. However this innovation is not recognized by the consumers’ eyes and they lack of knowledge and understanding.

With this study, the authors will investigate the consumer behavior with a special focus on the consumer’s attitude towards the Smart Grid. Out of the problem statement the following strategic and research question can be formulated.

**Strategic question:** How to increase consumer awareness towards more flexible purchase of electricity?
Research question: What are the consumers’ attitudes towards the possible benefits that the Smart Grid provides?

1.3 Purpose of the study

The purpose of this study is to investigate and analyze the consumer attitude towards the benefits that the Smart Grid provides.

1.4 Target Audience

This study is appropriate for utilities, electricity companies, consumers, suppliers, managers; that they are dealing with the Smart Grid concept. This study aims to help with its reliable and relevant research; all the participants in the Smart Grid that they want to acquire a better knowledge of the consumer attitude. Another target audience will be the academic scholars, which are interested in researching the consumer attitude towards the Smart Grid.

1.5 Choice of the topic

The idea for writing about the Smart grid was obtained through a meeting with some representatives of ABB Västerås which woke interest in the authors mind for further investigation. However, there was no further collaboration or any other involvement between ABB and the authors for this Thesis. The Thesis was chosen to be conducted using the Swedish market due to the fact that the authors currently are living and studied in Sweden. The importance of the infrastructure that will be able to handle the technology of smart grid is growing in importance throughout the globe (Blumsack & Fernandez, 2011).
2. Theoretical Framework

In the following chapter, the necessary theories and the theoretical model will be introduced that will be used to conduct and analyze the study of this Thesis. Firstly, Smart Grid will be introduced which is the main concept for this dissertation. Secondly, the future goals that EU has for the year 2020 in the field of Smart Grid also called as 20/20/20 will be introduced, including the Swedish situation. Thirdly, renewable and green electricity will be introduced with its relationship to the Smart Grid. Last and not least, the model of this dissertation The Theory of Reasoned Actions (TRA), including theories for consumer attitude which will be related to Smart Grid.

2.1 How is Smart Grid presented in the literature?

As it has mentioned in the introduction part, Smart Grid is a greener way of providing electricity to consumers by combinations of newer, more efficient electrical grids with net metering, which allows consumers to see their energy consumption in real time, and to make adjustments to save power and money (Revas, 2010).

The most of the existing electricity transmission and distribution systems around the world were put in place 30-50 years ago. These grids have organized at a one-way distribution of electricity, meaning that the electricity comes to the consumers (end-users) from the generation plants. The consumers have to pay for the amount of the electricity that they have consumed. These old grids suffering from significant losses of electricity in transmission (loss range in Europe 2-4%) and distribution, loss range in Europe 4-9% (Majstrovic, 2010).

Although, there is an important inefficiency related to the peak demand. Demand varies, but capacity and generation are normally kept at peak demand level. But, there are vast amounts of electricity that are unused. Moreover, the electricity from renewable sources to the current grid presents important challenges for the management of the grid and the quality of electricity it delivers. So, the renewable energy is a part of the smart grid and will help it to be more efficient. Renewable energy will increase the efficiency of the grids by modernizing its operation, feeding in electricity from decentralized renewable sources and by interlinking multiple grids, moving electricity around to where it is required, as well as by adjusting demand to match supply of electricity (Zanden, 2011).

To achieve more efficiency the “new” smart grids must enable the measurement, communication and management of demand and supply throughout the grid. Based on two-way communication of real-time electricity consumption, utilities and grid operators can manage their operations more efficiently (Zanden, 2011). Smart Grid will enable a two-way communication between the supplier and the consumer (Liotta et al., 2012). The consumers can also adjust their consumption patterns to take advantages of lower prices in times of excess supply of electricity (Zanden, 2011).

The ability and actual potential of the Smart Grid is to analyze and process large amounts of information. The Smart grid will lead to smarter decision-making by both system operators and
electricity consumers if it can be managed with the right software tools, infrastructure and architectures control (Blumsack & Fernandez, 2011).

2.2 Smart meter

Currently there is no generally an accepted definition of the term of smart meter. The existing descriptions of the term generally contain a description of the functionality of the equipment or a description of the services that the technology that supports. In the European Union there is an ongoing work, to define minimum functional requirements for meters, and to define the capabilities that a meter must have in order to call it smart meter. Two key properties of meters are often mentioned in discussions about smart metering:

- Interval metering - usually on an hourly basis or shorter. There are even discussions about real-time metering.
- Two-way communication between the customer site and the network company, or between the customer site and the electricity supplier. (Swedish Energy Markets Inspectorate, 2011)

Smart meter is the consumer side of the Smart Grid. The smart meters is a digital electric meter that can store and timestamp electricity usage and ease the communication between the consumer and the utility. With the information provide through the smart meter, the decision making for the consumers’ can be more accurate and relief (Blumsack & Fernandez, 2011). The main benefits of the smart metering is that it can facilitate the introduction of renewable electricity generation, create the conditions for load reductions, increase energy efficiency, and give electricity customers the opportunity to become more active participants in the electricity market (Swedish Energy Markets Inspectorate, 2011).

2.3 Benefits of Smart Grid

The benefits of the Smart Grid are brought from National Energy Technology Laboratory, U.S. Department of Energy (Miller & Renz, 2010). These benefits will result from improvements in the following key value areas:

- **Reliability**: by reducing the cost of interruptions and power quality disturbances and reducing the probability and consequences of widespread blackouts
- **Economic**: by keeping downward prices on electricity prices, reducing the amount paid by consumers as compared to the “business as usual” (BAU) grid, creating new jobs, and stimulating the national gross domestic product (GDP).
- **Efficiency**: by reducing the cost to produce, deliver, and consume electricity
- **Environmental**: by reducing emissions when compared to BAU by enabling a larger penetration of renewable and improving efficiency of generation, delivery, and consumption

However, for all of the benefits that Smart Grid will provide, it will need fundamental changes in business models, public policies, social attitudes and last but not least in engineering (Blumsack & Fernandez, 2011).
2.4 Renewable energy

Renewable energy is the energy that can be generated from natural resources such as wind, sun, biomass, geothermal heat and hydro power. Nowadays, the renewable energy market is growing rapidly, because the high oil prices are increasing also in a demand. The governments around the world have to support the renewable energy and its projects, considering the legislation, incentives and commercialization. According to the International Energy Agency is estimating that nearly 50% of the global electricity supplies will be come from renewable energy sources, in order to halve carbon dioxide emissions by 2050 and minimize significant, irreversible climate change impacts (Wenxin, 2010).

Sweden has a high share of renewable, accounting for 29% of gross inland consumption in 2006, as compared to an average of 7% for the EU-27. This high share is due to the high share of biomass and other renewable sources for heat and power generation. As well, the high share of biomass (56%) used in the pulp and paper industry. A significant expansion of the wind power is planned, expected to amount to 30 TWh of generation by 2030. The main policy support mechanism for renewable is the renewable electricity certificate scheme, which began in 2003. An estimated 12.7 TWh of renewable electricity was generated within the system in 2007. In the figure below we can see the renewable generation in the electricity certificate system by hydropower, wind power and biomass power (excluding peat), 2003–2010, in TWh, Sweden (Swedish Energy Agency, 2011).

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<tr>
<td>2005</td>
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<td>1,8</td>
<td>0,9</td>
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<tr>
<td>2006</td>
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<td>1,0</td>
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<td>2010</td>
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<td>2,6</td>
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</table>

Figure 1: Renewable generation (Source: Swedish Energy Agency, 2011).

2.5 Demand Response integrated into the Smart Grid

Demand response which is an important factor in the Smart Grid concept. It refers to the capacity of electricity and the platform that communicates with the consumer and makes them aware of the high peak time frames that electricity is at a high price level (Chardon, et al., 2008). Prices are increasing at that particular time the more consumers consume. Consumers are usually not aware of the high peak time frames (due to not having access to demand response appliances) so they are unable to modify their consumption e.g. switch off or reduce the usage of appliances at high peak hours in order to reduce costs (Spees & Lave, 2007). Demand Response will make the electricity consumer to increase awareness and responsibility
of their consumption. This will help the consumer to reduce the electricity costs by reducing maximum capacity and increase energy savings (Capgemini, 2008).

2.6 Demographics

According to Evans et al. (2009, pp. 154-156), demographics involves important variables such as age, gender and occupation that can help to determine the consumer behavior. Demographics add value to the stock of knowledge of consumer behavior and in this case it should not be avoided.

2.7 Consumer Attitude

Attitude is an important variable when measuring consumer behavior towards an object or a product. It can help to determine what a consumer know, feel, value or how it is position in their mind about that particular object or product. According to Evans et al. (2009, p. 105) “attitude is a complex mental state involving what we know, our feelings, our values dispositions to act in certain ways”. According to Fishbein and Ajzen (1975, pp. 5-6) it is tough to give an exact definition for attitude because it is dependent on the variables, other concepts and the general theory that are included in the particular attitude towards the targeted issue or object. There are basic characteristics of attitude that need to be kept in mind when defining its meaning: Attitude is learned, it is a predispose action and that the action needs to be consistently favorable or unfavorable towards the targeted issue or object (Fishbein & Ajzen, 1975). Attitude can be measure by hundreds of different operation designs including Likert scale and semantic differential attitude scale (Ibid). Verbal (meaning that questionnaires are used to evaluate the attitude for a particular issue or object) and nonverbal (has to do with psychological measurements) approaches can be implemented to measure attitude of an issue or object (Ibid).

Through individuals attitude towards an issue or object, a feeling of liking or disliking can be developed and it is usually when a level of understanding has been reached towards the issue or object (Evans et al. 2009; p. 106).

2.8 Tri-component approach (Cognitive, Affective and Conative)

An orientation stable approach that can simplify the meaning of attitude is the tri-component attitude model that breaks attitude down to three fundamental components. Cognitive component – includes an individual’s beliefs, knowledge and their perception towards an issue or an object whereas a mismatch between beliefs and reality might take place. This means that these beliefs are of great importance and attached to the individual’s self where they reflect how they perceive the situation to be. Affective component – includes an individual’s feelings or emotions towards the attitude issue or object; these feelings can be positive or negative related to the attitude towards an issue or object and is based on the beliefs that the individual holds. Conative (behavioral) component – includes how an individual is likely to react to the attitude issue or object based on their knowledge towards it and how they feel about it; the readiness to respond behaviorally (Evans et al., 2009; pp. 106-107). The tri-component approach can be seen in the figure 2.
2.9 The Theory of Reasoned Action (TRA)

The Theory of Reasoned actions (TRA) is illustrated in figure 3. This model extends the tri-component model that was mentioned earlier in section 2.8 where here it includes the subjective norm; what other relevant individuals might be perceived to think about the attitude issue or object that is targeted. According to Fishbein and Ajzen (1975) this approach is used to evaluate the relationship between attitude and behavior of the consumer towards the target e.g. issue or object.

According to Fishbein and Ajzen (1975), The Theory of Reasoned Action (TRA) clarifies an individual’s beliefs (e.g. the information that the individual has towards an issue or object), from those beliefs the individual can create a positive or negative attitude towards the selective attitude target where later they are generated to behavioral intentions and finally determines the target’s behavior. The subjective norm (e.g. other relevant important individuals) may
influence the behavioral intention and trigger a change in the target’s behavior. The beliefs that other relevant individuals have against the subject’s intention for that particular issue or object that might influence the decision of a favorable or unfavorable behavior attitude towards the targeted issue or object.

In this Thesis the subjective norm will not be included and the main focus will be on the tri-component approach of attitude. According to figure 3, the focus will be on the upper part of the model.
3. Conceptual Model

From the theoretical framework connected with the research question the following model can be applied. A sample of the consumer attitude can be evaluated through the questionnaire that will be executed in this thesis concerning positive, negative or neutral attitude. From the questions asked in the questionnaire which are created according to the benefits of the Smart Grid, using mainly Likert Scale based; an attitude towards Smart Grid will be achieved.

Figure 4, listed below is generated from chapter 2 in section 2.3. This model consists of the four areas that the benefits rise from. Reliability, like mentioned in previous chapter is all about the reliability of electricity, how reliable and accurate is the electricity in terms of interruptions and power quality disturbances e.g. power failures and widespread blackouts. Economic is all about keeping prices low like mentioned in previous chapter, and creating new jobs. The environmental benefit is empowering more renewable energy sources and improving efficiency of generation, delivery, and consumption. Efficiency is all about reducing cost to produce, deliver, and consume electricity (Miller & Renz, 2010).

![Benefits of Smart Grid Diagram]

*Figure 4*: Conceptual Model – Benefits of the Smart Grid
4. Methodology

This chapter provides the description of how the authors conducted the research with reliable and relevant information. In addition, it will be analyzed which was the most appropriate research method and why.

According to Fisher (2007, p. 40), “methodology is the study of methods and it raises all sorts of philosophical questions about what it is possible for researchers to know and how valid their claims to knowledge might be”.

4.1 Research methods

The main research of this Thesis has been done on quantitative research based on a pre-coded approach. According to Fisher (2007) quantitative research is the method that deals with numbers and uses statistical tools to get the result. The pre-coded approach is more appropriate for this Thesis, because when it is about quantify particular points of interest, or get comparable results; the pre-coded structured approach is the most suitable approach (Fisher, 2007, p. 165). The following keywords have been the starting point of this research:

- Consumer attitudes
- Consumer behavior
- Smart Grid
- Green marketing
- Smart meter

4.2 Data Collection

In this Thesis, both primary and secondary data have been used. Primary data is the information that can be collected in a research, in order to examine a specific research problem. The primary data is mainly unstructured information that has been collected by researching the questionnaire. The secondary data is using to understand and explain better the research problem and not only to find information to solve the research problem (Ghauri & Groenhaug, 2010, p. 90).

In this Thesis the following methods as have been stated by Fisher (2007, p. 61) have been applied.

- Questionnaire
- Documents
- Databases

4.3 Primary data

The primary data has been collected through the questionnaire (pre-structure approach) that was designed and created by the authors for the purpose to collect the necessary primary data in order to conduct this Thesis. The details for the questionnaires and the ways that the methods have been applied will be analyzed in the following chapters.
5.3.1 Sample size and the selection of respondents

The sample size for this thesis is 203 people, while the respond rate is at 78 percent, meaning that 152 respondents have fully answered the questionnaire. However, the sample size is not a representative number of the Swedish population. The questionnaire for this study is made for the consumers that are paying for electricity in their household (living in a house or apartment) because the questions are sensitive to the price of electricity and therefore a probability sampling is not valid in this research. Bryman and Bell (2011, p. 713) states that: *convenience sampling is a sample that is selected because of its availability to the researcher. It is a form of non-probability sample.* According to Fisher (2007, p. 190) probability sampling is choosing randomly people from a sample frame until it receive enough respondents to complete the survey. Whereas everyone in the population has an equal chance of being selected and be included in the sample (Fisher, 2007, p. 190). The assumption of excluding the consumers that are not paying for electricity is because they don’t have an opinion about it and therefore they are not relevant for this study. The factor that influenced the way the questionnaire was distributed was to be certain to target consumers that are living in an apartment or house, and having work as their occupation.

The sample approach that is applied in this research is purposive sampling which counts as a non-probability sampling approach. According to Fisher, (2007, p. 191) the disadvantage is that any level of margin of error is unreliable in this situation because it excludes the fact of everyone has an equal chance of being selected e.g. excludes the random selection.

5.3.2 Design of the Questionnaire

The questionnaire for this Thesis was designed by the authors with the help of the variables that describes the benefits of Smart Grid which are also mentioned in the theoretical framework and also connected to the conceptual model. The questionnaire is divided into five categories according and to be consistent with the theoretical framework. The explanation behind this approach is that an assumption was taken in the beginning of the creation of the questionnaire that the majority of the consumers are not aware of the term Smart Grid. Therefore the initiative was taken to form the questions according to the benefits of Smart Grid. With this approach, the risk of having misunderstandings and unknown variables were reduced for the respondent. This made it easier for the respondents to answer. However, the questionnaire was made by having our strategic and research question as a starting point. The questionnaire was created in the spring semester, 2012.

The first attempt of the questionnaire that was created for this Thesis was given to two Ph. D students that have expertise in the field of Smart Grid at Mälardalen University. With the help of their feedback, the questionnaire was reformulated and strengthens in order to better suit the purpose and make it easier for the respondents to understand the content of the questionnaire. The questionnaire was translated into Swedish and distributed in the following two techniques.

- Firstly, with the help of Google Documents, an online survey/questionnaire was formulated and distributed through email to 62 individuals in May, 2012. Those individuals were selected due to the fact that they have a job and were paying for electricity. According to
Ghauri (2005, p. 124) a survey is a useful and effective tool to use in order collect and measure attitudes from the respondents, as well as it is less costly and time consuming.

Secondly, a printed version of the questionnaire in hardcopy was made and distributed to 124 individuals at a big company in Västerås, May, 2012. Permission was asked and was granted by the operator manager at the company’s department to distribute the questionnaire. Once again those individuals were selected due to the fact that they were employed and were paying for electricity, and for the reason that access was granted. A small portion of the questionnaire (n=17) was distributed at Mälardalen University, in May 2012, to the employees of the University. The authors had access and permission in the company that the questionnaire was distributed. However the company wants to be anonymous and the authors respect their demand.

The question formats along with its selected questions from the questionnaire (see the English version of the questionnaire from Appendix), as stated below, have been used in order to cover the requirements of the questionnaire;

- **Dichotomous questions** (e.g. question 1, 4, 6, 10-15, 22, 23, 26-28)
- **Multiple choice questions** (e.g. question 2, 5, 7, 8 and 20)
- **Rating scales** (e.g. question 25)
- **Likert scales** (e.g. question 16-19, 21, 24, 29-37)

**Dichotomous questions** are the questions that offer to the respondent only two options to choose between (e.g. male/female). **Multiple choice questions** provide the respondents with three to five options and ask them to choose one (e.g. black, blue, green, yellow). **Rating scales** are the questions that ask the respondents to rate or evaluate an option, service or policy, based on a carefully graduated scale (e.g. Excellent 1 2 3 4 5 Poor). **Likert scales** are the questions that ask the respondents questions about their attitudes and opinions. It provides a series of statements (negative or positive in tone), and ask the respondents to decide in a five-point scale between strongly disagree or strongly agree (Fisher, 2007, p. 193).

However, the principal basis of the questions have been based on Likert scales, because according to Fishbein and Ajzen (1975) this is one of the most common question formats to be used to measure consumer attitudes.

Demographic questions have been used in the questionnaire, in order to check the representativeness. Demographics are an important factor that has to be examined in a questionnaire, but they should be limited in number. Sometimes the respondents that will answer the questionnaire have different demographic characteristics, but the main questions are the same for all (Fisher, 2007, p. 192).

Additionally, another factor in the designing of the questionnaire that has been bear in mind is the language. Ghauri & Gronhaug (2005, p. 129) states that the language has to be simple so that everyone is able to understand it. Considering that our Thesis is written in English the authors made a carefully translation of the terms in Swedish, because the questionnaire targets
Swedish consumers that are living in apartments or houses and there are paying for electricity consumption.

5.4 Secondary Data

Secondary data was conducted through reliable sources like literature from books and articles. A theoretical framework has been done, in order for the researchers to retrieve information from databases (open approach). A detail analysis of documents has been included in order to have a more clear view of the topic. In this way, searching information has been done with certain keywords; which have already mentioned in the previous chapter. The secondary data was used in order to build a theoretical framework, as well as for collecting updated information that is relevant to our topic. The information was retrieved from books, journal articles, databases and online data sources. The journal articles were retrieved from the Mälardalens University databases, namely ABI/INFORM Global (ProQuest) and Emerald. These sources have been checked for the reliability and relevance of their information. In the meanwhile, the secondary data has been also used in order to have more updated information of the topic. In addition, all of the selected information is peer-reviewed, which is an indication of their reliability. The following key words were used to find the relevant literature:

- Smart Grid
- Smart Meter
- Renewable energy
- Green electricity
- Consumer attitude
- Consumer Behavior

5.5 Data analysis

The data analysis are been done by firstly, placing every question according to the content of the question (e.g. variables) into the right category of each of the benefits that are shown in the conceptual model, chapter 3, figure 4 of this thesis e.g. reliability, environmental, efficiency and economic. Reliability is measured through the questions that have to do with consumption information, power reliability and accessibility to appliances that provides the necessary tools to reduce blackouts, interruptions and power quality disturbance as mentioned in the theoretical framework, chapter 2. These questions may be found in Appendix B with the sign [B1]. Economic is measured through the questions that have to do with the reduction on electricity prices compare to today’s grid and job creation. These questions may be found in Appendix B with the sign [B2]. Efficiency concerns questions that have to do with cost reduction in production, delivery and consumption of electricity, including demand response and smart meter. These questions may be found in Appendix B with the sign [B3]. Environmental is measure through questions that has to do with reduction of emissions or questions concerning renewable energy and environmental sustainability. These questions may be found in Appendix B with the sign [B4].

The questions are place so they are consistent with the category that they are assigned in. However some of the questions might overlap with one or more categories, but in that case the question is placed in the category that it has the strongest influence in. Secondly, by knowing
which question belongs in what category/benefit the relevant theory and empirical data was used to analyze each of the questions in order to answer the research question.

*What are the consumer attitudes towards the possible benefits that the Smart Grid provides?*

In addition, the neutral, positive and negative attitude is measure with the help of the empirical data. With the help of a scale that consists of strongly agree | positive attitude, uncertain | neutral attitude and strongly disagree | negative attitude. The majority response from each of the questions in the questionnaire will determine if there exists a neutral, positive or negative attitude in that particular question and towards where it points e.g. towards a neutral, positive or negative attitude.
6. Empirical data

In this chapter are presented the empirical data of our research, based on the questionnaire. This chapter is divided into five categories. The following four categories (except of demographics) shown below are derived from the conceptual model, figure 4 which can be found in chapter 3. The demographics are used as an introduction of the respondents of the questionnaire. The five categories can be seen in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Categories of the empirical data (Source: own illustration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Demographics</td>
</tr>
<tr>
<td>2</td>
<td>Reliability benefits of Smart Grid</td>
</tr>
<tr>
<td>3</td>
<td>Environmental benefits of Smart Grid</td>
</tr>
<tr>
<td>4</td>
<td>Efficiency benefits of Smart Grid</td>
</tr>
<tr>
<td>5</td>
<td>Economic benefits of Smart Grid</td>
</tr>
</tbody>
</table>

6.1 Demographics

In this survey was found that the 51% of the respondents were having gender female and the 49% male. At the age of 18-28 were found to be 48 respondents. The majority (68) of the respondents was at the age of 30-49 and the minority (36) was at the age of the 50-64. All the results considering the demographics factor can be seen in the following figures:
The 28% of the respondents were living in a house and the 72% in an apartment as it can be seen in the figure below.

**Figure 6:** House or apartment

Another important factor in the demographics part was the income per household. The majority of the respondents with the amount of 31% had income per household 31.000–40.000SEK and the minority 60.000SEK or more as it can be seen in the figure below.

**Figure 7:** Income per household
The following figure is showing how often the consumers are paying for the electricity. The majority of the respondents are paying their electricity bill every month (59%) and the minority of the respondents is paying every three or four months (4%).

![How often do you pay for electricity?](image)

*Figure 8: Monthly period payment of the electricity*

In the figures below (Figure 9 and 10) the 51% of the respondents were having higher education and the 49% high school. In the meanwhile the 91% of the respondents were employees; the 8% are students and 1% pensioner.

![What is your education?](image)

*Figure 9: Education*

![Occupation](image)

*Figure 10: Occupation*
6.2 Reliability benefits of Smart Grid

In this category the information is dealing with the reliability of the electricity consumption.

In the following figure the majority of the respondents (65%) answered that they don’t want to have more information about their electricity consumption, the minority (14%) answered that they don’t know and the 21% of the respondents answered that they want to have more information of their electricity consumption.

![Information about my Electricity Consumption](image1)

*Figure 11*: Information about the Electricity Consumption

In the figure below the respondents were asked if they are aware that they have a smart meter installed in their household. The 44% answered that they are aware, 34% they are not aware and 22% of the respondents don not know.

![Aware of Smart Meter](image2)

*Figure 12*: Smart Meter awareness
In the figure below the respondents asked if they trust the information that they get from the smart meter. The 52% answered that they trust the information from the smart meter, 31% they don’t know and the 17% they don’t trust.

![Pie chart showing trust in smart meter information](image)

*Figure 13*: Trustiness from the Smart Meter

In the figure below the respondents were asked to answer if they think that their electricity is reliable. The 42% answered that is not reliable, the 38% answered that is reliable and the 20% answered that they don’t know.

![Pie chart showing reliability of electricity](image)

*Figure 14*: Reliability of the electricity
In the following figure the respondents were asked to answer if they are interesting to share and distribute electricity. The 35% of the respondents answered that they are uncertain, 22% partly disagree, 21% partly agree, 17% strongly disagree and 5% strongly agree.

![Share and Distribute Electricity](chart)

*Figure 15: Share and distribution of the electricity*

In the following figure the respondents were asked if they want to have a better understanding of their electricity consumption. The 32% of the respondents were uncertain, 30% partly agree, 16% strongly agree, 13% partly disagree and the 9% strongly disagree.

![Better understanding of my electricity consumption](chart)

*Figure 16: Better understanding of the electricity consumption*
In the figure below the respondents were asked if they have physical access to their meter. The 44% answered that they have access, the 35% they don’t have access and the 21% they don’t know.

**Figure 17:** Physical Access to the Meter

### 6.3 Environmental benefits of Smart Grid

In this category the questions are dealing with the usage of the renewable energy in the electricity consumption.

In the following figure the respondents were asked to answer if they are interesting to use more renewable energy in their electricity consumption, knowing that it creates jobs. The 33% answer that are uncertain, 30% partly agree, 13% strongly agree and with the same percentage (13%) partly disagree and the 11% strongly disagree.

**Figure 18:** Demand of the renewable energy
In the following figure the question has to deal with the volition of the respondents to pay more for renewable energy. The 25% of the respondents answer partly agree, 23% uncertain, 21% strongly disagree, 16% strongly agree and the 15% partly disagree.

![Bar chart showing responses](image)

**Figure 19:** Volition to pay more for renewable energy

In the figure below the respondents have to answer if they want their electricity to come from renewable energy. The 38% of the respondents’ answer that they are uncertain, 30% partly agree, 16% strongly agree, 10% strongly disagree and the 6% strongly disagree.

![Bar chart showing responses](image)

**Figure 20:** Volition for the electricity to come from renewable energy
In the figure below the respondents have to answer in a scale from 1 to 7 (price-environment) what is the most important reason to reduce the electricity consumption. The 26% answered in this scale four, 19% 1, 13% 6 and 13% 3, 12% 7, 9% 5 and 8% 2.

![What is the most important reason to reduce your consumption?](image1)

**Figure 21:** Reduction of the electricity consumption

In the figure below the respondents answered the question; if it is important to reduce CO₂ emissions by consuming electricity in a more efficient way knowing that the price of electricity might increase (become more expensive). The majority (31%) of them answered that they are uncertain, 28% partly agree, 20% strongly agree, 12% partly disagree and 9% strongly disagree.

![It is important to reduce CO₂ emissions by consuming electricity in a more efficient way knowing that the price of electricity might increase (become more expensive)](image2)

**Figure 22:** Reduce CO₂ emissions
6.4 Efficiency benefits of Smart Grid

In this category the questions have to deal with the efficiency and demand response of the electricity consumption.

In the following figure the respondents have answered if they had been heard the term demand response. The 83% have answered they don’t know what does it mean and the 17% they answered that they know.

![Demand Response](image)

**Figure 23:** Demand response

In the figure below the respondents answered if they are willing to switch off the electrical appliances during the peak hours. The 30% answered partly agree, 25% uncertain, 19% partly disagree, 15% strongly disagree and the 11% strongly agree.

![Would you be willing to switch off appliances during peak hours](image)

**Figure 24:** Peak hours
In the figure below the respondents answered if they think that are using their appliances efficiently. The 46% answered yes the 38% no and the 16% they don’t know.

![Usage of Electricity Appliances](image)

**Figure 25:** Efficiently usage of electricity appliances

In the figure below the respondents asked if they are interested in having real time consumption data in their house or apartment. The 58% answered that they are interested and the 42% they are not interested to have real time consumption data.

![Real time consumption data](image)

**Figure 26:** Real time consumption data
In the following figure the respondents were asked to answer if they do care about their waste of the electricity. The majority (41%) answered Partly Agree and the minority (4%) Strongly Disagree.

**Figure 27:** Waste of electricity consumption

In the figure below the respondents have to answer if they like to control their electricity consumption. The 37% were uncertain, 27% partly agree, 20% strongly agree, 8% partly disagree and with the same percentage have answer strongly disagree.

**Figure 28:** Control of the electricity
In the following figure the respondents were asked to answer if they care how much electricity other third party consumers consume e.g. neighbors. The 30% of the respondents have answered strongly disagree, 30% have also answered that are uncertain, 21% partly agree, 15% partly disagree and 4% strongly agree.

![How much Electricity others Consume](image)

*Figure 29: Electricity consumption of third party consumers*

In the following question the respondents were asked to answer if they are interesting to sell electricity back to the grid. The 29% of the respondents answered strongly disagree, 21% partly agree, 18% uncertain, 17% strongly agree and the 15% partly disagree.

![Selling electricity back to the grid](image)

*Figure 30: Selling electricity back to the grid*
In following figure the respondents answered if they would like to use home automation systems for their electricity. The results showed that 33% of the respondents were uncertain, 27% partly agree, 21% strongly agree, 12% strongly disagree and 7% partly disagree.

*Figure 31: Home Automation systems*

### 6.5 Economic benefits of Smart Grid

In the figure below the respondents were asked if they are aware that the renewable energy creates jobs. The 61% answered that they are aware and 39% answered that they are not aware of this statement.

*Figure 32: Renewable energy creates jobs*
In the figure below the respondents have to answer how they will be charged for their electricity consumption. The results showed that the 40% are willing to pay in a flat rate, 24% hourly priced, 23% cheaper price at night and 13% average peak consumption.

<table>
<thead>
<tr>
<th>I would like to be charged for my electricity consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat rate</td>
</tr>
<tr>
<td>40%</td>
</tr>
</tbody>
</table>

*Figure 33: Charge of the electricity consumption*

In the figure below the respondents answered if it is important to know the price of electricity in real time. The 33% answered that they were uncertain, 29% partly agree, 19% strongly agree, 11% strongly disagree and 8% partly disagree.

<table>
<thead>
<tr>
<th>It is important to know the price of electricity in real time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
</tr>
<tr>
<td>11%</td>
</tr>
</tbody>
</table>

*Figure 34: Real time price*
In the figure below the respondents were asked to answer if they are satisfied with their existing providers. The results of the questionnaire showed that 37% of the respondents were uncertain, 30% partly agree, 15% strongly agree, 14% partly disagree and 4% strongly disagree.

![Satisfaction of Existing Providers](image)

**Figure 35:** Satisfaction of existing providers

In the figure below we want to see if the respondents have volition to pay a higher price at the moment that they are paying in order to receive more returns in the future. The results showed that the majority of them with 45% were uncertain, 18% partly disagree, 17% strongly disagree, 15% partly agree, 5% strongly agree.

![I am willing to pay a higher price now in order to receive more returns in the future](image)

**Figure 36:** Volition for a higher price
In the following figure the respondents had answered if they like to be able to sell and buy electricity from different electricity providers. The 30% answered that are uncertain, 28% partly agree, 17% strongly disagree, 14% partly disagree and 11% strongly agree.

![Bar chart showing survey results](image)

**Figure 37:** Different electricity providers
7. Analysis

In this chapter the authors have analyzed the empirical data with the help of the theoretical framework (chapter 2), and the conceptual model (chapter 3). The analysis is divided into the four benefits of Smart Grid brought from the conceptual model. The following benefits e.g. reliability, environmental, efficiency and economic are terms from the Smart Grid perspective and therefore the analyses are done concerning the Smart Grid.

7.1 Reliability enforced by the Smart Grid

The reliability that rises from the Smart Grid is one of the essential benefits that Smart Grid will be able to ensure. The people within the boundaries of this Thesis e.g. the respondents of the questionnaire, one of the first question that they were asked; if they were interested in receiving more information on their consumption of electricity. The empirical data shows that the majority of the respondents had a negative response towards the above statement. The respondents are not aware of the capability of the Smart Grid. At the moment we are all using electricity that passes through the current grid and according to chapter two of this Thesis (Theoretical Framework) the current grid is inefficient in the way it uses and distributes electricity; one-way distribution of electricity, from the provider to the end-user. The respondents are not aware of the accessibility of information that will be provided through the implementation of the Smart Grid. Another interesting fact that rose from the empirical data was that; the majority of the respondents believed that the electricity power is not reliable enough in terms of blackouts or other interruptions that may cause power failure at the moment, using the current grid. This fact shows a positive attitude towards the Smart Grid, because the Smart Grid is able to provide consumers with services that enable them to no longer be dependable of just one power source e.g. a power plant. They will have the accessibility to get electricity from more than one power source. Another interesting fact that rose from the questionnaire is that the more awareness that consumers get from the concept of the Smart Grid, the better understanding they are willing to have. Similar results were found in the research made by a non-profit organization, SGCC (2011). The more knowledge consumers’ gain about Smart Grid, the more are they interested to find out.

7.2 Environmental as a Smart Grid benefit

According to section 2.3 (chapter 2) of this Thesis, the environmental benefit implemented into the Smart Grid will be able to provide an improved efficiency level of generation, delivery and consumption of electricity. It will also enable a larger penetration of renewable energy compared to the current grid. According to the empirical data the respondents were asked if they want their electricity to come from renewable energy. The majority of the responses were that they had a neutral towards a more positive attitude. However, the empirical data to this issue shows that they were uncertain (neutral attitude) to some degree. The reason might be that they don’t have enough or do not receive enough information concerning this issue. They are uncertain in how it will affect them in their daily life when it comes to the price and the costs of the electricity, because usually in the most cases environmental friendly products and services costs more than the ones that are less environmental friendly. Another interesting fact is that the respondents were asked if they are willing to pay more in order to ensure that their
electricity comes from renewable energy. The majority had a more favor attitude in this manner; it gives them more control of the situation if they are willing to pay a premium price. The respondents were also asked two additional questions concerning the environmental benefits of the Smart Grid. One of the questions were if they find it important to reduce CO$_2$ emissions consuming electricity in a more efficient way knowing that the price of electricity might increase (become more expensive). Second question were if they would be interested in using more renewable energy knowing that it creates jobs even if it means that they need to pay more. Both of the questions, according to the empirical data, had similar response like the previous question regarding the environmental benefit of the Smart Grid. Their attitude was between neutral towards a positive. This implies that the majority of the respondents have a neutral with a penchant to positive attitude concerning the environmental benefits of the Smart grid.

7.3 Smart Grid provides an enhance level of Efficiency

Smart Grid will enable an enhance efficiency usage of electricity; it is meant to reduce the cost to produce, deliver and consume electricity. It will enable new ways to manage and control electricity for consumers in order to be able for them to participate and being a part of the decision making of their own electricity consumption. The demand response has an important role in order to engage to a better efficiency level of electricity. The respondents were asked if they have heard of the term demand response and 83 percent of them replied no. However, when they were asked if they are willing to switch off the electrical appliances during the peak hours, the empirical data shows that they have a neutral with a penchant to positive attitude. This service is a part of the demand response and it seems that consumers are ready for it (the consumers in this case are the respondents of the questionnaire). Real time consumption data is another good way to increase efficiency usage of electricity. Therefore, the respondents were asked if they are interested in receiving real time consumption data in their household and the majority agreed on this statement. Consumers do care about the waste of electricity and for that reason they are interested of being more efficient with their electricity consumption. They are willing to participate and have a greater control over their own electricity consumption. This proves a positive attitude towards this service from the respondents and only a small percentage had a negative attitude. In addition, consumers are willing to have automation systems placed in their household. The empirical data shows that consumers have a neutral attitude with a strong penchant to a positive attitude for this issue. This is consistent with the study made by Pike Research (2011), that consumers are willing to have smart appliances in their household to manage their energy consumption more efficiently. Consumers are willing to increase their energy efficiency, but if only they have the necessary tools that will ease their daily life and not be placed as a burden.

7.4 Economic improved by Smart Grid

The economic benefits that the Smart Grid will enable is all about keeping electricity prices low, reducing the amount paid by consumers, stimulating the GDP (gross domestic product) and last not least creating new jobs. In this category the respondents were asked if it is important to know the price of electricity in real time and the empirical data shows that the respondent had a neutral attitude with a penchant to a positive attitude in regards to the above
statement. But, on the other hand when the respondents were asked how they are willing to be charged for their electricity consumption. The majority of the respondents chose flat rate as the way to be charged for their electrical bill. This means that they are used with the current grid and how the electricity is managed at the moment. However, this might also mean that a consumer does not know any other technique of how to deal with this issue and therefore s/he don’t want to complicate life even more by adding more workload in their daily life. The respondent showed a positive response when it comes to the statement about real time price, but they don’t have any knowledge of how it might work in real life. With the enabling of real time price data, the consumer can make adjustments to save power and money but this means that they need to invest a bit of their time to make it profitable for themselves. A motivating fact is that 61 percent of the respondents are aware that renewable energy creates jobs and this is exactly what the implementation of the Smart Grid will enable; it will bring forward new job openings. The respondents are not willing to pay more now for their electricity in order to receive more in return in the future, this indicates that they have a negative attitude towards this statement according to the empirical data. The majority of the respondents are in between price and environment with a strong difference towards the price of electricity which means that they concern more about what they pay for electricity rather than the environment. Smart Grid will provide more efficient way of keeping prices down and an interesting fact is that the more consumers will be eager of cutting costs and holding prices down the more sustainable will the environment become through the Smart Grid. So it is a win-win situation for both the consumer and the environmental sustainability. Like it was mentioned in a study made by Park Associates (Abloni, 2010), consumers are interested in learning how to cut electricity costs and save money. However, in the study made by Green Research (2010), woke interest in consumers mind when they found out that they can be environmental friendly and at the same time be price sensitive.
8. Conclusion

The intent of this thesis is to investigate the consumer attitude towards the benefits and of Smart Grid; if the consumers have a positive, neutral or negative attitude on the Smart Grid that will be implemented in the near future. Consumers are interested on acquiring a better understanding of their electricity consumption but it doesn’t necessarily mean that they will prefer receiving more information about it. This implies that consumers do not want to have more information about the Smart Grid, but they are willing to acquire a better understanding of the process considering the new grid. However, the real time consumption data was appreciated by the majority of the consumers in the sample, a positive attitude was achieved in this content. As well, the real time prices on the electricity were highly appreciated with a positive attitude from the majority of the respondents. The majority of the respondents have a negative attitude concerning the generated electricity of renewable energy that could be sold back to the grid. But, this may be because of the fact that consumers do not understand the mechanism behind it and how they can benefit from it. The respondents were not aware of the term “Demand Response”, but, they have a positive attitude towards its ability.

Considering the economic benefit of the Smart Grid, consumers are more sensitive to the price than to the environment. The environment is important in the most of the consumers mind but they are not willing to pay more for it. The sensitivity of the respondents’ showed an attitude that ranges from a neutral to a more negative attitude (price e.g. they less care about the environment).

The respondents have a positive attitude to the fact that the renewable energy creates jobs. Although, when it comes to the fact if they want to pay more for the renewable energy, even though that it creates jobs, their attitude is negative. As well, when is coming to the statement: to reduce CO₂ emissions by consuming electricity and the price of electricity might be increased, the attitude of the respondents showed a neutral attitude with a penchant to positive.

It can be concluded that the consumers have a neutral attitude with a penchant to a positive attitude concerning the Smart Grid concept. Even though the information is not lacking, the consumers want to have a better understanding of this new technology that will replace the old one.
9. Recommendations

In this chapter, recommendations will be presented that are derived from the study of this Thesis. Those recommendations can be useful for utilities, government, and other important actors within the electricity industry that found this study useful.

In order for the Smart Grid to be successful implemented and reduce delays, consumers need to start slowly by acquiring knowledge about it and how they can benefit from it. They need to reach a level of understanding that will be merging with their demands. After all, consumers’ need to have more flexible electricity and will be able to reduce their electricity consumption with the help of the services of the Smart Grid.

Utilities, governments, and marketers need to start assign marketing messages, capture the consumers’ interests and increase their awareness of the services of the Smart Grid. Main focus should be put on the advantages of the Smart Grid, but the disadvantages should also be highlighted in order to make the consumer aware of the consequences. On the other hand, consumers need to be informed how inefficient the electricity market is at the moment and how with their own contribution they can improve it. Smart Grid will be the solution for the current inefficient electricity market, but firstly trustiness and commitment needs to be acquired from the consumers.

10. Further Research

Further research can be made within the same field, but with a larger sample. Another suggestions will be the following:

- Which is the most efficient way to inform consumers about the implementation of the Smart Grid (e.g. social media)?
- How will the implementation of the Smart Grid affect the infrastructure of a municipality?
- How will it affect the consumer in terms of price or other important variables that might influence the process?
References


*The photo in the cover page is Retrieved from http://www.myenergyplatform.com/
Appendix A

Questionnaire in English

1. What is your gender?
2. What is your age?
3. How long have you lived in Sweden?
4. Do you live in an apartment or in a house?
5. What is your current income in SEK?
6. Is the electricity included in your rent?
7. How much is your electricity bill per month (approx.)?
8. What is your level of education?
9. What is your occupation?
10. I am interested in receiving more information on my consumption of electricity
    Yes  No
11. Do you trust that the information from your meter is accurate?
    Yes  No
12. Do you think that your power is reliable?
    Yes  No
13. Do you think you are using your appliances efficiently?
    Yes  No
14. Have you heard of the term “Demand Response”?
    Yes  No
15. Would you be willing to switch off appliances during peak hours?
    Yes  No
16. I want my electricity to come from renewable energy
    Strongly disagree  disagree  don’t care  agree  strongly agree
17. I would be willing to pay more for my electricity to make sure it comes from renewable energy.
    Strongly disagree  disagree  don’t care  agree  strongly agree
18. I want to have a better understanding of my electricity consumption
   Strongly disagree  disagree  don’t care  agree  strongly agree

19. I would prefer to use home automation systems (Explain what automation systems are, lights heating etc. - would you be interested in using them?
   Strongly disagree  disagree  don’t care  agree  strongly agree

20. I would like to be charged for my electricity consumption
   i. Flat rate
   ii. Cheaper at night
   iii. Hourly priced (depending on market price
   iv. Average peak consumption

21. I would be interested in producing my own electricity and sell it back to the grid when I am not using it
   Strongly disagree  disagree  don’t care  agree  strongly agree

22. I am happy with the current amount of electricity providers existing in my area
   Yes  No

23. Are you aware that renewable energy creates jobs?
   Yes  No

24. Would you be interested in using more renewable energy knowing that it creates jobs even if you have to pay more?
   Strongly disagree  disagree  don’t care  agree  strongly agree

25. What is the most important reason to reduce your consumption?
   Price  1----------------------------------------7  Environment

26. Will you be interested in having real time consumption data in your house/apartment?
   Yes  No

27. Are you aware that you have a smart metering?
   Yes  No

28. Do you have physical access to your meter?
   Yes  No
29. It is important to share and distributing my electricity with others  
   Strongly disagree  disagree  don’t care  agree  strongly agree

30. I would like to be able to sell and buy electricity from different providers  
   Strongly disagree  disagree  don’t care  agree  strongly agree

31. I do care about my waste of electricity  
   Strongly disagree  disagree  don’t care  agree  strongly agree

32. I would like to have different prices on day and night  
   Strongly disagree  disagree  don’t care  agree  strongly agree

33. I would like to control my purchase of electricity  
   Strongly disagree  disagree  don’t care  agree  strongly agree

34. I do care about how much electricity other consume e.g. neighbors, friends etc  
   Strongly disagree  disagree  don’t care  agree  strongly agree

35. It is important to know the price of electricity in real time  
   Strongly disagree  disagree  don’t care  agree  strongly agree

36. It is important to reduce CO₂ emissions by consuming electricity in a more efficient way knowing that the price of electricity might increase (become more expensive)  
   Strongly disagree  disagree  don’t care  agree  strongly agree

37. I am willing to pay a higher price now in order to receive more returns in the future?  
   Strongly disagree  disagree  don’t care  agree  strongly agree
Questionnaire in Swedish

Ange kön:

Man   Kvinna

2. Hur gammal är du?

18-29 år   30-49 år   50-64 år   65 år eller äldre

3. Hur länge har du bott i Sverige?

Antal år________

4. Bor du i lägenhet eller i hus?

Lägenhet   Hus

5. Hur hög är hushållets inkomst per månad, på ett ungefär (efter skatt)?

Mindre än 10000kr   10000 – 20000kr   21000 – 30000kr
31000 – 40000kr   41000 – 50000kr   51000 – 60000kr
60000kr eller mer

6. Är elen inkluderad i hyran?

Ja   Nej

Om inte, hur ofta får du en faktura för din el-förbrukning?

Varje månad   Varannan månad   Annat________

b) Om inte, hur hög är kostnaden för din el-föbrukning per gång (i SEK)? Ange antal i SEK, vad du får i genomsnitt

___________

7. Vilken är din högsta utbildning?

Gymnasium   KY/Yh   Kandidatexam
Master/Masters   Doktorant/Ph. D   Annat:_______

8. Vilken är din nuvarande sysselsättning?

Jobbar   Studerar   Arbetslös   Pensionä   Annat:_______

9. Jag är intresserad av att få mer information om min el-förbrukning

Ja   Nej   Jag vet inte

10. De följande frågorna kan du besvara genom att välja de svar som för dig låter mest rimligt
Från en skala "Tar helt avstånd" till "Instämmer helt"
11. Är du medveten om att du har en "smart meter" (el-mätare) i ditt hushåll?
   Ja  Nej  Jag vet inte

12. Har du fysisk tillgång till din el-mätare?
   Ja  Nej  Jag vet inte

13. Litar du på att informationen från din el-mätare visar korrekt
   Ja  Nej  Jag vet inte

14. Tror du att din el är pålitligt (med pålitligt innebär att som t.ex. du alltid har elektricitet i ditt hushåll, ifall det blir ström-avbrott)
   Ja  Nej  Jag vet inte

15. Kommer du att vara intresserad av att få realtids el priser om tidsåtgång i ditt hus / lägenhet?
   Ja  Nej

16. Tror du att du använder dina hushållsapparater effektivt
   Ja  Nej  Jag vet inte

17. Är du medveten om att förnybar energi skapar jobb?
   Ja  Nej

18. De följande frågorna kan du besvara genom att välja de svar som för dig låter mest rimligt
    Från en skala "Tar helt avstånd" till "Instämmer helt"
19. Vad är det viktigaste skälet för att minska din el konsumtion?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tr>
<td>Pris</td>
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<td></td>
<td></td>
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<tr>
<td>Miljö</td>
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</tbody>
</table>

20. Har du hört talas om begreppet ”efterfrågeflexibilitet”?

Ja  Nej

21. De följande frågorna kan du besvara genom att välja de svar som för dig låter mest rimligt

Från en skala "Tar helt avstånd" till "Instämmer helt"

<table>
<thead>
<tr>
<th></th>
<th>Tar helt avstånd</th>
<th>Tar delvis avstånd</th>
<th>Varken instämmer eller tar avstånd</th>
<th>Instämmer delvis</th>
<th>Instämmer helt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jag skulle vara beredd att stänga av hushållsapparater under högtrafik med högt nivå under en given tid eller period samt att det inte skulle ställa flera problem för elomkopplningen.</td>
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</tr>
<tr>
<td>Jag skulle vilja kontrollera mina inköp av el</td>
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</tr>
</tbody>
</table>

22. Jag skulle vilja bli debiterad för min elförbrukning efter

Fast kostnad
Billigare på natten
Rörlig kostnad (beroende på marknadspriset)
Genomsnittliga maximala förbrukningen
23. De följande frågorna kan du besvara genom att välja de svar som för dig låter mest rimligt
Från en skala "Tar helt avstånd" till "Instämmer helt"

<table>
<thead>
<tr>
<th>Varje svar</th>
<th>Tar helt avstånd</th>
<th>Tar delvis avstånd</th>
<th>Instämmer delvis</th>
<th>Instämmer helt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jag är villig att betala ett högre pris nu för att få mer avkastning i framtiden?</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
</tr>
<tr>
<td>Det är viktigt att minska CO2-utsläppen genom att konsumerar el på ett mer effektivt sätt med vetenskapen om att priset på elen kan öka (blir dyrare).</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
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</tbody>
</table>
Appendix B

[B1] Reliability
[B2] Economic
[B3] Efficiency
[B4] Environmental

1. [B1] I am interested in receiving more information on my consumption of electricity
2. [B1] Do you trust that the information from your meter is accurate?
3. [B1] Do you think that your power is reliable?
4. [B1] I want to have a better understanding of my electricity consumption
5. [B1] It is important to share and distributing my electricity with others

6. [B2] I would like to be charged for my electricity consumption by the following way (flat rate or cheaper at night or hourly priced or average peak hour)
7. [B2] I am happy with the current amount of electricity providers existing in my area
8. [B2] Are you aware that renewable energy creates jobs?
9. [B2] I am willing to pay a higher price now in order to receive more returns in the future?
10. [B2] I would like to have different prices on day and night
11. [B2] It is important to know the price of electricity in real time
12. [B2] I would like to be able to sell and buy electricity from different providers
13. [B2 and B4] What is the most important reason to reduce your consumption?

14. [B3 and B1] Have you heard of the term “Demand Response”?
15. [B3] Would you be willing to switch off appliances during peak hours?
16. [B3] Will you be interested in having real time consumption data in your house/apartment?
17. [B3] I would be interested in producing my own electricity and sell it back to the grid when I am not using it
18. [B3] I would prefer to use home automation systems (e.g. warm water heating, lights heating etc. -would you be interested in using them?
19. [B3] I do care about my waste of electricity
20. [B3] Are you aware that you have a smart metering?
21. [B3] Do you have physical access to your meter?
22. [B3] I would like to control my purchase of electricity
23. [B3] Do you think you are using your appliances efficiently?
24. [B3] I do care about how much electricity other consume e.g. neighbors, friends etc

25. [B4] I want my electricity to come from renewable energy
26. [B4] I would be willing to pay more for my electricity to make sure it comes from renewable energy
27. [B4] Would you be interested in using more renewable energy knowing that it creates jobs even if you have to pay more?
28. [B4] It is important to reduce CO2 emissions by consuming electricity in a more efficient way knowing that the price of electricity might increase (become more expensive)