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Students Energy Saving Behavior

Case study of University of Coimbra

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Abstract

According to Portuguese Directorate-General for Geology and Energy, renewable energy in Portugal was the source for 52% of country's electricity generation in 2010 [DGGE 2010, page 6]. The current Portuguese policy makers in the energy area argue that the story behind Portugal's success lies in government led initiatives in forms of efficient energy policies, which not only influenced the adoption of renewable technologies but also encouraged people to adopt a more energy efficient behavior.

In the context of a new consciousness around a difficult but desirable environmental, economic and economic equilibrium, consumer behavior plays a very important role.

The overall purpose of this study is to analyze the influence of Energy or Environmental lectures (or both) on university students' intention to pursue energy saving measures, because they will, in the short run, represent a relevant part of the future end-user consumers and bill-payers and will drive changes in the patterns of energy consumption.

An online survey (N=1582) on students' energy saving behavior was conducted to predict students' intention to perform energy saving measures. Based on the received responses, two groups of students were formed: one, with students who had access to one or more Energy or Environmental (or both) lectures and, another, with students who did not have access to Energy or Environmental (or both) lectures. This research departs from AJZEN (1988) Theory of Planned Behavior. According to this theory, students intention to conserve energy was compared between the groups; energy saving advice influence on students' intention to save energy was analyzed but also the choice between traditional light bulbs and energy saving bulb based on price was discussed.

Final findings show that Energy lectures stand as long term measures that influence students' intention to engage in energy saving measures. Energy lectures seem to increase student confidence and strengthen the social pressure of the intention to engage in energy saving measure. They have stronger influence on students' energy saving intention than the television campaigns, for instance.

Measuring the price influence on students' intention to peruse energy saving measure it was identified that those students who have access to Energy or Environmental lectures (or both) could estimate correctly the price between a traditional and energy saving bulb and have higher intention to engage in energy saving measures.

Furthermore, several interviews with staff in charge of energetic measures at European Universities were conducted to identify energy saving incentives and future measures are proposed to reduce energy demand.

Keywords: sustainability; energy; TPB; students

Table of Contents

List of Tables

List of Figures and Equations

List of Graphs

Abbreviations

ATT	Attitude toward Behavior
BEH	Behavior
F	F-ratio (test statistic used in ANOVA)
INT	Intention
M	Mean
n.s.	Non Significant
N	Sample Size
p	Probability (the probability value, p-value or significance of a test are usually denoted by *p*)
PBC	Perceived Behavioral Control
R	The multiple correlation coefficient
SD	Standard Deviation
S*N*	Subjective Norm
SPSS	Statistical Package for the Social Sciences
TpB	Theory of Planned Behavior

Introduction

Several studies have identified that citizens are aware of the benefits of using energy more efficiently, but a variety of social, economic or cultural factors discourage them from doing so [MARTISKAINEN, 2007][BROHMANN et al., 2009]. Identifying people energy-saving behaviors is a difficult task, but the observed behaviors may result in behavioral changes.

Moreover, an increasing number of energy policies and programs account for consumer behavior based on social and behavioral research. Policies designed to encourage energy-saving behavior need to target specific actions, to identify the barriers to these actions and to propose solutions to overcome the identified problems.

Hence, behavioral science and energy use are beginning to play a key role in solving the energy dilemma in the framework of the current economic context, in Europe and, namely, in Portugal.

This work tries to contribute to enlighten energy policy makers and university board members on students' energy consumption behaviors.

Universities are powerful independent institutions that benefit society and are extremely important in the diffusion and application of the sustainability concept. The University of Gloucestershire (United Kingdom), for example, considers that "*The University can best serve its local communities and enable sustainability to become reality and when it engages staff and students in partnership activities with local groups and businesses. Local collaborations and local action are key priorities for sustainability, and the University campuses are an important resource to be harnessed for promoting such projects*." [UoG, 2011]

Today several Universities offer degrees on *Renewable Energy, Environmental Risk Assessment, Sustainable Development* or *Energy for Sustainability*. But do the lectures included in their study plans really influence student's behavior to conserve energy at the University or in their private lives?

Are Energy or Environmental lectures (or both) institutional prerogatives in defining University energy policy?

This thesis (developed in a four month period!) is a contribution to the analysis and a tentative answer of these questions.

The first part of the thesis focuses on the theoretical background concerning energy saving behavior concepts. Then, an overview over the Portuguese electricity market is provided, followed by studies on individual decision of energy consumers and their relationship to sustainable consumption.

The second part of this thesis has a more practical character. The development of strategies to change energy consumer behavior requires an understanding of both the behavior and the influencing factors (in particular, beliefs, attitudes, and social influences). The *Theory of Planned Behavior (TpB)* is one of the most used and accepted models of the intention-behavior relationship [AJZEN, 2002] . TpB is considered to

be the most predicative persuasion theory, i.e., it is a theory that measures the link between attitudes and intention. Consequently, we hypothesized that students who have access to Energy or Environmental lectures (or both) would have a higher intention to engage in energy saving behavior then the others. To test the hypotheses we surveyed students attending University of Coimbra[1] during the school year of 2010/2011, obtaining 1581 valid questionnaires. The questionnaire measured *behavioral intention*, *attitude towards behavior*, *behavioral beliefs*, *normative beliefs*, *subjective norms*, *perceived behavioral control* and *behavior to perform energy saving measures*.

We identified that students who have access to Energy or Environmental lectures (or both) have a higher intention to engage in energy saving measures than the others.

We also measured the influence of the energy saving advice received from television on different groups of students and we found that an increased frequency of energy saving advice has a passive influence on the student energy saving behavior.

Also the energy saving advice from the television has a smaller influence on student's intention to engage in energy saving measure then the Environmental or Energy lectures (or both).

Further we identified that student attitude, confidence, subjective norm increases over the years; and with monetary rewards they can be influenced. Several interviews with persons in charge of energetic measures at European Universities are used to evaluate the actual situation and future measures are proposed to reduce energy demand.

Based on the theoretical findings of the first part of the thesis and practical examination of the second part, recommendations will finally be given of possible other electricity saving measures at the Universities.

[1] University of Coimbra has around 20000 students (Source: University of Coimbra, http://en.wikipedia.org/wiki/University_of_Coimbra)

Chapter I - An Overview of the Portuguese Electricity Market

The electricity sector in Portugal is organized in accordance with the laws and principles set by Decree-Law No. 182/95, of 27 July, amended by Decree-Law 29/2006, of 15 February.

The Directorate-General of Energy and Geology (DGEG) through the Ministry of Economy is responsible for conceiving, designing, assessing, advising the Government on energy related policies.

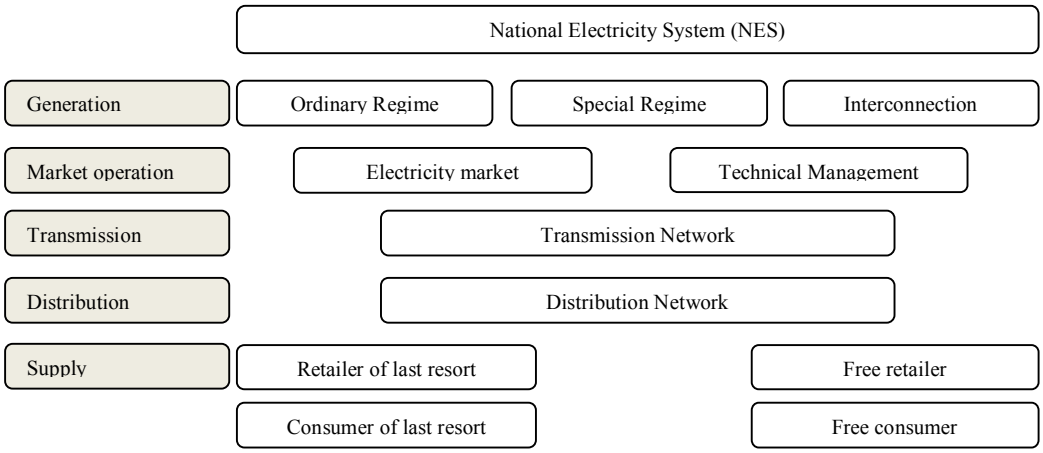


Figure 1.Portuguese Electricity System in 2008
(SOURCE: [AMORIM et al. 2010])

The National Electricity System (NES) can be divided into five major functions: generation, transmission, distribution, supply, and market operations [REN, 2010] .

In Portugal, the production of electricity is nowadays a liberalized activity (or market-based), but is subject to licensing and is carried out in a competitive environment. Electricity generation is performed with the use of several different technologies and energy sources that are divided into two categories: ordinary regime (which refers to the generation of electricity through traditional non-renewable sources and large hydro-electric plants) and special regime (in mini-hydro, cogeneration, producers at low voltage up to 150 kW, as well as from other renewable energy). Environmental concerns led to the creation of incentives that promoted the production of electricity through renewable resources.

In 2010 the renewable energy in Portugal accounted 52% of the country's electricity generation (DGGE, 2010, page 6). Thus, in recent years; there has been a very significant increase in the use of sources of renewable in electricity generation, expressly wind. Despite these figures, Portugal is still not self-sufficient in energy production. Currently, the main producers of electricity in Portugal are EDP Production, EDIA, Tejo Energia and Turbogás, which can sign contracts with suppliers and end customers, or may

participate in organized markets. Also the special regime allows them to sell the electricity they produce from the supplier of last resort[2].

The energy transportation in Portugal is managed by the National Transmission Grid, through an exclusive concession granted by the Portuguese State to REN (Redes Energéticas Nacionais) on June 15, 2007 for a 50-year period.

Today REN not only fits the role of the physical operator of the system (providing a link between the production and distribution via the transport function), but as well as the role of an economic operator (being the only buyer of energy producers).The National Transmission covers almost the entire national territory, having also some points of interconnection to the Spanish system, allowing the exchange of electricity in Iberia. These networks meet the quality standards established in Regulation of Quality of Service and allow access to all interested parties in a non-discriminatory and transparent way.

The distribution of electricity is carried out through the National Network Distribution. Currently the electricity distribution (in high and medium voltage) is undertaken by EDP Distribuição. The operation of low voltage distribution grids is based on contracts between local governments and distributors.

The electricity supply is open to competition, and is subject only to a licensing regime. Consumers may choose and change their supplier of electricity without paying any type of additional charge. Also they can purchase electricity directly from producers, traders or through organized markets. The process of changing supplier is provided by an independent entity with the scope to overcome the logistical operations that facilitate switching suppliers for consumers.

The electricity supply to Public Electric System (SEP) is assured by the suppliers of last resort, who are required to assure universal installment of the supply of electricity to all who request it, and practice a selling price set by ERSE (Entidade Reguladora dos Serviços Energéticos).

The Non-Linked Electricity System (SENV) consists of traders who can buy and sell electricity freely, paying access charges to the transmission and distribution defined by ERSE. Among the major retailers are EDP, Endesa, Iberdrola, Union Fenosa, EGL and Galp Energy.

Legislation obliges all retailers to comply with certain standards regarding the quality of service and provide information to consumer. This includes information on the general services, tariffs and prices, on the efficient and rational use of resources. This information must be provided in a not discriminatory, transparent manner.

Trading electricity is an activity of buying and selling electrical energy. In a liberalized market trading constitutes the same approach: customers are free to choose their supplier, further they can change supplier according to the provider that meets up their needs.

[2] Supplier of the last resort means that they "*Can refer to either an energy supplier who is automatically assigned to serve an existing customer immediately following deregulation, or an energy supplier who must supply a given classification or sub classification of customers who may not be able to acquire energy from any other provider. In most cases, the supplier of last resort is the utility company that the customer used before deregulation*", Energy Dictionary http://www.energyvortex.com/energydictionary/supplier_of_last_resort.html

Two different markets were developed to trade electricity: *Non-Organized* (or Bilateral Trading) and *Organized Trading*. The first one (Non-Organized) also known as Over-the-Counter (OTC) meaning that the transactions are carried out directly between the parties involved, without a clearing house and where the contracts are not regulated. On this market electricity is traded either by means of physical delivery or by using financial contracts (Forwards and Option contracts). The second (Organized Trading) is a structured market, organized in Power Exchanges or Power Pools. The trading procedures and the structural conditions to operate are established by the market rules.

The management of organized electricity markets in Portugal is a market-based activity based on the responsibilities of market participants. As mentioned earlier, both the producers and the traders may become members of these markets and are subject to authorizations granted jointly by the Minister of Finance and by the Minister of Economy responsible for the energy sector.

To ensure that these activities take place without abuse of the National Electric System, and within the legal parameters, to ensure the efficiency and rationality of operations in terms of transparency, non-discrimination and competitive, there needs to be regulation on transport activities, distribution and supply of last resort, as well on logistics operations, changing supplier and market management.

In Portugal, the regulation of the electricity sector is attributed to the ERSE (Entidade Reguladora dos Serviços Energéticos) which, as described in Article 3 of Decree-Law No. 97/2002 of April 12, serves not only to ensure that the entire population is served in a continuously and non-discriminatory manner, the minimum standards of quality and security of supply are respected, but also to set rules and obligations, to promote price transparency and confidence to consumer and to prevent abuse of dominant position and "predatory behavior".

It is still a function of the regulatory authority to protect consumers' interests, to promote access to information and to promote effective competition in order to get either a higher performance of the regulated companies or a greater satisfaction of end customers. Other additional functions are the promotion of environmental performance in transmission and distribution; loss reduction in electrical power and active distribution networks to better serve the market.

Chapter II - Definitions of Sustainable Consumption

Sustainable development is vital for a green and protected future. The idea behind sustainable development is very simple:"*it is about ensuring a better quality of life for everyone, now for generations to come*" [UNESCO, 2005] In 1987 the United Nation World Commission on Environment and Development (WCED) elaborated "Our Common Future" best known as the "BRUNDTLAND REPORT" that defines sustainable development as: "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: (1) the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and (2) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs*" [WCED, 1987] .

Particularly *sustainable development* means delivering economic growth in the form of higher living standards while preserving the environment. The objectives of sustainable development are: social progress based on people needs (for instance reduction of unemployment, pollution, etc.); active protection of the environment (for instance climate change, protection of wildlife); wise use of natural resources (for instance renewable sources) and support of high and stable levels of economic growth and employment (for instance high quality goods) [UK FORESTRY, 2010] .

It is suggested that *consumption* is fundamental in achieving a sustainable development; otherwise unsustainable consumption might be one of the causes for the climate change and pollution.

Sustainable consumption is "*the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations*" [IISD, 2010] .

But is sustainable consumption a support for consumer behavior change? Individual consumption behavior is driven by a variety of factors such as lifestyles, habits, and routines; hence consumer behavior change is faced with a large variety of actions and needs of modification. However, *it is suggested that changing to a sustainable consumption behavior requires more than rising awareness among consumers, it requires new product policies or the existence of sustainable supply.*

JACKSON (2005) defines sustainable behavior as "*a function of partly attitudes and intentions, partly of habitual responses, and partly of the situational constraints and conditions under which people operate*" [JACKSON, 2005]

Individual energy consumer behavior is restricted to a specific context that characterizes a part of his or her energy consumption (for instance, he may be a rent payer and may not be interested in energy

savings). Most of the studies refer to private household's energy conservation[3]. Specific research on student's electricity saving behavior in the University context could not be found the literature. Therefore we assume that the behavior of students in the University is similar to the behavior of the same group of individual in their private ambience.

The next section analyzes individual consumer decision and its relationship with sustainable consumption.

2.1. Individual Consumer Behavior in Socio-Economic and Psychological Studies

The structure of this part is as follows: first consumer decision models are presented (consumer sovereignty and bounded rationality model) followed by JAGER (2000) classification of the consumer behavior; finally the common psychological models used to analyze the consumer behavior are referenced.

The first consumer decision model was developed based on the belief that people try to maximize their utility under budget constraints. HANSEN (2007) affirms that *"consumers in the market should be sovereign and that they are indeed sovereign, at least partly. Prerequisites for consumer sovereignty are freedom of consumption, on the demand side and (perfect) competition, on the supply side. Given their preferences, consumers can decide which goods they want to purchase at what price*" ([HANSEN et al., 2007] , page 447).

Specifically consumer psychology (individual behavior and habit) decides what will be produced not the budget constraints.

HERBERT SIMON (in 1957) proposed the *"bounded rationality"* as an alternative for the mathematical modeling of decision making. He identified that *"rationality of individuals is limited by the information they have and the finite amount of time they have to make decisions"*[WU, 2009] . For instance someone spills coffee on his shirt in a bar, and immediately goes next door to buy a new one. The best alternative is to buy the same type of shirt, but his decision is limited by time; hence a cheap shirt is appropriate. His choice is maybe not the best overall, but it is the best within the current situation. *Therefore people decide rationally only in a limited number of situations, their decision is based on the interpretation of the present situation.*

BROHMANN (2009) propose an economic interpretation to the bounded rationality since *"time- and resource-consuming effort of information can be interpreted as costs"* ([BROHMANN et al., 2009] , page 5). After all, the received information helps customer in the decision making process (it is a positive cost), they conclude that the model of bounded rationality match the approach of consumer sovereignty (in a free market consumer determine the goods that are produced).

[3]For more information about the Intervention Studies on Household Energy Conservation please see the attached CD (Information can be found in Chapter II – Definitions of Sustainable Consumption)

Therefore based on the consumer sovereignty each individual itself decides how to maximize information cost. This also means that information may result behaviors that are not optimal from an individual perspective (for instance, fast food is cheap (price) but may cause obesity (health)).

In the case of *energy consumption* this behavior may change influenced by the increasing energy prices, which may encourage energy-saving behavior. Studies identified that in the case of energy-related investment, people give more importance to the initial investments (to the money invested to start the business) than to the gains from cost savings.

The *sustainability-oriented approach* is concerned with joining the relationship between changed behavior and individual decisions. Specifically sustainable *"consumption in itself is not a behavior, but rather a consequence of behaviors such as turning the lights off or lowering thermostat levels"* ([MARTISKAINEN, 2007] , page 12).

A particularly energy consumption behavior in many cases is based on habits or routines. Analyzing behaviors JAGER (2000) differentiates between *"reasoned behavior"* (analyzed by economic models) and *"automated reactions"* (habits and routines). Moreover he differentiates between those behaviors and decisions that are less influenced by the others behavior (individually determined) and those that depend on the observation of others (socially determined). The result is a four-fold typology of behaviors illustrated by Table 1.

	Automated Reactions	**Reasoned Actions**
Individually determined	**Repetition / habit** • Conditioning	**Deliberation** *Planned behavior* • Attitudes • Behavioral Control
Socially determined	**Imitation** • Social learning/ normative conduct	**Social comparison** • Relative deprivation / social comparison

Table 1. Four-fold typology of behaviors (Source: [MARTISKAINEN, 2007] , page 19)

The analysis of consumer behavior is based on several psychological approaches and identifies the most common psychological models and approaches applied to analyze consumer behavior, as summarized in Table 2.

	Representative	Issues
Behavioral Approaches	Behaviorism (e.g. B.F. Skinner 1979)	Reaction to stimuli in the immediate environment, learning from the immediate consequences of action (positive or negative feedback).
Cognitive Approaches	Problem solving with respect to cognitive structures and previous experience (De Young 1990)	Social meaning of the costs and benefits of current energy use.
Attitude-Behavior Models	Theory of reasoned action (TRA) (Fishbein and Ajzen 1975); Theory of Planned Behavior (e.g. Ajzen 1985; 2002) (Corbett 2005)	Predicts behavior on the basis of attitudes, norms and behavioral intentions.
Social Cognitive Theory	Observational learning Bandura (1986)	
Value-Belief-Norm-Theory	VBN (Stern 2000)	
Reasonable Person Model	(Kaplan 2000)	

Table 2. Psychological schools on consumer behavior
(Source: [HEISKANEN et al., 2006] , page 19)

"Behavioral research is used to analyze individual reactions to different initiatives; *experimental (or cognitive) research* is used to analyze the *"social meaning of the costs and benefits of current energy use"* ([HEISKANEN et al., 2006], page 8). *Attitude behavioral models* analyzing behaviors, attitudes, norms are frequently used in social psychology research. The ethical aspects of the behaviors, norms and values are analyzed using the *Social Cognitive Theory or Value Belief Theory* (pro-social attitudes and personal moral norms are predictor of pro-environmental behavior).

The *Theory of Reasoned Action* considers that individual aspect certain benefits from the outcome of their behavior.

2.2. Individual Consumer Decisions in Different Context

The purpose of this section is to identify the relationships between individual consumer decisions in a different environment. Specifically the following characteristics and functions of the consumption behavior are identified: complexity, nonverbal communication, adaptation (in the sense to conform), influence of the self esteem (or information), influence of the lifestyle (or information).

Individual choice is influenced by the present circumstances. EBERLE (2004) suggest that there is *no "on-dimensional" consumer behavior,* since today individuals pursue "*diverse and interdependent mix of roles as citizen, market participant and employee, and as member of a household or family performing coordination, repair, provisioning and purchasing functions"*([EBERLE et al., 2004] , page 13).

Others argue that nonverbal details of consumption may reveal who we are and how we relate to other people. Specifically BARTIAUX (2003) underlines the importance of the consumption "*as a non-verbal means of communication: goods allow communication, they create identity and establish relationship. But also they exclude as well as they include since goods are mean of distinction*" ([BARTIAUX, 2003] , page 1240).

DOUGLAS (1979) considers that the consumption role is not to fulfill our "body needs" but rather its capability to conform. When we are hungry we consider any type of food might be able to satisfy our body needs, but we are aware that we would not eat human flesh (not because it lacks nutritional value) but because of our perception on human being. Hence the role of goods: *"are needed for making visible and stable the categories of culture"* ([DOUGLAS et al., 1979] , page 59). Moreover *"goods in their assemblage present a set of meanings more or less coherent, more or less intentional. They are read by those who know the code and scan them for information"* ([DOUGLAS et al., 1979] , page 59).

Domestic tasks (housework) may increase people self-esteem or to influence people self-realization by action. KAUFMANN (1993) in his analysis identifies consumption as a method of identity management: *"Self-esteem is at the origin of every change (...) the demand for acknowledgment overcomes society. Everyone is on the lookout for approval admiration, and love in the eyes of the others. (...) Without limitations. (...). The necessity of identity management seems indeed to be powerful explanatory factor of behavioral change, even when it comes to household chores and every-day routines"*([ANDERSEN, 2006] , page 24). BARTIAUX (2003) identifies some gender differences how men and women view the electric appliances: *"Housework nowadays implies the use of electric appliances and there are gender differences in their associated meanings: men are attributing an instrumental value to these objects which represent their social achievements whereas women more often insist on the objects' symbolic value that represent affective ties"*([BARTIAUX, 2003] , page 1240).

Technological sociologist research on consumption practices are based on consumer lifestyle. ANTHONY GIDDENS (1991) examines the problems faced by individuals in maintaining self-identities in today's modern world. He determines self-identity as: "*the self as reflexivity understood by the individual in terms of his or her biography"*([EMILE et al., 2009] , page 6). For GIDDENS (1991) the biggest challenge to the individual is the fact that *"Modernity confronts the individual with a complex diversity of choices and, because it is non-foundational, at the same time offers little help as to which options should be selected"* ([GIDDENS, 1991] , page 80). From this results the supremacy of the lifestyle which *"can be identified as a more or less integrated set of practices which an individual embraces, not only because such practices fulfill utilitarian needs, but because they give material form to a particular narrative of self-identity"* ([GIDDENS, 1991] , page 81)

2.3. Studies on Behavioral Energy Consumption

This part reviews the literature from different disciplines (behavioral psychology, cognitive psychology and social psychology) that are relevant and applicable in this research.

We will present behavioral studies on energy consumption, particularly we focus on the different intervention measures such as: *commitments, goals settings, information, workshops, mass media, TV, feedback, rewards, Eco Teams, master meters*, etc., applied to change energy consumer behavior. Also sociological investigations on energy conservation will be reviewed (*effect of eco-labeling, lifestyle, environment, etc.*)

The literature identifies three different psychological schools analyzing energy conservation behavior: behavioral psychology, cognitive psychology (or experimental psychology), and social psychology (especially attitude-behavior models) ([BROHMANN et al., 2009] , page 8). Almost all focus on the individual aspect of behavioral change.

Psychologists who investigate energy related behaviors underline the importance of the participation, social context, as well as the macro-level factors (namely technological development, economic growth, demographic factors, institutional factors and cultural factors) influence on energy conservation.

ABRAHAMSE (2005) reviews thirty-eight energy related studies applied in the field of social and environmental psychology. Studies are classified as involving either *"antecedent strategies" (i.e. commitment, goal setting, information, and modeling)* and *consequence strategies (i.e. feedback, rewards).* The difference of these interventions is that *the first one "influence one or more determinants prior to the performance of behavior"*([ABRAHAMSE et al., 2005] , page 275) and that strategies of *the second "are based on the assumption that the presence of positive or negative consequences will influence behavior"*([ABRAHAMSE et al., 2005] , page 278).

Antecedent interventions are considered: *commitments, goal settings, information and modeling*. Commitments are *"oral or written pledge or promise to change behavior*" ([ABRAHAMSE et al., 2005] , page 275).

KATZEV (1983) analyzed *the influence of commitments on electricity consumption*, of course supposing that individual electricity consumption depends on the extent of the energy-related task. They examined the electricity use of four groups using the following techniques: (1) short questionnaire about energy use and asking them to reduce their consumption with 10%; (2) a written commitment to save 10% of electricity and (3) using a "foot-in-the-door" treatment they applied a questionnaire and they requested individuals to sign a commitment to reduce their electricity consumption by 10%. As a feedback households received their monthly electric bill. KATZEV (1983) *found that participants in the "foot-in-the-door group" behaved as "conservers" during the 12-week follow-up phase.*

However, the actual savings "foot-in-the-door group" was almost similar to the other groups, "their behavior was consistent with a greater desire to conserve" ([McCALLEY et al., 2006] , page 130).

Goal setting is similar to the commitment: the defined reference point (for instance to save 10%) on electricity saving makes the difference. BECKER (1978) experimenting the effectiveness of the goal setting intervention found that the stated goal should be difficult (less easy) to achieve. In his research he assigned households with two-reference point in saving electricity. First, they had to save 2% of electricity; later, he set a more difficult goal to save 20% of electricity. He also provided information on the electricity consumption of appliances. BECKER (1978) identified that *20% savings proved to be more effective than an easy 2% saving goal* [BECKER, 1978].Hence a goal should have an intermediate level of difficulty.

Information is a frequently used intervention to influence individual behavior on energy efficiency. Information can be given in several different ways: workshops, mass media campaigns or home audits.

GELLER (1981) studied the effectiveness of seven energy conservation workshops. He conducted workshops were he surveyed 117 participants applying before-after questionnaires. He identified a modification in people attitude and behavior in energy conservation. Moreover he continued this investigation after the workshop; after six weeks he made home visits to approximately half of the participants and concluded that the workshop had minimal effect on energy conservation behavior. In other words, there was no relevant difference between attendees and non-attendees based on the number of adopted energy-saving measure. ***GELLER (1981) identified that information influence people in energy conservation, but it does not result in behavioral change [GELLER, 1981] .***

STAATS (1996a) identified the *effectiveness of a mass media campaign*. Moreover they evaluated the mass media information campaign on the greenhouse effect. During more than two months the Dutch mass media (national television, newspaper, and billboards) intensively promoted to the public the causes of greenhouse effect, its consequences and ways of dealing with environmental problems. In their analyses they used a pre- (965 participants) and post- (704 participants) campaign survey. STAATS (1996a) found that

"with the exception of a slight increase of knowledge about the greenhouse effect, no campaign effects were found for problem awareness" [STAATS et al., 1996a] , page 198). In other words they found that knowledge and problem awareness are less efficient promoting behavioral change.

MCMAKIN (2002) conducted energy-conservation surveys in two US military installations where residents do not pay their own utility bills. Specific tailored approaches were used for each installation based on social-psychological models. They measured before-and-after the energy use and survey was conducted to measure resident end-use behavior. The residents wanted to do the save energy, to be an example for their children. MCMAKIN (2002) identified that *"some aspects of social-psychological model appear useful in motivating energy-use behavior change, but others are not as effective "*([McMAKIN et al., 2002] , page 15).

WINETT (1985) used a television channel to broadcast energy saving measures. The programs were modeled and directed to middle-class homeowners and showed different energy saving behavior. Their research reported the following: *"One viewing of 20-minute TV program resulted in the adoption of some simple no-cost strategies that yielded overall electricity savings across conditions of close to 10%, with no reported loss in comfort, and about 23% savings on electricity used for cooling"* ([WINETT et al., 1985] , page 42). ***They suggest that TV could possibly be used in a behavior change strategy. However a follow-up study applied one year later showed that energy savings were not maintained.***

The second type of measures –consequence interventions- suppose that the presence of positive or negative consequences will influence behavior. The most common consequence strategies are feedback and reward. Feedback consists in *"providing households information about their energy consumption or energy savings"* ([ABRAHAMSE et al., 2005] , page 278). They are characterized based on their frequency.

VAN HOUWELINGEN (1989) investigated the *effects of continuous versus monthly feedback on gas consumption.* Several identical homes are heated with natural gas in Nieuwegein. Their target group was 325 families separated in two groups: the first group committed themselves to save 10% of gas while the second group did not agree to the conservation goal. Fifty households received electronic monitor devices to monitor natural gas use. This so called *"Indicator"* displayed the daily gas consumption compared with the conservation goal. The remaining households were divided into two groups: the first received monthly external feedback and the second monitored their gas consumption based on their utility meters. As result *VAN HOUWELINGEN (1989) found that the self monitoring group, who had the option of checking their utility meters as frequently as desired, regarding to the other groups managed to achieve an average reduction of 5,1%. The group that received monthly feedbacks achieved an average reduction of 7,7%. The greatest average reduction 12% was achieved by the "Indicator" group.* However after one year a post analysis identified that gas use had increase for all groups. VAN HOUWELINGEN (1989) found that "*The Indicator has a positive impact on consumer knowledge of household energy use and helps residence to reduce gas use"* ([VAN HOUWELINGEN et al., 1989] , page 103).

STAATS (2004b) investigated *"The Eco Team" program* by targeting different behaviors related on waste management, gas, electricity and water use, on transportation and food consumption. They focused on the relationship between intentions and changes in habitual behavior. Eco Teams are small groups consisting of six to ten members (like neighbors, friends, church members, etc.). Usually they hold monthly meetings to discuss experiences, ideas and achievements related to energy-savings. STAATS (2004b) during one year period applied questionnaire surveys to a total of 60 Eco Teams who committed to save energy. The result was 20,5% savings on natural gas, 4,6% savings on electricity usage, 2.8% savings on water use and they reduced their waste with 28,5%. A post-analysis applied after 2 year period measured the following savings: 16,9% natural gas use, 7,6% for electricity use, 6,7% for water use and 32,1% for waste reduction. Hence long term energy saving measures was maintained. STAATS (2004b) identified that *"perceived behavioral control and habit, two components that have become stronger during participation in the Eco Team Program, are factors that promote the use of more environmentally friendly transportation means"* ([STAATS et al., 2004b] , page 6). In other words durable changes in habits result from a pre-existing intention to change to sustainable consumption.

MCCLELLAND (1980) conducted an experiment in master-meter apartments. They organized an energy conservation contest (on natural gas usage) among four apartment buildings. The participants received weekly feedbacks on their and rival energy savings and practical information on how to save energy. After every two week of competition the winning building was awarded 80$. After 12 weeks the competing apartments managed to reduce 6,6% of natural gas consumption which covered the cost of competition. MCCLELLAND (1980) identified that *money factor has a short-term effect on conserving energy* [McCLELLAND et al., 1980] .

KURZ (2002) demonstrates that the rational-economic, social dilemmas, attitudinal, behavioral approaches to energy saving behavior suffer certain limitation: "*These limitations arise primarily, out of what appears to be a need to explain behavior in a particular way, as opposed to simply trying to explain behavior"* ([KURZ, 2002] , page 276). He suggests four psychological approaches to environmentally sustainable behavior: 1) *rational-economic models*, 2) *social-dilemmas models*, 3) *attitude models*, and 4) *models based on behavior modification and learning theory*; and investigates their application complexity.

KURZ (2002) considers that rational-economic approach limits the motivation of the consumer. As example when analyzing the contribution of single-occupant motor vehicles to long rush hours, the rational economic model would not examine such motivations as a sense of personal status, or freedom. Moreover price increase at the pump will not reduce their gas consumption; they will not change to more environmental transportation (bicycle, public transport). Social-dilemmas are based on game theory research and their lack in practical applicability to complex global environmental issues. As example he considers that game theory presumes that all participants feel the loss of resources equally, which is not true in the real word: Americans pay less for gas then Europeans. *Attitude models* approaches fail to predict exactly or to

explain behavior. He states that attitudes *are considered as "inherently static and separable from the other aspects of the system"* ([KURZ, 2002] , page 269). As example many organizations are promoting water save devices in households. But if in the newly installed households, people tend to take long, hot showers maybe the pro-environmental reasons are negligible.

KURZ (2002) proposes a social-ecological framework for analyzing environmentally sustainable behavior. Moreover the analysis of the environmentally sustainable behavior:" *needs to consider the interaction between the individual and the relevant objects as the unit of analysis"* ([KURZ, 2002] , page 269). It is also important to know if individuals "are equipped with the knowledge and skills (i.e. affectivities) required to utilize objects in such a way as to reduce their environmental impact" ([KURZ, 2002] , page 276).

In sociology the investigation on energy conservation is applied not on individuals, but on society and social groups or social practices. *Sociology investigates the behavior of socio-technical networks: the technology we use in our everyday life is shaped by social factors.* Sociologist considers that the obstacles to energy efficiency are not only the characteristics of individuals. *They suppose asking people to become aware of their energy consumption means asking people to perform a task what they are not used to do.* Hence energy use is socially invisible.

AUNE (1998) analyzed the influence of *lifestyles* in energy use. He considers that energy use is a *"determinant and result of different constructions of the material and cultural spheres."* ([PALM, 2009] , page 6) She develops a framework on how culture is formed through energy consumption and how *energy consumption is connected with everyday life.*

AUNE (1998) considers that a specific mixture is created "through negotiation between individuals and technologies" ([PALM, 2009] , page 6). Also introduce a new concept *"domestication";* which describes in what way the negotiation are performed *"including the practical, symbolic, and cognitive content of the process"* ([PALM, 2009] , page 6). AUNE (1998) defines the notion of *energy culture*, and classifies cultures with different implications on energy consumption as: *"the self-indulgent"* who do not consider at all their energy consumption, *"the environmentalists"* who are involved in ecological problems. AUNE (1998) research underlines *the need of studying symbolic and material conditions involved in energy use process.*

WILHITE (2000) considers *"the nature and causes of "energy demand" have been oversimplified, reduced or ignored in the community of energy research and policy".* They consider that energy-related social science has "largely been limited to the "behavior" of the "end users" ([WILHITE et al., 2000] , page 1). Although during years several energy efficiency measures were developed the energy demand in the United States and Europe has increased, moreover there is an increasing need for new policies in climate change. The new approach should consider not only *"prices and degree of consumer awareness, but also on social norms and a network of social institutions"* ([WILHITE et al., 2000] , page 109). In other words with

the new approach we would not only analyze decisions on energy conservation but also how people possibilities are organized by infrastructural networks, and other people decisions at a different points of the network.

BIGGART (2007) analyses prove that usually policy makers are often sending ordinary energy users conflicting messages. BIGGART (2007) considers that *"Traditional approaches to energy analysis and policy prescriptions in this sector have relied upon constructs from neoclassical economics regarding market prices, technical efficiencies, rational calculation, and so on to formulate analyses and solutions...Unfortunately, these have proven to be of limited value in either explaining or influencing the behavior of the actors involved…".*

WOOSLEY identified that *"...energy use...[is].....now defined largely by economic reasoning ... [which] ... presupposes an autonomous and rational individual unaffected by others. This simplifying assumption ignores the impact of social relations...In fact, the role of community and any non-individual element is not considered"* [BIGGART et al., 2007] , page 6).

SHOVE (2000) analyzed the sociology of technology on energy efficiency in buildings. They use a critical approach to the techno-economical model of technology transfer, which consists of a linear issue from development to energy-saving action as shown in Figure 2. *They identify the "social" or "non-technical" barriers to be the obstacles for the energy efficiency knowledge into practice.*

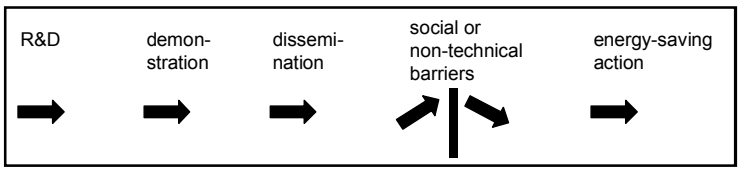


Figure 2. A linear and techno-economic model of technology transfer
(Source: [HEISKANEN et al., 2006], page 4).

Also they debate the difference between technological, social and political aspects of energy efficiency; *"they argue that these different aspects make up a 'seamless web' – thus, there is work for social scientists in all stages of the production and consumption of energy efficiency knowledge "*([HEISKANEN et al., 2006] , page 4). Hence social scientist should research these new "socio-technical" networks; they should examine "*how tacit knowledge about energy efficiency develops, and how the adoption of new solutions starts to 'make sense' in a specific context"* ([HEISKANEN et al., 2006] , page 4). They suggest that applications of energy efficiency in practice should consider: (1) Participants social context; (2) *"Innovative and valuable practices can also arise from the local context and from users' everyday experiences"* ([HEISKANEN et al., 2006] , page 5) (3) Analyzes of the energy consumer attitude is less important than the interaction between energy users and the advocate of energy efficient measures.

In a sociological context, claiming that single issue measures have not led to change in energy use in the past ([VAN VLIET, 2002] , page 11) debates :*"lack a proper scheme for analyzing the interplay between 'action' and 'structure' or between 'micro' and 'macro' levels. Economic models [...] do not pay attention to the 'motives' or 'reasons' of citizen-consumers behind a certain pattern of behavior. Within the economic theory of 'revealed preferences', everything judged an 'irrational' factor is excluded from conceptual schemes."*

In a recent work WILHITE (2007) argued that technologies play a crucial role in increasing energy use. The introduction of these technologies may increase energy use *"but at the same time create potentials for new energy intensive practices"* ([WILHITE, 2007] , page 23). He underlined the need for change on technology and in the social-cultural context. Based on the available energy technology, systems, social networks and movements the individual behavior is characterized as (efficiency behavior) and routine behavior (curtailment behavior).

MARTISKAINEN (2007) in his literature review on household energy consumption identifies two groups of energy saving behavior: (1) *Curtailment Behavior* (which includes conservation efforts such as turning appliances off) and (2) *Efficiency Behavior* (which include buying decisions – addressing the investment phase). However behavioral researchers could not agree on whether curtailment or efficiency behaviors are more effective in domestic energy saving [MARTISKAINEN, 2007] .

SCHÄFER (2008) conducts a research on the opportunities for sustainable consumption, they target *people who trapped by circumstances must change their behavior* (birth of the first child and relocation). They assumed that people in these life moments *are more open to change to sustainable consumption.* Their approach is based on a theory-based interaction marketing campaign [SCHAFER et al., 2008] .

POORTINGA (2003) measured the adoption of different energy-saving measures. Mainly *"they energy saving measures on acceptability, next to the relationships between preferences for different types of energy-saving measures and various socio-demographic variables, and environmental concerns of the respondents"*([POORTINGA et al., 2003] , page 59).

During almost 2 months they applied a survey to 455 randomly selected households in Netherlands. POORTINGA (2003) identified differences in acceptability of energy-saving strategy measures with regard to age, household type, income, and level of education.

CAREW (2002) applied a questionnaire survey to 52 undergraduate students to measure their understandings on sustainability. Each of the students had to answer the question "In your own words, what is sustainability?" They found that *"there was substantial variation in the way that our engineering undergraduate students described sustainability. These descriptions ranged from pre-structural in which students had only the vaguest notions of what sustainability might be, to extended abstract conceptions which were structurally sophisticated and included evidence of critical and/or creative thinking about sustainability."* ([CAREW et al., 2002] , page 358). Hence although today a variety of literature exists on

what students should learn in terms of sustainability, only a few researches investigate what students understand on the subject.

However KAGAWA's (2007) study on *"Dissonance in students' perceptions of sustainable development and sustainability Implications for curriculum change"* found that more than *90% of students held a positive attitude towards sustainability, naming sustainability as a "good thing" or declaring supporters of sustainability*[KAGAWA, 2007]

GRAM (2004) research on household energy consumption resulted that *electricity consumption depends on income and age, education, gender, or ethnicity have a small influence.* The first target group included over 50,000 households, and he analyzed the connection between individual electricity and socio-economic data, building size and type. The second group included 100 households, with electricity consumption "every 10 minutes during one month for each appliance and for the most lamps" ([GRAM et al., 2004] , page 3). Survey was conducted to identify the connection between use of appliances and socio-economic factors, building size and type.

GRAM (2004) found that *electricity consumption is "highly dependent on income. Age, education, gender and ethnicity seem to have very little influence"*([GRAM et al., 2004] , page 11). Moreover analyzing purchasing behavior he found no evidence justifying decisions on environmental concerns. For instance *"Electricity use for refrigerators/freezers and television seems independent of both age and income, whereas dishwashing, washing/drying, lighting and standby depend both on age and income, whereas computers depend on income not age" ([GRAM et al., 2004] , page 11).*

PEDERSEN (2000) in his analysis assumes that *"environmental concern is a factor behind the consumption of organic food"* ([PEDERSEN, 2000] , page 202). Investigating the relationship between organic food and electricity consumer has found little correlation. He states: *"investigation of the social norms on electricity consumption in the household demonstrates that norms on energy saving exist within certain situation specific areas, but that these norms are not correlated with the consumption of organic food"* ([PEDERSEN, 2000] , page 207). PEDERSEN (2000) considers that *individual purchasing behavior is not predictable, there is a little connection between "green consumption" and people needs: "different types of consumption show different possibilities if the social signaling effect shall be used"* ([PEDERSEN, 2000] , page 193).

KAENZIG (2006) suggests a *"classification for categorizing different cost profiles for eco-innovation and a conceptual model for the influence of LCC information on consumer decisions regarding eco-innovation"* ([KAENZIG et al., 2006] , page 122). *Life cycle cost* (LCC) is used for evaluation and investigation of the environmental impacts of a product or service. He reviews empirical studies investigating LCC information on consumer investment decision. KAENZIG (2006) finds that *"existing studies report a positive effect of LCC information on the purchase likelihood of eco-innovations."*
([KAENZIG et al., 2006] , page 121)

Also the literature considers the importance of eco-labeling for an efficient energy behavior.

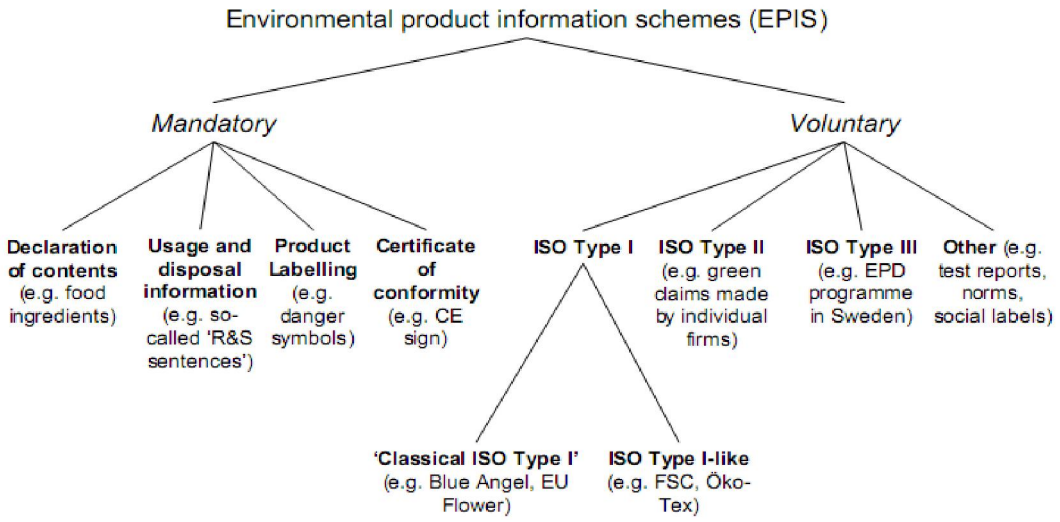


Figure 3. RUBIK (2000) categorization of environmental product information scheme

(Source: [LOCK, 2000] , page 3)

Environmental labeling was introduced by the International organization for Standardization (ISO). There are three types of labeling. The first one provides information on environmental information. The second is self-proclaimed environmental claim (are used by manufacturers, importers, distributors, retailers). The third one *"is quantified environmental data for a product with preset categories of parameters based on the ISO 14040 series of standards "* ([DG Environment, 2002] , page 18).

RUBIK (2000) suggest that *"eco-labels"* to be defined as ISO type one label (Figure 3). They suggest a new classification of labeling, type one should be divided in two groups: *"classical ISO Type I approaches and ISO Type I-like labeling which include the major elements of ISO Type I systems but in some sense differs from the classical type"* ([RUBIK et al., 2006] , page 13). RUBIK (2000) classification provides environmental information to producers and consumers. The environmental information may be administrated: (1) *using specific figures* (for instance the amount of carbon dioxide emissions), or (2) *using qualitative data* to describe certain types of information or (3) by using a *graphically designed methods*. Moreover they argue that the Environmental Product Information Scheme should provide reference to consumer on how to best use a product. RUBIK (2000) concludes that the *success or failures of an eco-labeling scheme is specific for the product group.*

2.4. Common Factors Acting on Sustainable Energy Consumption

The majority of the studies analyzing consumer energy consumption is applied to household and uses concepts from economics, psychology and sociology. These analyses on energy-efficient activities typically consider factors related to: (1) characteristics of occupants, (2) characteristics of the residence, (3) characteristics of the technology, (4) economic factors, (5) weather and climate factors, (6) information diffusion, (7) attitudes/preferences towards the environment ([CARLSSON-KANYAMA et al., 2007])

In the literature there exists an agreement on the classification of the energy-saving measures: (i) low-cost or no-cost measures (consider measures like switching off lights, substituting compact fluorescent lamps for incandescent light bulb) (ii) measures which require capital investment moreover they may require technical changes in the house.

Purchasing a new energy efficient appliance usually does not require technical changes in the house, but purchasing price may be high. DILLMAN [DILLMAN et al., 1983] and LONG [LONG, 1993] for the US, WALSH [MARTISKAINEN, 2007] and FERGUSON [FERGUSON, 1993] for Canada, and MILLS [MILLS et al., 2008] for Germany identifies that people with higher income save more. YOUNG (2008) investigation proved that richer households invest more in energy-efficient appliances [YOUNG, 2008]

Higher levels of education generate greater energy-saving activities
([HIRST et al., 1982]).The economic explanation of this issue is that higher education level reduces the cost of information acquisition.

Social status, lifestyle ([WEBER et al., 2000]) has a strong influence on energy conservation, also higher energy prices may accelerate technological improvements of the energy appliances ([MILLS et al., 2008]).

Younger households adopt more easily new technology, which is usually also more energy efficient ([CARLSSON-KANYAMA et al., 2007]). Also younger people are more familiar with energy saving measures than older people ([MARTISKAINEN, 2007]).

Family size may influence household energy saving. House insulation, household size and composition may be less relevant. In terms of research, the literature provides mixed results ([CURTIS et al., 1984] , [LONG, 1993]).

Large cities tend to be more open to implement and promote environmental policies. Information on energy operating costs is typically transmitted via energy bills. Hence the electricity bill frequency, design and other marketing elements may be relevant. WILHITE (1996) reports that more frequent and more informative billing, results energy savings [WILHITE et al., 1996]

Energy-consumption labels can transfer information on energy performance of appliances. Information on energy-efficient technologies is often transmitted by local campaigns, regional, national and international administrations or institutions, by energy agencies, consumer associations, technology

providers and their associations, or by utilities [SCOTT, 1997] . Information may level the quality of knowledge, but it does not mean that it improved the result in sustained energy savings.

2.5. Conclusions

The objective of this chapter was to review individual consumer decision and its relationship with sustainable consumption. Consumer behavior is defined by individual decisions and is influenced by economic measures or socio-political factors (eco-labels). There is no "one-dimensional" consumer behavior, they from our self-identity, our lifestyle. Hence behavior must be analyzed in a specific context. Once it was underlined that the analyses of the beliefs, norms and values should be pursued in a sustainable consumption context.

Based on the literature review we identified the following factors influencing energy consumer behavior:

1. Characteristics of the households: influenced by age, family members and size, ownership, income, education etc;
2. Characteristics of the building: influenced by the age of the building and location (urban versus rural);
3. Information: Energy bills or energy labels encourage energy saving behaviors. Information credibility is higher if it is administrated by state agency than by utility company;
4. Economic factor: Energy price has a strong influence on reducing energy use. Once it is suggested that higher prices encourage consumers to save more energy (to purchase more energy saving technology) and
5. Attitudes, beliefs, and norms are important, but no author proved that these factors are determinants of energy consumption.

My personal opinion is that the new research should be based on the following questions: Which combinations of intervention techniques give the most effective energy saving results? (For instance: Which is more efficient to the consumer: to save energy or to save CO_2? (Energy saving bulbs or house insulation)). Or how to obtain "long-term" intervention measures for energy savings?

Chapter III - Theory of Planned Behavior

This section is a brief description of the *Theory of Planned Behavior* (TpB). First the application of TpB is presented, followed by the definition of the TpB components and the measurement of the belief based measures.

The aim of the study is to measure the effectiveness of students attending Energy or Environmental courses (or both) with other mass media which simulates the electricity saving behavior. The research framework was based on the *Theory of Planned Behavior* developed by ICEK AJZEN (1985). TpB considers that "*behavioral change is ultimately the result of changes in beliefs"* ([AJZEN, 1991] , page 181). In practice the TpB is used to forecast and explain situation-specific human behavior, for instance the decision to donate blood ([ARMITAGE et al., 2001]) the use of legal and illegal drugs ([ARMITAGE et al., 2001]) but it is also used to predict energy saving behavior [CHEUG et al., 1999] examined the waste paper recycling behavior among college students in Hong Kong. Their results *"reveal that TpB significantly predicted both behavioral intention and subsequent wastepaper-recycling behavior self-reported a month later".*

TpB is useful in predicting student behavior. For instance, BECK (1991) used with success the TpB to analyze student class attendance. *However, we should state that TpB should be used to predict environmental problems rather than college student's behavior!*

Based on the Theory of Planned Behavior human behavior is affected by three equivalent factors: individual beliefs about the consequences of a particular belief (behavioral belief), individual perception about a particular belief (normative beliefs) and *"beliefs about the presence of factors that may facilitate or impede performance of the behavior"*([AJZEN, 2002] , page 1).

They behave in certain characteristic ways: *"behavioral beliefs produce positive or negative attitude toward the behavior, normative beliefs contain the subjective norm or perceived social pressure, and the control beliefs define the level of perceived behavior control. Jointly, attitude toward the behavior, subjective norms and perceived behavior control define the creation of behavioral intention"* ([AJZEN, 2002] , page 1).

Therefore behavioral intention is believed to be the most powerful tool to predict a specific behavior. Intention to apply for a benefit is defined by AJZEN (2002) *"as the degree of willingness one has to engage in a specific behavior."* Specifically *"the more favorable the attitude and the subjective norm and the greater the perceived control the stronger should be the person's intention to perform the behavior in question"* ([AJZEN, 2002] , page 1).

Also if an individual has a sufficient degree of actual control over the behavior AJZEN (2002) considers that perceived behavioral control can act as an assistant for intention, and provide directly to the prediction of behavior [AJZEN, 2002] , page 1).

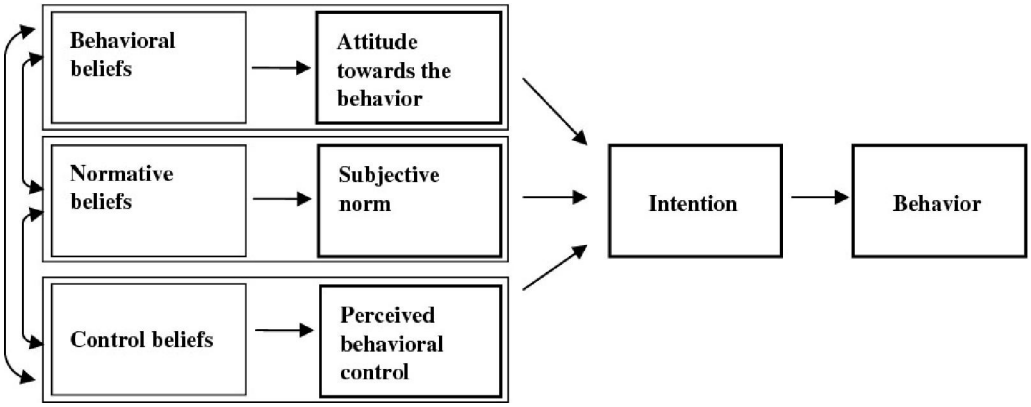


Figure 4. The Theory of Planned Behavior (Source: [AJZEN, 2002] , page 1)

The free determinants of behavioral intention have been further characterized using an expectancy-value model defined by MARIN FISHBEIN (1977).

Attitude toward a fundamental behavior ishh computed, according to Equation 1, by summing up the products of one's behavioral beliefs and their corresponding outcome evaluations.

$$ATB \propto \sum_{i=1}^{n} \left(b_t \times e_t \right)$$

Equation 1. Computation of Attitude toward Behavior (Source: [AJZEN, 2002] , page 10)

Hence ATB is the Attitudinal toward Behavior, b_t is the belief that performing a specific behavior will lead to a desired outcome, and e_t is the individual's evaluation of the positive or negative value of outcome. These are summed over n beliefs, which are the number of significant beliefs an individual holds about performing a specific behavior.

The normative part identifies the individual's perceived social pressure to perform or not perform the behavior. In other words *subjective norms* are one's attitude about the importance of other's belief regarding the performing of a specific behavior.

$$SN \propto \sum_{i=1}^{n} \left(n_i \times m_i \right)$$

Equation 2. Computation of Subjective Norm (Source: [AJZEN, 2002] , page 12)

Specifically *"n_i is the individual's normative belief that a specific person or important group (referent i) thinks that he or she should or should not perform a specific behavior, and m_i is the individual's motivation to comply or not to comply with that particular referent"* ([FISHBEIN et al., 1977] , page 68). These are summed over n normative beliefs that an individual holds about performing specific behavior.

The Perceived Behavioral Control refers to the individual's "confidence that they are capable of performing the behavior under investigation" ([AJZEN, 2002] ,page.6).

The *Perceived Behavioral Control* is calculated as:

$$PBC \propto \sum_{i=1}^{n} \left(c_i \times p_i \right)$$

Equation 3. Computation of Perceived Behavioral Control (Source: [AJZEN, 2002] , page 13)

Where PBC is perceived behavioral control *"c_i is the control belief that a specific factor will facilitate or inhibit the performance of a specific behavior, and p_i is the perceived power of a specific control factor to facilitate or inhibit the performance of the behavior."* ([AJZEN, 2002] , page 13). These are summed over n control beliefs that an individual holds about performing a specific behavior.

In other words, TpB works with three "determinants of behavioral intentions", and these three determinants are deviated from:

(1) "beliefs about the likely consequences of a behavior, and the evaluation of these outcomes (Behavioral Consequences X Evaluation) ([AJZEN, 2002] , page 9).

(2) Beliefs about the normative expectations of important others and the motivation to comply with these expectations (Normative Beliefs X Motivation to Comply)
([AJZEN, 2002] , page 12) and

(3) beliefs about the presence of factors that may facilitate or impede performance, and the perceived power of these factors (Control Beliefs X Motivation to Comply) ([AJZEN, 2002] , page 13)".

AJZEN (2002) considers that the "perceived behavioral control "can serve as a proxy for actual control and contribute to the prediction of the behavior in question" ([AJZEN, 2002] , page 1).

3.1. Statistical Support for the Theory of Planned Behavior

Four classical literature reviews of TpB have demonstrated the theory's predictive power.[ARMITAGE et al., 2001] ARMITAGE et al. (2001), based on nineteen TpB studies, have analyzed the relationship between *Interaction* and *Perceived Behavioral Control*. They found that *"nine (47%) reported evidence of a significant interaction effect. In each case, higher levels of PBC were associated with stronger intention–behavior relationships ([ARMITAGE et al., 2001] , page 475)."*

GODIN AND KOK's (1996) review found that the Perceived Behavioral Control *"contributed a mean additional 13% of variance to the prediction of intentions and 12% to the prediction of behavior"* ([ARMITAGE et al., 2001] , page 475). Particularly findings showed that the attitude toward the behavior and the perceived behavior control were used to predict intention and intention significantly predicted behavior.

AJZEN's (1991) review of the application of TpB resulted "an average multiple correlation of attitude", subjective norm and PBC, with intention of R = .71 (19 correlations), and an average multiple correlation of R = .51 (17 correlations) for prediction of behavior from intention and PBC" ([ARMITAGE et al., 2001] , page 475). The author concluded that the TpB is an effective predictor of both self-reported as well as observed behavior.

NOTANI (1998) based on 36 studies from various domains assessing TpB analyzed the theory robustness and circumstances in which the PBC component predicted behavioral intention and behavior. He concluded *"PBC was a significant determinant of behavior for samples familiar with the behavior, whereas it was not a significant determinant of behavior among samples unfamiliar with the behavior"* ([AMIREAULT et al., 2008] , page 3)

Specifically PBC could be a better predictor with students versus non-students samples!

3.2. Measurement of the Components-Theory of Planned Behavior by the Questionnaire

This part presents the construction of the TpB questionnaire components: the methodology and the scale used to measure the TpB components are described.

A questionnaire on student's electricity saving behavior was constructed based on AJZEN (2002) suggestions in *"Construction of a Standard Questionnaire for the Theory of Planned Behavior"*. AJZEN (2002) underlines the fact that the TpB prediction accuracy depends on *"three antecedents and the intention must be accurately assessed in relation to the focal behavior by following four specific guidelines"* ([AJZEN, 2002] , page 2)." In other words each behavior must be clearly defined in terms of target, action,

context and time. After these terms are clearly defined, indicators of the TpB's constructs can be obtained by questionnaires. Although ***AJZEN (2002) considers "there is no standard* TpB *questionnaire"!***

There are two different belief assessment methods, one direct and one indirect. The indirect method offers the best results concerning individual's underlying cognitive process.

In the following we will present construction of the TpB questionnaire.

Belief: The energy saving behavior is defined in terms of its Target, Action, Context, and Time aspect. One example: *"In the past 2 months, how many times you turned off the lights when you left the room for more than 5 minutes?"* measured on a scale 1-*Never*, 2-*Rarely*, 3-*Quite Infrequently*, 4-*Moderately*, 5-*Quite Frequently*, 6-*Often* and 7-*Always*. Turning off the light is the action element; the room is the target in a general context. The time element refers to the time the behavior is performed, and in this example it is defined as the past 2 month.

Attitude toward the behavior. AJZEN (2002) underlines "dealing with personal or modal accessible beliefs, two questions are asked with respect of the generated outcomes" ([AJZEN, 2002]). In other words two questions should be formulated to measure behavioral belief strength (b) and outcome evaluation (e). Assume that one of the advantages observed is that the energy saving behavior can decrease University expenses. In this case belief strength and outcome evaluation are assessed as follows:

- Behavioral belief strength (b)

"Do you agree with that: Saving electricity at the University will decrease University expenses?" measured on a scale 1-*Never*, 2-*Rarely*, 3-*Quite Infrequently*, 4-*Moderately*, 5-*Quite Frequently*, 6-*Often* and 7-*Always*.

- Outcome evaluation (e)

"How much importance do you give to the following aspects: Decreasing University expenses?" measured on a scale -3-*Not at all important*, -2- *Low Importance*, -1-*Slightly Importance*, 0-*Neutral*, 1-*Moderatly Importance*, 2-*Very Important*, 3-*Extremly Important*.

Subjective norms. AJZEN (2002) suggests that the "assessment of normative beliefs follows a logic similarity to that involved in the measurement of behavioral beliefs"
([AJZEN, 2002] , page 12). Hence two questions should be formulated to measure normative belief strength (n) and motivation to comply (m). In this case normative belief strength and motivation to comply are assessed as follows:

- Normative belief strength (n)

  "Do you think that your parents expect you to perform electricity saving behavior?" measured on a scale 1-*Never*, 2-*Rarely*, 3-*Quite Infrequently*, 4-*Moderately*, 5-*Quite Frequently*, 6-*Often* and 7-*Always*.
- Motivation to comply (m)

"Do you want to have the same electricity saving behavior as your parents?" measured on a scale -3-*Never*, -2-*Rarely*, -1-*Quite Infrequently*, 0-*Moderately*, 1-*Quite Frequently*, 2-*Often* and 3-*Always*.

Perceived behavioral control: AJZEN (2002) considers that two questions should be asked "with respect to each accessible behavior" ([AJZEN, 2002] , page 13). Hence these two questions should be formulated to measure control belief strength (c) and control belief power (p). In this case normative belief strength and motivation to comply are assessed as follows:

- Control belief strength (c)

  "Do you think that the appearance of new TV channel will influence your behavior?" measured on a scale 1-*Never*, 2-*Rarely*, 3-*Quite Infrequently*, 4-*Moderately*, 5-*Quite Frequently*, 6-*Often* and 7-*Always*.
- Control belief power (p)

  "Do you think that mass media will influence your energy saving behavior?" measured on a scale -3-*Never*, -2-*Rarely*, -1-*Quite Infrequently,* 0-*Moderately*, 1-*Quite Frequently*, 2-*Often* and 3-*Always*.

Behavioral intentions: AJZEN (2002) suggest that "several items are used to assess behavioral intentions" ([AJZEN, 2002] , page 4). For instance energy saving behavior was measured by the following questions:

- *"In the past 2 months how many times did you leave the computer in "Safe Mode" when it was not in use?"* measured on a scale 1-*Never*, 2-*Rarely*, 3-*Quite Infrequently*, 4-*Moderately*, 5-*Quite Frequently*, 6-*Often*
  and 7-*Always*.
- *"In the next 2 months how much will you try to leave the computer in "Safe Mode" when it is not in use?"* measured on a scale 1-*Very Improbably*,
  2- *Improbably*, 3- *Somewhat Improbably*, 4- *Neither Probably nor Improbably* 5- *Somewhat Probably*, 6- *Probably*, 7- *Highly Probably*.

3.3. Questionnaire Design

The questionnaire was first prepared in English and translated into Portuguese with small modifications.

The design of the questionnaire was made using Google Documents and the collected data was analyzed using SPSS version 17.

The students from the University of Coimbra are familiar with this type of surveys and with the Likert scale because each time they subscribe to a new study year they are obliged, based on a questionnaire survey with Likert scale, to evaluate their course.

The first twelve questions of the questionnaire are for identifying student background characteristics, namely: specialization, gender, age, marital status, residence, etc.

The following multi optional questions are figuring out the background information for electricity, electricity bill payer or electricity expenses.

In the next section three set of electricity saving behavior questions are directed to the respondents in a seven point Likert scale from "*Never*" till "*Always*".

In what follows six multiple choice questions are asked to understand factors influencing purchase decision.

This is followed by five questions measuring student intention to save electricity. After these twelve questions (six measuring belief strength and six measuring outcome of evaluation) measuring attitude toward behavior are asked in a seven point Likert scale from *Strongly Disagree* till *Strongly Agree*.

Subjective norm is measured by four set of questions (four measuring control belief strength and four measuring control belief power). The responses were treated on a Likert scale from *Strongly Agree* till *Strongly Disagree*.

The questionnaire is ended with some measurement of perceived behavioral control. The responses were treated on a Likert scale from *Always* till *Never*.

3.4. Reliability of the Questionnaire

AJZEN (2002) underlines *"People's attitude toward a behavior can be ambivalent if they believe that the behavior is likely to produce positive as well as negative outcomes. And the same is true for the set of accessible normative beliefs and to the set of accessible control beliefs. Consequently, internal consistency is not a necessary feature for belief-based measures of attitude, subjective norm, and perceived behavioral control."*([AJZEN, 2002] , page 8)

Based on AJZEN (2002) suggestion, no reliability assessment was conducted on the belief-based aspects of the TpB antecedents of attitude, subjective norm and perceived control behavior.

The questionnaire was pre-tested and the Cronbach's alpha internal consistency coefficient estimates was λ=0,847 (N = 63). The normality of the data was analyzed after that some of the questions was removed; in some cases the scale was also changed.

The changed questionnaire was constructed using Google Documents and applied online; during one-month period (between 15th of February 2011 and 15th of March 2011) and 1582 responses were

collected. The results were collected in an excel sheets. After collecting, the data was analyzed by SPSS 17, the statistical package for Windows.

3.5. Conclusion

The purpose of this chapter was to assess the Theory of Planned Behavior. The chapter starts with the brief description of the TpB and its components. The use of the TpB is exemplified with different application areas; the statistical support of the theory is reviewed and the construction of the components is described.

The chapter ends with the presentation of the design and of the reliability of the questionnaire.

Chapter IV – Discussion

4.1. Demographics[4]

The first twelve questions of the questionnaire are for identifying student background characteristics- namely: specialization, gender, age, marital status, residence, etc.

The first question "*Please select your Faculty*" is aimed to identify student specialization. This question was answered by 1570 students[5]. A summary of the responses is as follows: 40.2% of the students are from Faculty of Science and Technology, 24.1% of the students are from Faculty of Economics, 12.8% of the students are from Faculty of Humanities, 8.3% of the students are from Faculty of Medicine, 6.5% of the students are from Faculty of Psychology and Education Sciences, 4.5% of the students are from Faculty of Pharmacy, 1.8% of the students are from Faculty of Law and 1.8% of the students are from Faculty of Sport Sciences and Physical Education. Hence 64.3% (!) of the responses was given by students from Faculty of Economics and students from Faculty of Science and Technology, and the remaining 35.7% was given by students from other Faculties.

The second and third questions were "crucial" questions aimed to identify student access to Environmental or Energy courses[6] (or both). Based on the responses we constructed two sample groups.

The first group consists of students who had access to Energy courses and Environmental courses but also students who had either an Environmental course or an Energy course. The second group consists of students who had no access to Energy course or to Environmental courses.

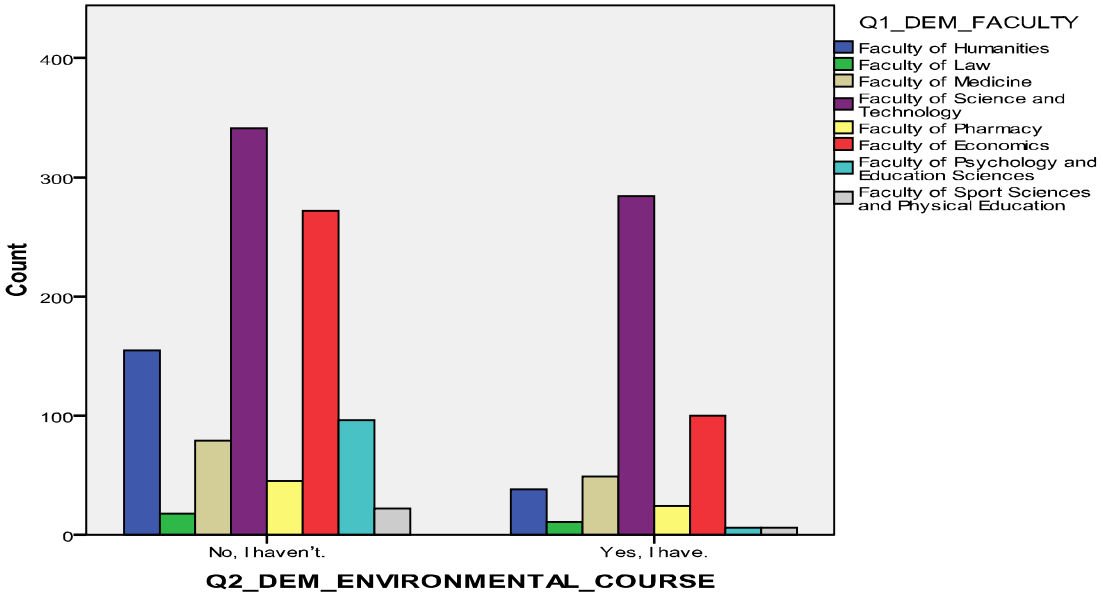
The second question was answered by 1546 students, and the results are: 66.5% of the responses did not have access to environmental courses, and only 33.5% of the answers were positive.

Based on the first question, on student specialization, we identified (verified) the specialization of the students who had Environmental courses. Hence using the Statistical Package for the Social Sciences (SPSS) we constructed a graph based on the student's study area and their access to Environmental Courses. The graph below identifies students from the Faculty of Science and Technology with the most Environmental Courses followed by the students from the Faculty of Economics.

[4] For more information about the Demographics please see the attached CD (Information can be found in Chapter IV/4.1. Demographics)

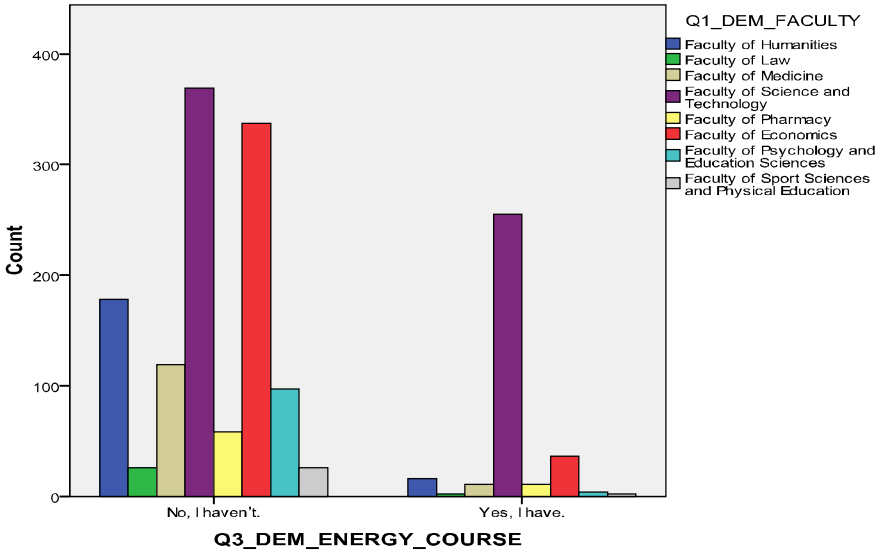
[5] Students could choose between 1- Faculty of Humanities, 2- Faculty of Law, 3- Faculty of Medicine, 4- Faculty of Science and Technology, 5- Faculty of Pharmacy, 6- Faculty of Economics, 7- Faculty of Psychology and Education Sciences and 8- Faculty of Sport Sciences and Physical Education.

[6] Students could response either 1-Yes, I have or 0-No, I haven't.



Graph 1. Student access to Environmental Course based on their study area.

The third question (*"During my studies I have had one or more Energy Course?"*) was answered by 1547 students. The results are as follows: 78.2% of the students did not have access to Energy Courses and only 21.8% of the answers were positive. This statistic identifies two facts: the Faculty of Science and Technology offers the biggest access to energy related lectures and not all students from Departments of Faculty of Science and Technology (for instance Anthropology) have access to energy related courses. Hence the below graph confirms our assumption, several students from Faculty of Science and Technology responded negatively to this question. Furthermore the graph identifies students from Faculty of Economics (for instance: Utilities Management course) and the Faculty of Law having access to energy related courses in contrast with students from the Faculty of Medicine or Faculty of Pharmacy.



Graph 2. Student access to Energy Course based on their study area.

We were also interested to find the number and the specialty of students who had access to Environmental *and* Energy course. This group accounts 224 students; the majority is from the Faculty of Science and Technology. As I mentioned earlier based on the questions two and three we constructed two sample groups: a.) group of students who had access to Environmental or Energy (or both) courses and b.) group of students who had *no* access to Environmental or Energy courses.

Using SPSS, we created the two groups: sample one ("Environmental or Energy (or both)" Group) consisting of 619 students and the second sample ("Others" Group) much larger with 911 students. The difference between the groups is 292 responses.

The fourth question was used to identify the gender of the students. The question was responded by 1560 students, and the results are as follows: 59.4% of the answers were given by female students and 40.6% of the responses were given by male students.

Based on gender we were interested to see the gender distribution of the two groups.

In the first group ("Environmental or Energy (or both)" Group, N = 614 responses) consisting of 47.4% of male students and 52.6% of female students. In the second group ("Others" Group, N = 910 responses) consisting of 36.2% of male students and 63.8% of female students. The first group ("Environmental or Energy (or both)" group) has more male students then the second one, but it has less female students than the second group ("Others" Group).

The questionnaire continued with the question: *"Q5.What is your age?"*. This question was answered by 1539 students and majority of responses was 20 and 21 (N = 409 responses, 25.8%).

In the case of the first group ("Environmental or Energy (or both)" Group, N = 680 responses) the mean was 23.99 age. A more accurate measure of the age is calculated by the mode (identifies the score that occurs most frequently in the data set) and is 22 year. In other words the majority of the students from this group are in third or fourth year (master students) of their study. In the second group ("The Others" Group, N = 897) the mean was 23.67 and the mode 20! Hence the majority of the students are in their first or second year of study.

Question number six aimed to identify the student's marital status. The question was responded by 1548 students choosing between Single or Married. The big majority 93% in this case are single only 7% are married. In the case of the first group ("Environmental or Energy (or both)" Group, N = 610 responses) the responses showed that 94% of the students are single, and only 39 students (6%) are married. Based on marital status we wanted to find out how many of the married students belong to the "Environmental or Energy (or both)" group. We identified sixteen married students from the Faculty of Science and Technology and eleven married students from Faculty of Economics, eight married students from Faculty of Humanities, two from Faculty of Sport Sciences and Physical Education, and two from Faculty of Law and one from Faculty of Pharmacy.

In case of the second group ("Others" Group, N = 906 responses) the responses showed that 93.2% of the students were single and 6.8% were married.

Why is this important? We consider married students to be more responsible for their action than the others.

Question seven *"How many children do you have?"* was answered by 1454 students and the big majority 93.3% has no children, 6.7% of the students have more than one child (This could be true in the previous question only 6.8% of the students stated that they are married!).In the case of the first group ("Environmental or Energy (or both)" Group, N =574 responses) the responses showed that 93.25 of the students have no children, 39 students (6.8%) have more than one children.

Based on specialization, age, and marital status we identified those students who have one or more than one child. Practically only 26 (from 39) are married; eighteen students are from Faculty of Science and Technology and thirteen students are from Faculty of Economics, six from Faculty of Humanities and two student is from Faculty of Psychology and Education Sciences. The mode (the most frequently occurring score) of their age is 34 and the mean age is 35.51. These students could be PhDs or University Professors, Lecturers.

In case of the second group (The "Others" Group, N = 850 responses) the responses showed that 93.6% of the students have no children and 6.4% had one or more children.

Question eight and nine aimed to determine the period of study at the University. Question eight asked *"In what year did you begin your studies?"* This question was answered by 1463 students, the mean of this data set was 1973.67 and the mode was 2009 (215 responses).

In the case of the first group ("Environmental or Energy (or both)" Group, N = 586 responses) the responses showed that the majority of the students started their studies in 2007 (N = 86 responses). We were researching those students (N = 418) who started their studies at the University till 2007. They are from the Faculty of Science and Technology (N = 141), there are single and the mode of their age is 22 years. This could verify the assumption that the majority of these students are in their last year of study.

In the case of the second group ("Others" Group, N = 846 responses) the responses showed that 30.5% of the students stated that they started their studies till 2005.

Question nine *"In what year do you plan to complete your studies?"* was answered by 1466 students; the mean of the data set was 2027.81, and the mode was 2012. In other words the majority of the students who filled in the questionnaire consider finalizing their study between 2011 and 2012.

In case of the first group ("Environmental or Energy (or both)" Group, N = 583 responses) the mean was 2045.68 and the mode was 2011 (28.6%). This proves our assumption that the majority of the students from the first group ("Environmental or Energy (or both)" group) who filled in the questionnaire are in their last year of studies. These students consider ending their studies until 2012 (54.2%). We conducted a research on this group (N = 195 responses) who considers ending their studies until 2011, analyzing their

specialization, age, marital status and the starting year of their studies. First we found out that 20.5% of these students started their studies in 2005. Analyzing their specialization, age and marital status we found that, the majority of the students are from the Faculty of Science and Technology (N = 107), they are single and the mode of their age in 23.

In case of the second group ("Others" Group, N = 851 responses) the responses showed that 90.6% of the students intend to end their studies between 2011- 2015.

Question number ten, aimed to identify the average of the student's grade for the last year. This question was answered by 1310 students, the median is 14 (from 20) and the mode (the most frequently occurring score) is 13 (from 20).

In case of the first group ("Environmental or Energy (or both)" Group, N = 547 responses) the median is 13.00 and the mode (the most frequently occurring score) is 12; 51.5% of the students from the first group ("Environmental or Energy (or both)" Group) have a last year average between 13 and 15. Based on their specialization, age and graduation year we researched students from the first group ("Environmental or Energy (or both)" Group) who have their average between 13 and 15 (N = 273 responses). The majority of students are from Faculty of Science (56.8%) and from Faculty of Economics (15.4%) their age is between 22 and 25; 33.1% of the students consider graduating in 2011.

In case of the second group ("Others" Group, N = 739 responses) the median (the typical score) is 14 and the mode (the most frequently occurring score) is 13; 53.2% of the students have their last year average between 13 and 15.

Question eleven and twelve aimed to identify students who leave in a student residence. Students could choose between "On-Campus Residence" and "Off-Campus Residence". The majority of the responses (N = 1495 responses) indicated that 94.4% of the students leave off-campus residence and only 83 students indicated that they leave on-campus residence.

In case of the first group ("Environmental or Energy (or both)" Group, N = 589 responses) the majority, 95.4% of the students indicated that they leave off-residence and 4.6% (27 students) indicated that they leave in an on-campus residence. Based on specialization, gender, age and graduation year we researched the group of the students (N = 27 responses) who live in a residence. We identified sixteen students from Faculty of Science and Technology, five students from Faculty of Economics and four students from Faculty of Medicine, one from Faculty of Pharmacy and one from Faculty of Humanities; the majority are twenty-three years old, 40% of them considers finalizing their studies until 2011, 56% considers finalizing their studies between 2012 and 2014.

In case of the second group ("Others" Group, N = 877 responses) 94% of the students stated that they live in an off-campus residence and 53 students stated that they live in an on-campus residence. We were interested to find more about these 53 students who did not have access to Environmental or Energy (or both) courses. Sixteen students from Faculty of Science and Technology, fourteen students are from the

Faculty of Economics, eight from Faculty of Humanities, five from Faculty of Medicine, five from Faculty of Pharmacy and five from Faculty of Sport Sciences and Physical Education; 45.1% of students are between 19-20 years old (We assume they are first year students) and 82.4% of the students consider graduating between 2012-2015. The difference between the first group ("Environmental or Energy (or both)" Group) and the second group ("Others" Group) of students based on number of students who leave in the residence is twenty six.

Question twelve aimed to collect the email addresses of the students, for further research. In this case 25 students living in residence shared their email addresses. This means that in the case of the first group of students ("Environmental or Energy (or both)" Group) ten (from 27 students) emails were collected and in the case of the second group of students ("The Others" Group) fifteen (from 53 students) email addresses were received.

4.2. Conclusion – Demographics

Based on the first twelve questions we could characterize (based on the majority of responses) *one* student from each sample group.

The "Environmental or Energy (or both) Student" studies *(maybe)* at the Faculty of Science and Technology, the student is a 22 years old male, is single, started his studies in 2007 and in this year he will graduate. His last year average was 13 and he lives off-campus. The "Other Student" studies *(maybe)* at Faculty of Economics, the student is a 20 years old female, single, started her studies in 2009 and she assumes that she will graduate in 2011. Her last year average was 14 and she lives off-campus.

		Environmental or Energy (or both) Student	**The Other Student**
Specialization		Faculty of Science and Technology	Faculty of Economics
Gender		Male	Female
Age		22	21
Marital Status		Single	Single
Period of Study	**From**	2007	2009
	Until	2011	2012
Last Year Average		13.00	14.00
Residence (on-campus residence or off-campus residence)		Off-Campus	Off-Campus

Table 3. Demographic Profile of Survey Respondents

4.3. Source of Energy Saving Advice[7]

Based on the demographics we were interested to find out from where and how much energy saving information receives the two sample groups. The thirteenth question asked students to choose "*How often you receive "Energy Saving" advice from the following sources?"* In other words we wanted to identify the source and frequency of the energy saving tips received by the students. The sources were: *Internet, TV, Radio, Newspaper, Brochure, Billboard, Flyers* and *Person*. Students could choose between *1-Everday, 2-Per week (1 time), 3-Per week times (2-3 times), 4-Per month (5-6 times), 0-Never.*

Some will observe that the scale per month (5-6 times) is identical with the per week scale (1 times). Let us consider January with 31 days. If a student receives 5-6 times energy saving advice in a month this means after each 6 days he receives one advice per week. The difference between the scales relies in its frequency: you can receive 5 advices in the last week of the month. For more accurate measures two other scales were defined: 4-5 times per week and 1 times per month. Unfortunately the design of the questionnaire (namely the grid in Google Documents allows only 5 columns) limited the size of the scale.

In case of the *Internet* we received 1543 responses. The results are as follows: 31.3% of the students said that they received energy saving advices from the Internet 5-6 times per month and 15.6% of the students said that they receive energy saving advice from the Internet once per week. Almost 30% of the students consider that they don't receive any energy saving advice from the Internet; 14.7% of the students consider that they receive per week two-three times energy saving advice from the Internet and 8.5% of the students considers receiving energy saving advice every day from the Internet.

Hence we could assume that 91.5% of the daily energy saving advice is collected from other sources than the Internet.

In case of the first group ("Environmental or Energy (or both)" Group) we received 611 responses. In this case the 30.9% of the students considered that they receive per month five-six times energy saving advice from the Internet, and only 16.4% of the students considered that they receive energy saving advice from the Internet once per week. Also 13.4% of the students considered that they received per month 2-3% energy saving advice from the Internet, 10.8% of the students considered that they receive energy saving advices from the Internet every day, and only 28.5% of the of the students considered that they never receive energy saving advice from the Internet.

Hence we could assume that 89.2% of the daily energy saving advice is collected from other sources than the Internet.

In the case of the second group (The "Others" group) we received 898 answers. In this case 31.6% of the students reported that they receive energy saving advice from the Internet five-six times per month, and

[7] For more information about the Energy Saving Advice please see the attached CD (Information can be found in Chapter IV/4.3. Energy Saving Advice)

seventeen percent of the students reported that they receive energy saving advice from the Internet once a week. Only fifteen responses differ in the option receiving energy saving advice once per week (15%) and receiving energy saving advice two-three times per week (15.4%). Only seven percent of the students reported that they receive energy saving advice everyday (in the case of the first group this percentage was 10.8) and 31% of the students considered that they don't receive energy saving advices.

Hence we could assume that 93% of the daily energy saving advice is collected from other sources than the Internet.

The second source of energy saving advice was considered to be the *television*. In this case we received 1541 responses. In this case 27.3% of the students considered that they receive energy saving advice from television five-six times per month, 21% of the students considered that they receive energy saving advice from television once per week or two-three times per week and 24.7% consider receiving energy saving advice 2-3 times per week. Only 16.7% of the students reported that they receive everyday energy saving advice from television, and only 10.3% consider that they did not received any energy saving advice from TV.

Hence we could assume that 85.6% of the daily energy saving advice is collected from other sources than the television.

In case of the first group ("Environmental or Energy (or both)" Group) of students we received 609 responses. In this case 22.7% of the students considered that they receive energy saving advice from TV two-three times per week but also 27.3% of the students considered that they receive energy saving advice from TV five-six times per month and 23.3% of the students considered that they receive energy saving advice from TV once per week. Only 17.1% of the students considered that they receive energy saving advices from TV every day and 9.7 % of the students considered that they don't receive any energy saving advice from TV.

We can assume that 82.9% of the daily energy saving advice is collected from other sources than the television.

In the case of the second group ("Others" Group, N = 898 responses) of students we identified that 27.6% of the students consider that they receive energy saving advice from television five-six times per month, 19.6% of the students consider that they receive energy saving advice from television once per week and 25.9% of the students consider that they receive energy saving advice from television two-three times per week. Also 16.6% of the students considered that they receive energy saving advice from the TV every day and only 10.2% of the students considered that they don't receive energy saving advices from the TV.

Hence we could assume that 83.4% of the daily energy saving advice is collected from other sources than the television.

The third source of energy saving advice was considered to be the *radio*. We received 1531 responses the results are as follows: 35.7% of responses were negative, 26.5% of the student answered that

they receive energy saving advices from radio five-six times per week, 16.7% considered that they receive energy saving advices from the radio once per week, and 15.9% considered that they receive energy saving advices two-three times per week from the radio and 5.2% of the students considered receiving everyday energy saving advices from the radio.

Hence we could assume that 94.8% of the daily energy saving advice is collected from other sources than the radio.

In the case of the first group of students ("Environmental or Energy (or both)" Group) from 606 students 34% considered that they do not receive energy saving advices from the radio. Also 27.9% of the students considered that they receive energy saving advice from the radio five-six times per week, 17.3% of the students considered that they receive energy saving advice from the radio once per week, 15.2% of the students considered to receive energy saving advice from radio two-three times per week and 27.9% of the students considered receiving energy saving advice from radio every day.

We can assume that 95.3% of the daily energy saving advice is collected from other sources than the radio.

In the case of the second group (The "Others" Group) from 899 students 328 students (36.8%) percent considered that they never receive energy saving advice from radio. However 25.5% of the students considers receiving energy saving advices from radio five-six times per month, 16.4% of the students state that they receive energy saving advices from the radio two-three times per week, 16.4% of the students receive energy saving advices from radio once per week and 36.8% of the responses state that they never receive energy saving advices from the radio and 4.9% receive everyday energy saving advice from the radio.

We could assume that 95.1% of the daily energy saving advice is collected from other sources than the radio.

The fourth source for energy saving advice was considered the *newspaper*. From 1522 answers more that 31.1% of the students receive per month five-six times energy saving advice from the newspaper. Moreover, 19.1% of the students receive energy saving advice from newspaper once per week and 17% of the students receive energy saving advices from the newspaper two-three times per week. This statistics indicate that they receive more energy saving advice from newspaper than from the Internet.

However 28.1% of the students considered that they never receive energy saving advice from newspaper and only 4.8% of the students considered receiving everyday energy saving advice from it.

Hence we could assume that 95.2% of the daily energy saving advice is collected from other sources than the newspaper.

In the case of the first group 600 answers were collected, and 32.7% of the students receive energy saving advice from the newspaper five-six times per month. Moreover 19.1% receive energy saving advice from the newspaper at least once per week and 17% receive energy saving advice from newspaper two-three

times per week. A significant number of students (26%) considered that they never receive advice of energy saving measures from the newspaper and only 4.7% of the students receive energy saving information from the newspaper every day.

Hence we could assume that 95.3% of the daily energy saving advice is collected from other sources than the newspaper.

The second group of students (N = 889 responses) considered that 29.8% receive energy saving advice from newspaper five-six times per month, 18.7% consider that they receive energy saving advice from newspaper 1 time per week, 17.2% of the students receive energy saving advice from the newspaper two-three times per week. 260 students (29.2%) consider that they do not receive energy saving advice at all from the newspapers and only 5.1% of the students receive energy saving advice from the newspaper every day.

Hence we could assume that 94.9% of the daily energy saving advice is collected from other sources than the newspaper.

For the fifth source for advising energy saving measures we considered the *brochure.* Brochures can commonly be found in major shops, or in hospitals (here they are called pamphlets). From 1509 responses 45% stated that they have never received energy saving advices from brochures. However 34.8% received energy saving advice from brochure at least five-six times per month, 10.8% received energy saving advices two-three times per week, 8.5% received energy saving advice once per week. Only thirteen (optimistic) students (0.9%) receive energy saving advice from brochures every day.

We could assume that 99.1% of the daily energy saving advice is collected from other sources than a brochure.

Almost half of students of the first group ("Environmental or Energy (or both)" Group, N = 591 responses), more exactly 43.3% considered that they never receive energy saving advice from a brochure, however 35.5% responded that five-six times per month they received advice from the brochures. Only 8.5% of the students receive energy saving advice from brochure once a week, 70 students (11.8%) receive energy saving advice from brochure two-three times per week, and five students 0.8% receive everyday energy saving advice from brochure.

We can assume that 99.2% of the daily energy saving advice is collected from other sources than brochures.

In the case of the second group ("The Others" Group, N = 885) 406 students (45.9%) considered that they have never received energy saving advices from brochures, but also 34.5% of the students received energy saving advices five-six times per month. A small number of students, 8.8% responded that receive energy saving advices from brochures once per week, and 9.9% of the students receive energy saving advice two-three times per week and eight students (0.9%) received energy saving advice from brochure every day.

We could assume that 99.1% of the daily energy saving advice is collected from other sources than brochure.

The fifth source for energy saving advice was the *billboard.* Billboards are highly visible; they usually present large advertisements to pedestrians or drivers. From 1519 responses 49.4% were negative about receiving energy saving advice from a billboard. However 25.4% of the students considered that they receive five-six times per month energy saving advice from a billboard, 12.2% of the students considered receiving two-three times per week energy saving advice from a billboard, ten percent of the students receive energy saving information from billboards once per week and three percent of the students receive energy saving advice from billboards every day.

We can assume that 97% of the daily energy saving advice is collected from other sources than billboards.

In case of the first group ("Environmental or Energy (or both)" Group, $N = 600$) a number of 281 students (46.8%) considered that they never receive energy saving advices from billboards, and 25.5% received energy saving advice from a billboard five-six times per month. Also 14.3% of the students receive energy saving advice from a billboard two-three times per week, 9.8% of the students receive energy saving advice from a billboard once per week and 3.5% of the students receive energy saving advice from a billboard every day.

We could assume that 96.5% of the daily energy saving advice is collected from other sources than billboards.

The big majority of the second group 51.4% (The "Others" Group, $N = 886$ responses) considered that they do not receive any energy saving measures from billboards but also 25.1% of the students considered that they receive energy saving advice from a billboard five-six times per month. Moreover 10.3% of the students receive energy saving advice from the billboard once per week and 10.6% of the students receive energy saving advice from billboard two-three times per week. A number of twenty four students (2.7%) receive energy saving advice from the billboard every day.

We can assume that 97.3% of the daily energy saving advice is collected from other sources than billboards.

As the sixth source for energy saving advice we considered the *flyers*. Typically used by individuals for advertisement or for the promotion of a product, flyers are an inexpressive way to direct marketing.

Thus from 1517 responses 40.3% of the students considered that they do not receive energy saving advices from flyers, and 36.7% received energy saving advice from flyers five-six times per month. Also 12.1% of the students received energy saving advices from flyers two-three times per week, 9.7% received energy saving advice from flyers once per week and more than one percent (1.3%) receives energy saving advices from flyers every day.

We can assume that 98.7% of the daily energy saving advice is collected from other sources than flyers.

In the case of the first group ("Environmental or Energy (or both)" Group, $N = 599$) 39.1% of the students consider that they never receive energy saving advice from flyers, but 37.1% of the students receive five-six times per month energy saving advice from flyers. Also a number of 77 students (12.9%) receive energy saving advice from flyers two-three times per week, 9.6% receive energy saving advice from flyers once per week but only 1.2% (seven students) receives energy saving advice from flyers every day.

Hence we could assume that 98.3% of the daily energy saving advice is collected from other sources than flyers.

In the second group of students ("The Others" Group, $N = 886$) 40.4% of the responses considered that they never receive energy saving advice from flyers but 36.9% receive energy saving advice from flyers five-six times per month. Also 11.5% of the students receive energy saving advice from flyers 2-3 times per week, 9.8% receive energy saving advice from flyers once per week and 1.4% of the students receive energy saving advice from flyers every day.

Hence we could assume that 98.6% of the daily energy saving advice is collected from other sources than flyers.

The last source of energy saving advice was considered to be a third-party person. In this case 1527 responses were received, 31.4% of the students receive energy saving advice from a third-party five-six times per month, 18% of the students receive energy saving advice from a third-party once per week, and 18.9% of the students receive energy saving advice two-three times per week.

However 21.8% of the students consider that they never receive energy saving advice from a third-party person and 9.8% receive energy saving information every day.

We can assume that 90.2% of the daily energy saving advice is collected from other sources than from third-party persons.

The "Environmental or Energy (or both)" Group (the first group, $N = 607$ responses) 31.6% receive energy saving advices from a third-party five-six times per week, 17.8% receive energy saving advices from a third-party once per week and 20.3% receive energy saving advices two-three times per week. Only 19.8% of the students consider that they do not receive energy advice from a third-party person and 10.5% of the students receive energy saving advice from this source every day.

We can assume that 89.5% of the daily energy saving advice is collected from other sources than from third-party persons.

In the case of the second group ("The Others" Group, $N = 888$ responses) 31.5% of the students receive energy saving advices from a third-party person five-six times per week, 17.9% receive energy saving advices two-three times per week and 18.1% receive energy saving advices from this source once per week.

More than 23% of the students consider that they do not receive energy advice from a third-party and 9.3% of the students receive energy saving advice from this source every day.

We can assume that 90.7% of the daily energy saving advice is collected from other sources than from third-party persons.

4.3. Conclusion - Source of Energy Saving Advice

The findings are summarized in the table below (Table 4.). In the case of the first group ("Environmental or Energy (or both)" Group), students have never received energy saving advices from billboard or from brochures. They receive energy saving information from television, from another person or from the Internet every day. During the week they receive advice on energy saving from television, from a person or from a newspaper. However considering the long term, the highest number of energy saving advices is collected from flyers, brochures or from newspapers (printed media).

In the case of the second group students had never received energy saving advices from a billboard, brochure or flyers. They receive energy saving information daily from the television, a person or from the newspaper. Once per week they receive advice from the television, newspaper or from the Internet. During the week they receive at least two-three times advice from the television, from a third party or from the newspaper. However, on the long term the biggest amount of energy saving advice is collected from flyers, brochures or internet. Both groups of students receive few advices with daily frequency.

	Environmental or Energy Group (or both)						The Others Group					
	N	Never (%)	Everyday (%)	Per Week 1 time (%)	Per Week 2-3 times (%)	Per month 5-6 times (%)	*N*	Never (%)	Everyday (%)	Per Week 1 time (%)	Per Week 2-3 times (%)	Per month 5-6 times (%)
Internet	611	28.5	**10.8**	16.4	13.4	30.9	898	31	**7**	15	15.4	**31.6**
TV	609	9.7	**17.1**	**23.3**	**22.7**	27.3	898	10.2	**16.6**	**19.6**	**25.9**	27.6
Radio	606	34	5.6	17.3	15.2	27.9	891	36.8	4.9	16.4	16.4	25.5
Newspaper	600	26	4.7	**19.7**	**17**	**32.7**	889	29.2	5.1	**18.7**	**17.2**	29.8
Brochure	591	**43.3**	0.8	8.5	11.8	**35.5**	885	**45.9**	0.9	8.8	9.9	**34.5**
Billboard	600	**47.6**	3.5	9.8	14.3	25.5	886	**51.4**	2.7	10.3	10.6	25.1
Flyers	599	**39.1**	1.2	9.8	12.9	**37.1**	886	**40.4**	1.4	9.8	11.5	**36.9**
Person	607	19.8	**10.5**	**17.8**	**20.3**	31.6	888	23.1	**9.3**	**18.1**	**17.9**	**31.5**

Table 4. Summary of the Energy Saving Advice Frequency

4.4 Electricity Bill Payer[8]

The survey continued with the question *"Are you the person who usually pays the electric bill in the house?"* The question was responded by 1508 students, 35.7% were positive (539 responses) and 64.3% were negative (969 responses).

In the case of the first group ("Environmental or Energy (or both)" Group) from 598 responses 36.6% are electricity bill payer and 63.4% are not. In the case of the second group ("The Others" Group) from 461 responses 34.2% are electricity bill payer and 64.9% are not.

We were researching students who pay their electricity bill from the first group ("Environmental or Energy (or both)", $N = 219$) based on specialization, age, marital status, graduation year and energy saving advice.

Based on their specialization the majority is from Faculty of Science and Technology (130 students) 59.4% and Faculty of Economics (37 students) 26.7%. The mode (the most frequently occurring score) of their age is 23 and the mean is 26.57. The majority is single 85% and only 15% are married. More than 30% of the students consider graduating in 2011, and more 77% of the students consider graduating between 2011 and 2013. They receive energy saving advice from the television, the Internet or from a person every day. Once per week they find advice on energy saving on the television, from a person or in a newspaper. During the week they receive at least 2-3 times energy saving advice from the television, from the radio or from a third party-person. However for long term the biggest amount of energy saving advice is collected from flyers, internet or brochures.

Question fifteen is an open question aimed to identify the electricity bill payer. Hence students ($N = 1582$ responses) were asked to name their relative who pays their electricity bill. The big majority of the students did not answer this question however the responses pointed out that 55.3% of the electricity bill is paid by students families (father, mother, sister, brother, etc.), 3.1% t of the students name their landlords as their electricity payer.

In the case of the *first group ("Environmental or Energy (or both)" Group, N = 619 responses) 55.9% of the electricity bill is paid by the family, 19 students have their electricity bill included in their room rent.* In the case of the *second group ("The Others" Group, N = 911 responses) the 55.9% of the students named their electricity bill payer to be one member for their families, and only 3.2% of the students pay their electricity together with room rent.*

Question sixteen aimed to identify student awareness of the electricity bill expense. Hence students were asked to rate their electricity bill size in their expenses[9]. From 1529 responses, *the majority 54.2%*

[8] For more information about the Electricity Bill Payer please see the attached CD (Information can be found in Chapter IV/4.5. Electricity Bill Payer)

[9] Students could choose between 1- Between 5% - 25%, 2- Between 25% - 50%, 3- Over 50% and 0- I don't know.

considered that the electricity bill rate in their expenses is between 5%-25%, 30.6% of the students responded with "I don't know", 12.8% of the students considered that the rate of the electricity bill in their expenses is between 25%-50% and 36 students considered that the rate of their electricity bill in their expenses is more than 50%.

However is hard to believe that the electricity bill weighs more than 25% in student expenses, therefore 15.2% of the responses are incorrect. *Hence the percentage of the students who cannot weigh exactly their electricity bill in their expenses is 45.8% (from 1521 students!)*

In the first group ("Environmental or Energy (or both)" Group, N = 601 responses) 54.6% of the students considered that the rate of their electricity bill in their expenses is between 5%-25%, 29.5% of the students responded with "I don't know" and 13% of the students considered that the rate of their electricity bill in their expenses is between 25%-50% and eighteen students consider that that the rate of their electricity bill in their expenses is between 50%.

Hence we could assume that *45.5% of the students belonging to the first group could not estimate their electricity bill expenses correctly (accounting also the responses given as "I don't know").*

In the case of the second group (The "Others Group", N = 887 responses) more than half (53.7%) of the students considered that the electricity bill rate in their expenses is between 5%-25%, 31.6% of the responses were negative; 12.7% consider that the rate of their electricity bill in their expenses is between 25%-50% and 18 students (2%) consider that the rate of their electricity bill in their expenses is more than 50%.

Hence in the case of the second group we could assume that 46.3% of the students could not estimate their electricity bill expenses correctly.

We researched those students belonging to the "Environmental or Energy (or both)" Group, who considered that the rate of their electricity bill in their expenses is between 25%-50% or over 50% based on their specialization, age, marital status, end of study, average, place of residence and electricity saving advice. Based on specialization the majority of the students (N = 96 responses) are from Faculty of Science and Technology (60.4%) and 18.8% are from Faculty of Economics, the mode (most frequently occurring score) of their age is 22 and the mean is 25.20 year. Two students are married the others are single, 33.6% of the students consider graduating in 2011 and 78.5% between 2011 and 2013. Their last year average means is 13.16 (the mode 12) and their leave off-campus residence (97.9% off-campus residence). Their daily energy saving advice is from the television (22.1%), from a person (9.4%) and from the internet (11.5%).

I assume that those students who belong to the first group ("Environmental or Energy (or both)" Group) and who could estimate correctly their electricity bill expense have better averages as the students who missed the estimation.

Thus the result showed the majority of the students 48.6% has their last year average between 14-18 and 56.1% of the students from the first group who mismatched the rate of their electricity bill in their expenses has their last year average between 10-13.

Hence we could assume that students with higher last year average have a better estimation of energy saving efficiencies.

We were interested to see the difference between students who live in University residences and those who don't in estimation of their electricity bill weigh in their expenses.

Only 27 students from 80 (11 students belonging to the "Environmental or Energy (or both)" Group and 16 students belonging to the "Others group") who live in the residence could rate correctly their electricity bill expenses. *In other words 66.25% of the students who live on-campus residence cannot rate correctly their electricity bill.*

In the case of the students who live off residence from 824 responses 742 students responded correctly (298 students from the first group "Environmental or Energy (or both)" Group and 444 students from the second group).

Moreover 42.6% of the students who live off campus residence cannot rate correctly their electricity bill.

4.5 Conclusion Electricity Bill Payer

Hence we can conclude that in the first student group ("Environmental or Energy (or both)") the electricity bill is paid by a family member, but he is familiar with the electricity bill expense.

In the case of the second student group (The "Others") she also lives off-campus residence, the electricity bill is paid by a family member, and she has a relative idea on the rate of their electricity bill in her expenses.

4.6. Choice between Traditional Light Bulb and Energy Saving Light Bulb[10]

Question twenty asked students if they have bought energy saving bulb. Only 6% (95 students) from 1546 responses were negative. In the case of the first group ("Environmental or Energy (or both)" Group) from 609 responses 94.7% were positive and in the case of the second group ("The Others" group) from 903 responses 93.2% were positive. The questionnaire continued with a set of question aimed to identify those characteristics (factors) of the energy-saving light bulb that could have an influence on students buying

[10] For more information about the Choice between Traditional Light Bulb and Energy Saving Light Bulb see the attached CD (Information can be found in Chapter IV/4.7. Choice between Traditional Light Bulb and Energy Saving Light Bulb)

decision. We considered that based on the variety of the targeted sample and type of question a three type Likert scale is sufficient to capture the required information.

The findings are summarized in the table below (Table 5.). *Hence from 1468 responses 37.4% of the students considered that energy saving light bulbs are more expensive than traditional light bulbs, 38.4% of the students could not decide if energy saving light bulbs is more expensive than the traditional light bulbs and 24.2% of the students consider that energy saving light bulbs is more expensive than traditional light bulbs.* If we compare the price of an energy saving light bulb with a traditional light bulb we find that the energy saving light bulbs price could double the price of the traditional light bulbs.

Hence the energy saving light bulb is more expensive than the traditional light bulbs. Based on the responses we can conclude that 75.8% of the students consider that the price of an energy saving light bulbs has low importance in purchase decision (the acquisition frequency maybe low).

Also 42% of students consider that the shape, or the *design of the energy saving light bulb* may alternate their buying decision. Based on light bulbs *energy saving performance, efficiency, eco-friendliness and quality* students choice is for the energy saving light bulb.

	Environmental or Energy Group (or both) (Energy Saving Light Bulb vs. Traditional Light Bulb)				**The Others Group (Energy Saving Light Bulb vs. Traditional Light Bulb)**			
	N	**Disagree (%)**	**Undecided (%)**	**Agree (%)**	***N***	**Disagree (%)**	**Undecided (%)**	**Agree (%)**
Price (are cheaper?)	580	23.8	**38.4**	37.8	857	**37.3**	**37.8**	24.9
Design (has a better design?)	564	19	**41.5**	**39.5**	840	21.2	**40.8**	**38**
Eco-friendly product (has a better environmental performance?)	563	2.5	15.5	**82.1**	838	3	16.8	**80.2**
Efficiency (save more energy?)	559	0.5	14	**85.5**	839	1.2	17.3	**81.5**
Expected Life (last longer?)	556	4.1	31.1	**64.8**	837	5.9	35.4	**58.8**
Quality (are of better quality?)	571	5.6	38	**56.4**	843	8.1	41.0	**50.9**

Table 5. Summary of the Results of the Choice between Traditional Light Bulb and Energy Saving Light Bulb

4.7. Conclusion - Choice between Traditional Light Bulb and Energy Saving Light Bulb

Hence in the case of the first group ("Environmental or Energy (or both)" Group), student choice for an energy saving light bulb is influenced by the product environmental performance, efficiency and expected life. Price or designs are secondary factors that influence the choice for an energy saving light bulb.

In the case of the second group (The "Others" Group), student choice for an energy saving light bulb is influenced by the product environmental performance, efficiency and expected life. Price, designs or quality are secondary factors that influence the choice for an energy saving light bulb.

Chapter V - Determinants of Students Energy Savings: An Application of the Theory of Planned Behavior[11]

The questionnaire was designed to predict student intention in saving energy. What we want to research is whether student intention in energy saving could be broken down into specific forms of attitudes, norms or beliefs.

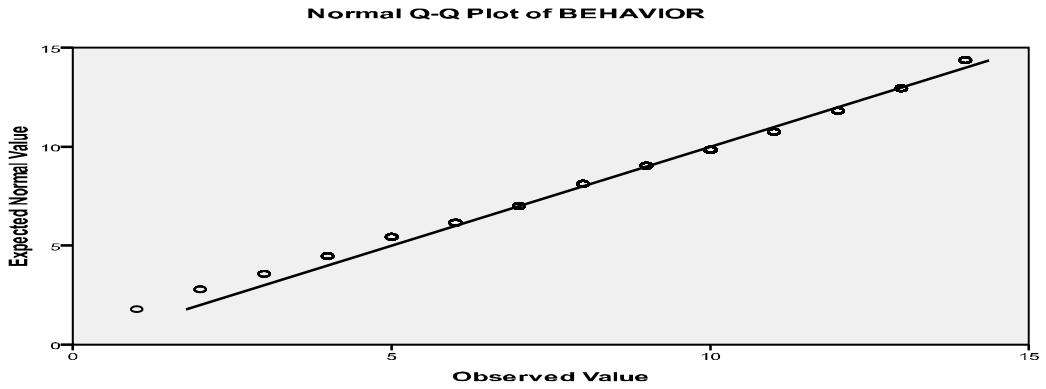
The questionnaire reliability (measured by 34 items, measuring intention, behavior and beliefs) was Cronbach's Alfa .819

5.1. Energy Saving Behavior

Energy saving behavior was measured by three questions (2 actions: turn off the lights and set computer in safe mode) on a scale from 1 (*Never*) to 7 (*Always*)[12]: Q_{17} (*"In the past 2 months, how often did you turn off the lights when you left the room for more than 5 minutes?"),* Q_{18} (*"In the past 2 months, how many times did you turn off the lights before leaving a room?"*) and Q_{19} (*"In the past 2 months, how many times did you leave the computer in "Safe Mode" when it was not in use?"*).

To measure the energy saving behavior the means of the Q_{17} and the Q_{19} were summed[13].

The means indicate a positive behavior (Between Moderate and Quite Frequent) to save energy.



Graph 3. The Q-Q Plot of the Energy Saving Behavior (N = 1582 responses)

[11] Additional information available on CD (Folder: Chapter V- Determinants of Students Energy Saving Behavior)

[12] The Likert scale of the energy saving behavior is: 1-Never, 2-Rarely, 3-Quite Infrequent, 4-Moderate, 5-Quite Frequent, 6-Often, 7-Always

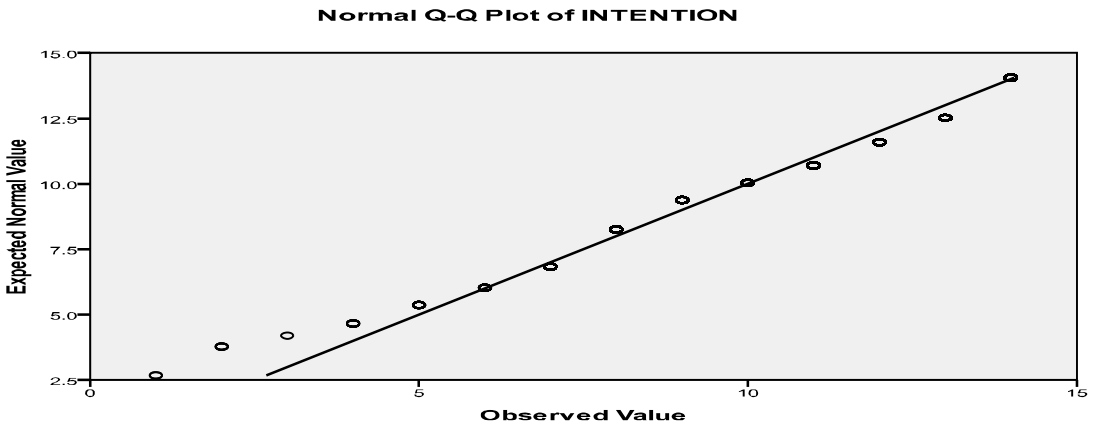
[13] Icek Ajzen suggestion how to analyze complex behaviors: "*I am studying a category of behaviors, not a single action. How can I apply the TPB to a behavioral category? We are often interested in predicting, explaining, or changing categories of behavior, such as exercising, studying, or conserving energy -- not any single action. It is possible to deal with such a criterion by assessing attitudes, subjective norms, perceptions of control, intentions, and actual behavior with respect to each of a representative set of actions that comprise the category of interest. These measures can then be aggregated to arrive at indices representing the behavioral category.*" (Source: Icek Ajzen FAQ http://www.people.umass.edu/aizen/faq.html)

5.2. Energy Saving Intention

The energy saving intention was measured by five questions on a scale from 1 *(Very Improbable)* to 7 *(Very Probable*[14]*)*: Q_{27} (*"In the next 2 months how much will you try to turn off the lights when you leave room for more than 5 minutes?"),* Q_{28} (*"In the next two months how much will you try to turn off the lights before leaving the room?"),* Q_{29} (*"In the next two months how much will you try to leave the computer in "Safe Mode" when it is not in use?"),* Q_{30} (*"In the next two months how much will you try to turn on the lights when you leave the room?")* and Q_{31} (*"In the next two months how much will you try to leave the computer on when you leave the room?"*).

The average results of Q_{27} and Q_{29} were summed up to measure the student's energy saving intention.

The means indicate a positive intention (between Somewhat Probable - Probable) to save energy. The distribution of the intention data is leptokurtic (positive kurtosis) indicating a relatively peak distribution (because of the large sample size).



Graph 4. The Q-Q Plot of Intention (N = 1582 responses).

5.3. Energy Saving Attitude (Indirect Measures)

AJZEN (2001) considers "*The belief strengths and outcome evaluations for the different accessible beliefs provide substantive information about the attitudinal considerations that guide people's decision to engage or not to engage in the behavior under consideration"*. Moreover they are used "to compute an indirect measure of attitude towards the behavior" ([AJZEN, 2002] , page 10).

[14] The Likert scale of the energy saving intention is: 1-Very Improbable, 2- Improbable, 3-Somewhat Improbable, 4-Neither Probable nor Improbable, 5-Somewhat Probable, 6-Probable and 7-Very Probable

In other words the attitude towards behavior indicates individual positive or negative feeling towards the behavior.

Belief strength was measured by six questions on a scale from 1 *(Strongly Disagree)* to 7 *(Strongly Agree)*[15]: Q_{32} (*"Do you agree with: Saving electricity at the university will decrease university's expenses?"*), Q_{33} (*"Do you agree with: saving electricity at the university will make us an example for other universities?"*), Q_{34} (*"Do you agree with saving electricity at the university will help to preserve natural resources?"*), Q_{35} (*"Do you agree with saving electricity at the university will decrease the import of electricity from neighboring countries?"*), Q_{36} (*"Do you agree with saving electricity at the University will help to reduce our carbon emission?")* and Q_{37} (*"Do you agree with saving electricity at the university will improve the national balance of payment?"*).

Behavioral beliefs are measured by six questions on a scale from -3 *(Not at all important)* to +3 *(Extremely Important)*[16]: Q_{38} (*"How much importance do you give to decreasing university expenses?"*), Q_{39} (*"How much importance do you give to the following: serving as an example to other universities?"*), Q_{40} (*"How much importance do you give to the following aspect: preserving natural resources?"*), Q_{41}(*"How much importance do you give to the following aspect: decreasing the import of electricity from neighboring countries?"*), Q_{42} (*"How much importance do you give to the following aspect: reducing our carbon emission?"*), and Q_{43} (*"How much importance do you give to the following aspect: improving the national balance of payment?"*)

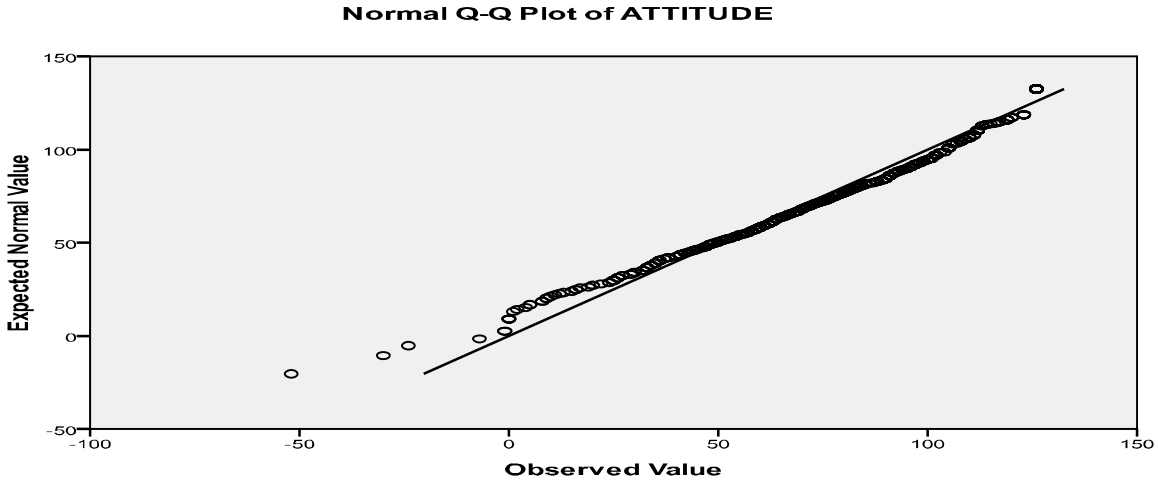
The indirect measures of the attitude towards energy saving[17] *was calculated as: "belief strength multiplied by the outcome of the evaluation, and the resulting product is summed over all accessible behavioral outcomes" ([AJZEN, 1991] , page 10).*

The average results indicate certainty towards energy saving behavior. The distribution of the indirect measure of attitude toward energy saving is leptokurtic (positive kurtosis) indicating a relatively peak distribution (because of the large sample size).

[15] The Likert scale of the Attitude Belief Strength : 1-Strongly Disagree, 2- Moderately Disagree, 3-Slightly Disagree, 4-Neurtral, 5-Slightly Agree, 6-Moderatly Agree and 7-Strongly Agree (Slightly is a synonym for HARDLY)

[16] AJZEN (2002) on bipolar scaling "…outcome evaluations should receive bipolar scoring because the low end of the scale represents a negative evaluation of the outcome and the high end a positive evaluation. A similar argument, however, cannot be made with respect to the measure of belief strength."([AJZEN, 2002] , page 10)

[17] The Likert scale of the Attitude Belief Strength : 1-Strongly Disagree, 2- Moderately Disagree, 3-Slightly Disagree, 4-Neutral, 5-Slightly Agree, 6-Moderatly Agree and 7-Strongly Agree (Slightly is a synonym for HARDLY)



Graph 5. The Q-Q Plot of Attitude toward Energy Saving
(Indirect Measures, N = 1582 responses)

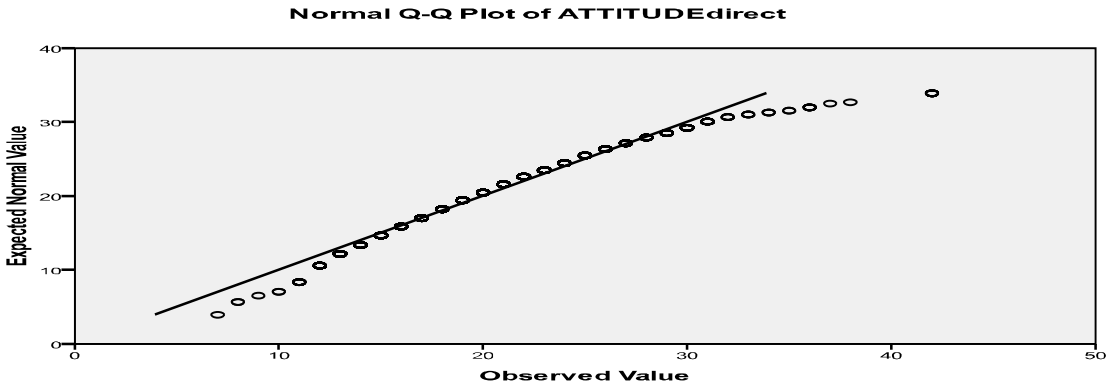
5.4. Energy Saving Attitude (Direct Measures)

Attitude towards energy saving is also measured directly by six questions on a scale[18] from 1 *(Strongly Disagree)* to 7 *(Strongly Agree)*: Q_{44} (*"Do you agree with: energy efficiency should be a school priority?"*), Q_{45} (*"Do you agree with: the current economic recession is more of worry for me than energy saving at university?"*), Q_{46} (*"Do you agree with: electricity saving is a Government responsibility, not the responsibility of students?"*), Q_{47} (*"Do you agree with: since students don't pay the university's electricity bill, we don't need to save electricity?"*), Q_{48} (*"Do you agree with: electricity saving at the university will not increase the quality of education?"*) and Q_{49} (*"Do you agree with: I cannot see the obvious benefits of electricity saving at the university?"*).

These six questions are summed up to estimate the attitude towards energy saving.

The means tend to be between Moderately Disagree and Neutral, slightly negative scale, indicates a certain uncertainty towards energy saving measures.

[18] The Likert scale of the Attitude Belief Strength : 1-Strongly Disagree, 2- Moderately Disagree, 3-Slightly Disagree, 4-Neutral, 5-Slightly Agree, 6-Moderatly Agree and 7-Strongly Agree (Slightly is a synonym for HARDLY)



Graph 6. The Q-Q Plot of Attitude toward Energy Saving
(Direct Measure, N = 1582 responses)

The distribution of the direct measure of attitude towards energy saving is leptokurtic (positive kurtosis) indicating a relatively peak distribution.

5.5. Subjective Norm

The calculation of the normative beliefs is similar to the measurements of behavioral beliefs. Two questions are asked to measure normative belief strength and motivation to comply.

Normative beliefs are measured by four questions on a scale[19] from 1 *(Never)* to 7 *(Always)*: Q_{50} (*"Do you think that your parents expect you to perform electricity saving behavior?"*), Q_{52} (*"Do you think your professors expect you to perform electricity saving behavior?"*), Q_{54} (*"Do you think that your colleagues expect you to perform electricity saving behavior?"*) and Q_{56} (*"Do you think that the University staff expect you to perform electricity saving behavior?"*).

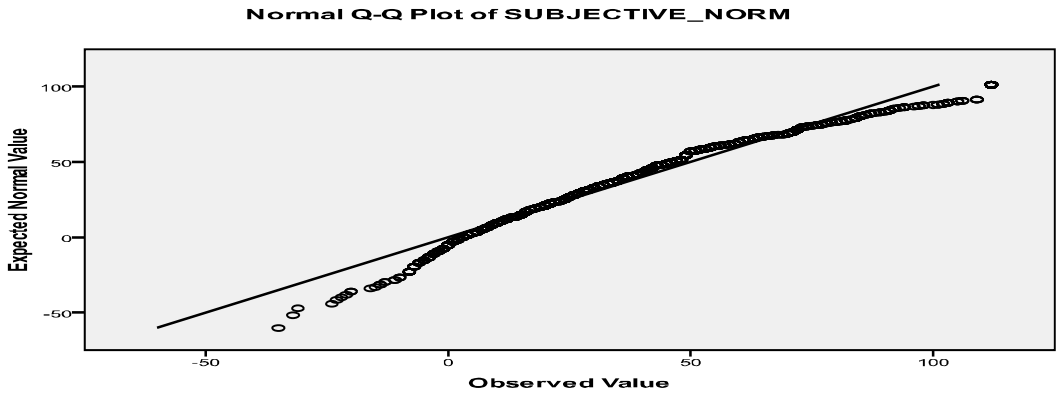
Motivation to comply is measured by four questions on a scale[20] from -3 *(Never)* to +3 *(Always)*: Q_{51} (*"Do you want to have the same electricity saving behavior as your parents?"*), Q_{53} (*"Do you want to perform electricity saving behaviors as your professors?"*), Q_{55} (*"Do you want to perform electricity saving behaviors as your colleagues?"*) and Q_{57} (*"Do you want to perform electricity saving behaviors as the university staff?"*).

The means tend to be between Never and Always, slightly positive, indicating that students perceived that only a few people important to them would expect them to save energy.

[19] The Likert scale for normative belief measures is: 1-Never, 2-Rarely, 3-Quite Infrequent, 4-Moderate, 5-Quite Frequent, 6-Often and 7-Always

[20] The Likert scale for motivation to comply is: -3-Never, -2-Rarely, -1-Quite Infrequent, 0-Moderate, 1-Quite Frequent, 2-Often and 3-Always

The belief base measure of subjective norm is obtained by summing the product of normative belief strength with motivation to comply.



Graph 7. The Q-Q Plot of Subjective Norm (N = 1582 responses)

5.6. Perceived Behavioral Control (Indirect Measure)

The calculation of the perceived behavioral control follows the same rule as that of the measurements of behavioral beliefs. Two questions are asked to measure control belief strength and control belief power.

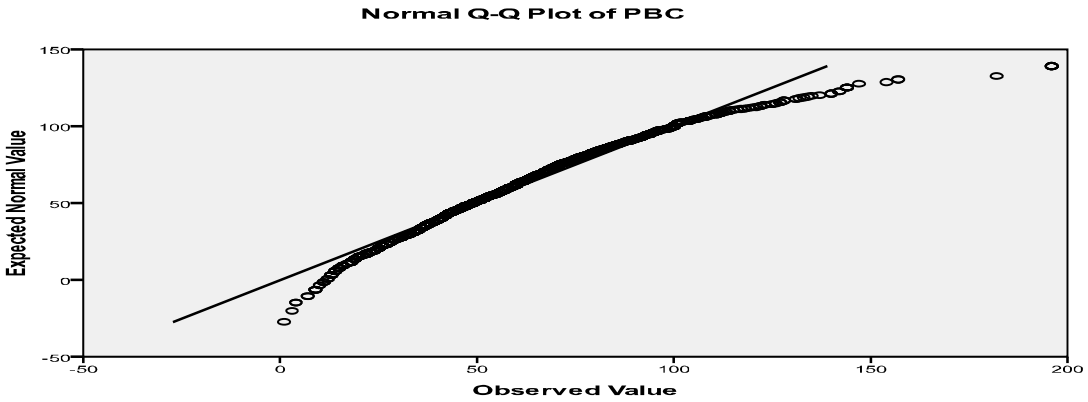
Control belief strength is measured by four questions on a scale from 1 (*Never*) to 7 (*Always*): Q_{59} (*"How often do you think that the weather will change?"*), Q_{61} (*"Do you think that the appearance of a new TV channel will influence your behavior?"*), Q_{63} (*"Do you consider buying a new appliance?"*) and question Q_{65} (*"Are you considering getting a job soon?"*).

Control belief power is measured by four questions on a scale from -3 *(Never)* to +3 *(Always)*: Q_{60} ("Do you think that weather will influence your energy saving behavior?"), Q_{62} ("Do you think that mass media will influence your energy saving behavior?"), Q_{64} ("Do you think that a new electricity appliance could act as an obstacle to saving electricity?") and Q_{66} ("Do you anticipate that having a job in the future is an obstacle to save electricity?").

The means tend to be between *Moderate* and *Quite Often*, slightly positive.

The perceived behavioral control is the sum of the products of the control beliefs and control belief powers.

The distribution of the perceived behavioral control of energy saving is leptokurtic (positive kurtosis) indicating a relative peak distribution.

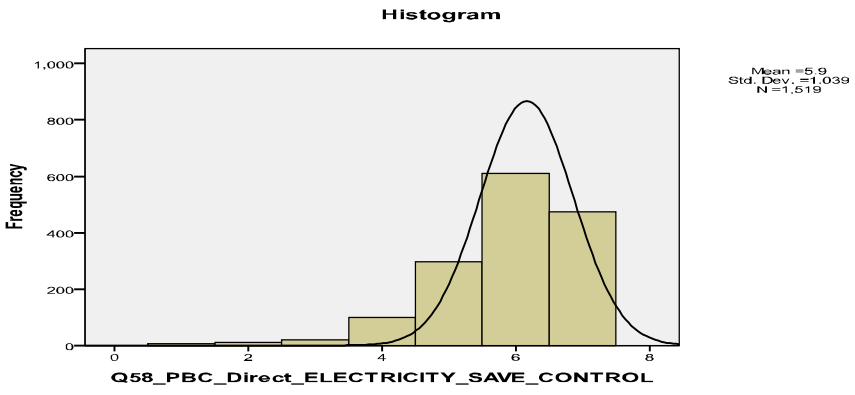


Graph 8. The Q-Q Plot of Perceived Behavioral Control
(Indirect Measure, *N* = 1582 responses)

5.7. Perceived Behavioral Control (Direct)

The Perceived Behavioral Control was also measured directly by question fifty-eight "Do you think that you can control yourself to save electricity?"[21]; measured on a scale from 1 (*Never*) to 7 (*Always*).

The direct measure of the distribution of the perceived behavioral control of energy saving is leptokurtic (positive kurtosis) indicating a relative peak distribution ([FIELD, 2009] , page 148). It is also negatively skewed and it lacks symmetry.



Graph 9. Histogram Perceived Behavioral Control (Direct Measure, *N* = 1519 responses)

The relationship between variables was assed using the Pearson correlation. The results showed a strong correlation between Intention and Behavior, also they moderately correlate with other predictor

[21] The Likert scale for perceived behavioral control (direct measure): 1-Never, 2-Rarely, 3-Quite Infrequent, 4-Moderate, 5-Quite Frequent, 6-Often and 7-Always

variables in the matrix. Perceived Behavioral Control do not correlate with the Behavior and Intention component indicating low interest to pursue energy saving behavior.

5.8. Conclusion

This chapter presents the structure and the components of the TpB. Questions used to measure the TpB components are presented, Q-Q Plots analyzing the normal distribution of the beliefs are assessed. This is followed by the evaluation of each TpB component based on the received responses.

Chapter VI – Hypothesis Tests

Based on Theory of Planned Behavior components the following 5 hypotheses were tested.

Hypothesis 1: Students from the first group ("Environmental or Energy (or both)" Group) have a favorable attitude and subjective norm, a higher perceived control than the students from the second group; hence a stronger intention to perform energy saving behavior.

Hypothesis 2: The belief-based measures of attitude provide a more accurate measure of intention than the direct ones.

Hypothesis 3: Advice from television has a significant influence on the students from the second group (The "Other" Group); they have a favorable attitude and subjective norm, a higher perceived control to perform energy saving behavior.

Hypothesis 4: Price and energy saving information has a significant influence on the students' intention to save energy. Those students from the "Environmental or Energy Group (or both)" who can estimate exactly the cost of energy saving light bulb have a favorable attitude and subjective norm, a higher perceived control to perform energy saving behavior then the others.

Hypothesis 5: Students' attitude, confidence and subjective norm increases with the years of study at the University.

6.1. Statistical Analysis of the Attitude towards Behavior, Subjective Norm and Perceived Behavioral Control on the General Group of Students (N = 1535)

The Attitude towards Behavior was measured using Direct and Indirect Measures.

Hypothesis 2: First using One-Way ANOVA we analyzed the relationship between the Attitude towards Behavior Variables (Direct Measures) and the Intention to save energy.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q44_ATTITUDE_Direct_ENERGY_EFFICIENCY_A_SCHOOL_PRIORITY	Between Groups	68.502	13	5.269	3.315	.000
	Within Groups	2411.063	1517	1.589		
	Total	2479.565	1530			
Q45_ATTITUDE_Direct_ECONOMIC_RECESSION	Between Groups	26.854	13	2.066	.788	.673
	Within Groups	3948.516	1507	2.620		
	Total	3975.370	1520			
Q46_ATTITUDE_Direct_GOVERNMENT_RESPONSABILITY	Between Groups	45.322	13	3.486	1.494	.112
	Within Groups	3515.814	1507	2.333		
	Total	3561.136	1520			
Q47_ATTITUDE_Direct_DO_NOT_NEED_TO_SAVE_ELECTRICTY	Between Groups	48.912	13	3.762	2.547	.002
	Within Groups	2232.072	1511	1.477		
	Total	2280.984	1524			
Q48_ATTITUDE_Direct_WILL_NOT_INCREASE_THE_QUALITY_OF_EDUCATION	Between Groups	89.038	13	6.849	1.877	.028
	Within Groups	5534.645	1517	3.648		
	Total	5623.683	1530			
Q49_ATTITUDE_Direct_I_CANNOT_SEE_THE_BENEFITS_OF_SAVINGS	Between Groups	57.774	13	4.444	1.847	.032
	Within Groups	3661.851	1522	2.406		
	Total	3719.625	1535			

Table 6. –Way ANOVA – Attitude toward Behavior (Direct Measures)

Hence two of the Attitudes towards Behavior (Direct Measure, $N = 1535$) variables showed no significant to the Intention to Save Energy: (1) the "economic recession" variable did not show significance with intention to save energy, multivariate $F(13, 1507) = .79$, *n.s.* and (2) the "political belief" (or "government responsibility") variable did not show any significance with intention to save energy, multivariate $F(13, 1507) = 1.49$, $p > .05$, *n.s.*

Using One-Way ANOVA we analyzed the relationship between the Attitude toward Behavior Variables (Indirect Measures) and the Intention to save energy.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
ATT1[22]	Between Groups	1659.664	12	138.305	3.053	.000
	Within Groups	67995.845	1501	45.300		
	Total	69655.509	1513			
ATT2[23]	Between Groups	2240.248	13	172.327	2.132	.010
	Within Groups	122064.672	1510	80.838		
	Total	124304.921	1523			
ATT3[24]	Between Groups	2403.153	13	184.858	5.171	.000
	Within Groups	53842.394	1506	35.752		
	Total	56245.547	1519			
ATT4[25]	Between Groups	1955.453	13	150.419	2.443	.003
	Within Groups	92664.071	1505	61.571		
	Total	94619.525	1518			
ATT5[26]	Between Groups	2272.498	13	174.808	3.768	.000
	Within Groups	68933.286	1486	46.388		
	Total	71205.784	1499			
ATT6[27]	Between Groups	3018.309	13	232.178	3.851	.000
	Within Groups	90849.563	1507	60.285		
	Total	93867.871	1520			

Table 7. One –Way ANOVA – Attitude toward Behavior (Indirect Measures)

In this case the Attitude towards Behavior is defined by two questions measuring belief strength and outcome evaluation. The lowest significance had the variable "show one example to other Universities", multivariate $F(13, 1510) = 2.13$, $p < .05$. Hence student's attitude towards "being one example to other Universities" is a factor with low significance in students' decision to engage or not in energy saving behavior. Hence the Attitude towards Behavior (Indirect Measure) showed a significant relationship with the Intention to save energy, multivariate $F(13, 1530) = 4.57$, $p < .001$ and the direct measure of the Attitude towards Behavior was significant, multivariate $F(13, 1530) = 1.75$, $p < .05$.

[22] ATT1= "decrease University expenses" variable
[23] ATT2="show one example to other Universities" variable
[24] ATT3= the environmental concern (or "to preserve natural resources") variable
[25] ATT4= the economic variable (or "decrease import)
[26] ATT5="reduce carbon emission" variable
[27] ATT6="to improve the national balance of payment" variable

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
ATTITUDE	Between Groups	191403.524	13	14723.348	4.404	.000
	Within Groups	5114601.958	1530	3342.877		
	Total	5306005.482	1543			
ATTITUDEdirect	Between Groups	546.940	13	42.072	1.754	.045
	Within Groups	36705.679	1530	23.991		
	Total	37252.619	1543			

Table 8. One –Way ANOVA – Attitude toward Behavior Indirect and Direct Measures

Specifically indirect measure of Attitude towards behavior is more efficient than the direct measure.

Secondly using One-Way ANOVA we also analyzed the relationship between the Subjective Norm (Indirect Measures) and the Intention to save energy.

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
SN1[28]	Between Groups	10915.143	13	839.626	4.153	.000
	Within Groups	306109.181	1514	202.186		
	Total	317024.324	1527			
SN2[29]	Between Groups	1690.356	13	130.027	1.754	.045
	Within Groups	110869.849	1496	74.111		
	Total	112560.205	1509			
SN3[30]	Between Groups	1624.651	13	124.973	1.661	.063
	Within Groups	112037.011	1489	75.243		
	Total	113661.662	1502			
SN4[31]	Between Groups	1164.881	13	89.606	1.299	.206
	Within Groups	101859.518	1477	68.964		
	Total	103024.398	1490			
SUBJECTIVE_NORM	Between Groups	39307.248	13	3023.634	3.298	.000
	Within Groups	1400091.901	1527	916.891		
	Total	1439399.149	1540			

Table 9. One –Way ANOVA – Subjective Norm Indirect Measures

[28] SN1="parents influence" variable
[29] SN2="professor influence" variable
[30] SN3="colleagues influence" variable
[31] SN4="staff influence" variable

In this case the Subjective Norm is defined by two questions measuring normative belief and motivation to comply. Hence two of the Subjective Norm variables showed no significant to the Intention to Save Energy The results are as follows: (1) the "colleagues influence" variable show no significance with the intention to save energy, multivariate $F(13, 1489) = 1.66$, $p > .05$, *n.s.* and (2) the "staff influence" showed no significance with the intention to save energy, multivariate $F(13, 1477) = 1.30$, $p > .05$, *n.s.*

Hence the measurement of the Subjective Norm (Indirect Measure) showed a significant relationship with the Intention to save energy, multivariate $F(13, 1527) = 3.30$, $p < .001$. The "professor influence" may offer some clues on the perceived pressure on students' intention to save energy.

Finally the Perceived Behavioral Control was measured using Direct and Indirect measures. Using One-Way ANOVA we analyzed the relationship between the Perceived Behavioral Control (Direct Measure) and the Intention to save energy.

In this case only one question was used (!) the result is as follows: the "control belief" variable showed high significance with the intention to save energy, multivariate $F(13, 1505) = 7.69$, $p < .001$.

Using One-Way ANOVA we continued to analyze the Perceived Behavioral Control (Indirect Measure) influence on Intention to save energy and we did not identified any significant relations between the Intention variable and the Perceived Behavioral Control variables, multivariate $F(13, 1525) = 1.27$, $p > .05$, *n.s.*

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PBC1[32]	Between Groups	2449.711	13	188.439	1.314	.197
	Within Groups	213543.097	1489	143.414		
	Total	215992.808	1502			
PBC2[33]	Between Groups	350.850	13	26.988	.820	.639
	Within Groups	49276.243	1497	32.917		
	Total	49627.093	1510			
PBC3[34]	Between Groups	454.306	13	34.947	1.205	.269
	Within Groups	43310.707	1493	29.009		
	Total	43765.013	1506			
PBC4[35]	Between Groups	1704.378	13	131.106	1.405	.149
	Within Groups	139746.731	1498	93.289		
	Total	141451.108	1511			
PBC	Between Groups	6649.093	13	511.469	1.266	.227
	Within Groups	616278.187	1525	404.117		
	Total	622927.280	1538			

Table 10. One –Way ANOVA – Perceived Behavioral Control Indirect Measures

[32] PBC1="weather belief control" variable
[33] PBC2= "mass media belief control" variable
[34] PBC3= "new appliance purchase" variable
[35] PBC4="employment belief control" variable

Moreover analyzing the relationship between *Behavior and the Perceived Behavioral Control* variables we identified tow variables that showed significance to the intention to save energy : (1) "new appliance purchase" show significance with the intention to save energy, multivariate $F(13, 1493) = 2.87$, $p < .001$ and (2) "employment belief control" show significance with the intention to save energy, multivariate $F(13, 1498) = 2.28$ $p < .05$;

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
PBC1[36]	Between Groups	2357.411	13	181.339	1.264	.228
	Within Groups	213635.396	1489	143.476		
	Total	215992.808	1502			
PBC2[37]	Between Groups	578.577	13	44.506	1.358	.173
	Within Groups	49048.516	1497	32.765		
	Total	49627.093	1510			
PBC3[38]	Between Groups	1072.923	13	82.533	2.886	.000
	Within Groups	42692.090	1493	28.595		
	Total	43765.013	1506			
PBC4[39]	Between Groups	2748.361	13	211.412	2.283	.006
	Within Groups	138702.747	1498	92.592		
	Total	141451.108	1511			
PBC	Between Groups	8085.993	13	621.999	1.543	.095
	Within Groups	614841.287	1525	403.175		
	Total	622927.280	1538			
Q58_PBC_Direct_ELECTRICITY_SAVE_CONTROL	Between Groups	62.680	13	4.822	4.603	.000
	Within Groups	1576.508	1505	1.048		
	Total	1639.188	1518			

Table 11. One –Way ANOVA – Relationship between Behavior and Perceived Behavioral Control

The highest significance had the variable "new appliance purchase", multivariate $F(13, 1493) = 2.87$, $p < .001$. Hence this means "purchase" may facilitate or may impede their intention to save energy.

[36] PBC1="weather belief control" variable
[37] PBC2= "mass media belief control" variable
[38] PBC3= "new appliance purchase" variable
[39] PBC4="employment belief control" variable

6.2. Comparisons between Different Groups of Students

There are two groups of students: the first group (or the "Environmental or Energy" (or both) group) includes students who had Energy or Environmental lectures (or both) and the second group (or The "Others" group) includes students who didn't have Energy and (or) Environmental lectures. AJZEN (2001) states that "As a general rule, the more favorable the attitude and subjective the norm, and the greater the perceived control, the stronger should be the person's intention to perform the behavior in question" ([AJZEN, 2002] , page 1).

Based on the TpB model we want to analyze the influence of Energy or Environmental (or both) lectures on the students intention, behavior, attitude toward behavior, subjective norm and perceived behavioral control. In other words we want to answer the question: "Does Energy or Environment (or both) courses influence student behavior to pursue energy saving measures?"

Hypothesis 1: From the statistical analysis there was a significant effect of the Energy lectures on the General group (N = 1500), *Wilks' Lambda*=0.99, multivariate $F(5,1496)=3.42$, $p<.05$.

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.935	4284.791[a]	5.000	1496.000	.000
	Wilks' Lambda	.065	4284.791[a]	5.000	1496.000	.000
	Hotelling's Trace	14.321	4284.791[a]	5.000	1496.000	.000
	Roy's Largest Root	14.321	4284.791[a]	5.000	1496.000	.000
During_my_studies_I_have_had_one_or_more_ENVIRONMENTAL_COURSE	Pillai's Trace	.005	1.578[a]	5.000	1496.000	.163
	Wilks' Lambda	.995	1.578[a]	5.000	1496.000	.163
	Hotelling's Trace	.005	1.578[a]	5.000	1496.000	.163
	Roy's Largest Root	.005	1.578[a]	5.000	1496.000	.163
During_my_studies_I_have_had_one_or_more_ENERGY_COURSE	Pillai's Trace	.011	3.422[a]	5.000	1496.000	.004
	Wilks' Lambda	.989	3.422[a]	5.000	1496.000	.004
	Hotelling's Trace	.011	3.422[a]	5.000	1496.000	.004
	Roy's Largest Root	.011	3.422[a]	5.000	1496.000	.004
During_my_studies_I_have_had_one_or_more_ENVIRONMENTAL_COURSE * During_my_studies_I_have_had_one_or_more_ENERGY_COURSE	Pillai's Trace	.002	.609[a]	5.000	1496.000	.693
	Wilks' Lambda	.998	.609[a]	5.000	1496.000	.693
	Hotelling's Trace	.002	.609[a]	5.000	1496.000	.693
	Roy's Largest Root	.002	.609[a]	5.000	1496.000	.693

a. Exact statistic

b.Design:Intercept+During_my_studies_I_have_had_one_or_more_ENVIRONMENTAL_COURSE+During_my_studies_I_have_had_one_or_more_ENERGY_COURSE+During_my_studies_I_have_had_one_or_more_ENVIRONMENTAL_COURSE*During_my_studies_I_have_had_one_or_more_ENERGY_COURSE

Table 12. Environmental and Energy lectures Influence on Energy Saving Behavior (Indirect Measures)

Further in the comparison between the groups; the sample sizes of the groups are different, the second group is larger.

The results (Table 13.) are as follows: students with Environmental lectures (only!) have the highest confidence, attitude and intention to engage in energy saving behavior and students with Energy lectures (only!) have the highest means scores to perform energy saving behavior feel the highest level of social pressure performing energy saving behavior.

The difference between the sample sizes is significant however in the first group ("Environmental or Energy (or both)" Group) students with Environmental or Energy (or both) lectures (N = 613) are more likely to engage in energy saving measure than the others from the second group (N = 907)

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Environmental or Energy (or both))	**Students with Environmental Lectures (ONLY!)**	**285**	***M***	**10.90**	**9.76**	**82.91**	**42.30**	**22.05**
			SD	**2.45**	2.40	**30.48**	28.31	**18.41**
			N	**285**	285	**283**	283	**282**
	Students with Energy Lectures (ONLY!)	**107**	***M***	**10.89**	**10.32**	**76.85**	**45.96**	**17.85**
			SD	2.39	**2.44**	35.72	**35.30**	18.45
			N	107	**107**	106	**105**	104
	Students with Environmental and Energy Lectures	**224**	***M***	**10.82**	**9.92**	**82.84**	**45.76**	**17.78**
			SD	2.58	2.67	35.03	32.93	23.31
			N	221	221	219	218	217
Second Group (The "Others")		**907**	***M***	**10.64**	**9.88**	**80.82**	**41.09**	**19.92**
			SD	2.53	2.38	34.72	29.97	20.05
			N	907	909	903	902	903

Table 13. Means and Standard Deviations of the Intentions, Behaviors, Attitudes, Subjective Norms and Perceived Behavioral Controls between the Two Groups of Students

In the following we consider two equal sized sample groups. Hence we selected randomly 619 responses for the first group ("Environmental or Energy (or both)" Group) and 619 responses for the second group (The "Others" Group).

The results (Table 14.) are as follows: students from the first group ("Environmental or Energy (or both)" Group) have a favorable attitude and subjective norm, behavior and intention to engage in energy

saving measure than the students from the second group; hence a stronger intention to perform energy saving behavior. Therefore, Hypothesis 1 is accepted.

	N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Environmental or Energy (or both))	**619**	***M***	**10.87**	**10.92**	**81.83**	**44.18**	**19.79**
		SD	**2.48**	**2.51**	**33.14**	**31.30**	20.39
		N	**613**	**614**	**608**	**605**	603
Second Group (The "Others")	**619**	***M***	**10.58**	**9.83**	**80.70**	**41.68**	**20.71**
		SD	2.49	2.37	35.07	30.00	**19.93**
		N	616	618	613	613	**614**

Table 14. Influence of Equal Comparison Group Samples on Intention, Behavior, Attitude, Subjective Norm and Perceived Behavioral Control Means.

In the following section we consider analyzing the First group ("Environmental or Energy (or both)" Group) based on three equal sized sample groups. Hence we selected 351 responses from the first group ("Environmental or Energy (or both)" group): 107 responses for students with Environmental lectures (only); 107 responses for students with Energy lectures (only) and 107 responses for students with Environmental or Energy (or both) lectures.

The results (Table 15.) are as follows: students with Energy lectures (only) have the strongest behavior and intention and feel the strongest social pressure to engage in energy saving behavior; students with Environmental lectures (only) have the strongest confidence to pursue energy saving behavior. Those students who had Environmental or Energy (or both) lectures have the strongest attitude toward energy saving.

Hence we could assume that students with Energy lectures have the strongest intention to engage in energy saving behavior

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Environmental or Energy (or both))	**Students with Environmental Lectures (ONLY!)**	**107**	***M***	**10.60**	**9.65**	**81.83**	**41.51**	**22.49**
			SD	2.48	2.55	30.46	28.57	**16.97**
			N	107	107	106	106	**105**
	Students with Energy Lectures (ONLY!)	**107**	***M***	**10.89**	**10.32**	**76.85**	**45.96**	**17.84**
			SD	**2.39**	**2.44**	35.72	**35.30**	18.45
			N	**107**	**107**	106	**104**	104
	Students with Environmental or Energy (or both) Lectures	**107**	***M***	**10.54**	**9.73**	**82.36**	**44.91**	**19.63**
			SD	2.58	2.72	**35.79**	32.19	22.55
			N	106	106	**106**	105	105

Table 15. Comparison of the Means and Standard Deviations of the First Group (Environmental or Energy (or both)) on the Intention to Save Energy

6.3. The Influence of the Television on Energy Saving Advice on Different Groups

Section 4.3 identified the most trusted source of the energy saving advice for the students. Usually students collect energy saving advices from the television. We decided to resize the scale based on the frequency of energy saving advices received per week. Hence the new scale will be: 1-Students who receive more than once energy saving advice per week from TV (for instance every day, Per week 2-3 times, Per month 5-6 times) and 0-Students who receive less than once energy saving advice per week from TV (for instance Never or Once per week).

Based on this we will analyze the influence of the television on students' behavior, intention, attitude, subjective norm and perceived behavioral control. This analysis gives rise to interesting questions: Does the advice from the television influence students' energy saving behavior?

The sample size of the two groups differs significantly; the second group doubled the first one. However we computed each subgroup based on TpB components. The table below (Table 16.) summarizes the findings

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Env. or Energy (or both))	**More than once per week**	**408**	***M***	**10.96**	**10.01**	**83.79**	**43.86**	**19.52**
			SD	2.45	2.43	31.88	31.16	20.84
			N	404	408	402	399	397
	Once or zero times per week	**201**	***M***	**10.64**	**9.70**	**77.82**	**44.26**	**20.15**
			SD	2.54	2.64	35.00	31.65	19.29
			N	199	201	196	197	196
Second Group (The "Others")	**More than once per week**	**630**	***M***	**10.51**	**9.79**	**80.75**	**40.82**	**19.55**
			SD	2.51	2.35	33.95	**29.80**	**19.37**
			N	627	629	624	**623**	**625**
	Once or zero times per week	**268**	***M***	**10.97**	**10.11**	**80.80**	**41.46**	**20.8**
			SD	2.56	2.43	36.62	**30.47**	**21.74**
			N	268	268	267	**268**	**267**

Table 16. Results from Group Comparisons of the Energy Saving Advice from Television

The two groups cannot be compared (the sample sizes are not adequate), but they show some interesting results.

In the case of the first group ("Environmental or Energy (or both)" Group) we can observe that as the sample size increases the intention, behavior and attitude to perform energy saving measures increases. In other words, this may suggest that for large sample sizes Environmental or Energy lectures (or both) joined by an increase frequency of energy saving advice from the television has a positive impact on students' intention, behavior and attitude to perform energy saving measures. Also as the sample size increases, the subjective norm and perceived behavioral control decreases. The statistical analysis in the case of the first group ("Environmental or Energy (or both)" Group) the covariate (or the outcome variable), energy saving advice from the television was significantly related to the energy saving attitude towards energy saving, multivariate $F(4,593)=2.80$, $p<.05$

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
INTENTION	Between Groups	33.932	4	8.483	1.378	.240
	Within Groups	3682.516	598	6.158		
	Total	3716.448	602			
BEHAVIOR	Between Groups	24.068	4	6.017	.960	.429
	Within Groups	3760.748	600	6.268		
	Total	3784.817	604			
ATTITUDE	Between Groups	12073.126	4	3018.281	2.800	.025
	Within Groups	639194.140	593	1077.899		
	Total	651267.266	597			
SUBJECTIVE_NORM	Between Groups	8399.127	4	2099.782	2.161	.072
	Within Groups	574334.846	591	971.802		
	Total	582733.973	595			
PBC	Between Groups	232.861	4	58.215	.140	.967
	Within Groups	244389.968	588	415.629		
	Total	244622.830	592			

Table 17. One –Way ANOVA - Energy Saving Advice from the Television

This indicates that the energy saving advice from the television has significant effect on students who have access to Environmental or Energy lectures (or both).

Hypothesis 3: In the case of the second group ("The Others" Group) we can observe that as the sample size increases, together with the amount of advice from the television, students' intention and behavior decreases in terms to performing energy saving measures. In other words this may suggest that with the increase in the sample size the advice from television has a smaller influence on student's intention, behavior and belief about how others assess energy saving measures. Also as the sample size increases the attitude, subjective norm and the perceived behavioral control increase as well; Hypothesis three is accepted. From the statistical analysis in the case of the second group (The "Others"), the covariate (or the outcome variable), energy saving advice from the television, was significantly related to the participants' confidence, multivariate $F(4,875) = 2.75$, $p < .05$. There was also a significant effect of energy saving advice of the television on subjective norm $F(4,886) = 3.60$, $p < .05$. This indicates that the energy saving advice from the television has an effect on students who have no access to Energy or Environmental lectures (or both)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
INTENTION	Between Groups	47.209	4	11.802	1.851	.117
	Within Groups	5675.108	890	6.377		
	Total	5722.317	894			
BEHAVIOR	Between Groups	40.779	4	10.195	1.812	.124
	Within Groups	5017.295	892	5.625		
	Total	5058.074	896			
ATTITUDE	Between Groups	3157.429	4	789.357	.653	.625
	Within Groups	1071399.076	886	1209.254		
	Total	1074556.505	890			
SUBJECTIVE_NORM	Between Groups	12812.663	4	3203.166	3.604	.006
	Within Groups	787391.117	886	888.703		
	Total	800203.780	890			
PBC	Between Groups	4406.539	4	1101.635	2.747	.027
	Within Groups	355688.578	887	401.002		
	Total	360095.117	891			

Table 18. Energy Saving Advice from the Television (Second Group - Indirect Measures)

In the following section we consider two equal size sample groups. Hence we selected randomly 200 responses for the first group ("Environmental or Energy (or both)" group) and 200 responses for the second group (The "Others") group.

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Environmental or Energy (or both))	More than once per week	200	*M*	10.87	10	80.34	41.04	18.10
			SD	2.50	2.50	33.54	32.30	19.07
			N	198	198	197	196	194
	Once or zero times per week	200	*M*	10.64	9.69	77.81	44.26	20.15
			SD	2.54	2.64	35.01	31.65	19.29
			N	199	200	195	195	195
Second Group (The "Others")	More than once per week	200	*M*	10.21	9.65	79.51	40.68	20.65
			SD	2.54	2.35	34.75	31.47	18.06
			N	198	200	196	196	197
	Once or zero times per week	200	*M*	11	10.10	79.14	40.96	20.71
			SD	2.54	2.50	37.36	29.01	21.85
			N	200	200	199	200	199

Table 19. Influence of the Environmental or Energy lectures (or both) and Energy saving Advice from the Television on Intention, Behavior, Attitude, Subjective Norm and Perceived Behavioral Control in the Case of Equal Sample Sizes

The results are as follows (Table 19.): in case of the first group (Environmental or Energy Group (or both)) as the frequency of the energy saving advice from the television increases, students' confidence and social pressure to engage in energy saving behavior decreases.

In case of the second group (The "Others") as the frequency of the energy saving advice from television increases, students' confidence and social pressure decreases.

Hence energy saving advice from the television could not influence students' confidence and strengthen the social pressure to engage in energy saving behavior.

Is the Environmental or Energy (or both) lectures influence on students energy saving measures bigger than the advertisement from the television?

The above table (Table 20.) underlines the fact that the Environmental or Energy lectures (or both) are powerful in influencing student's intention to save energy.

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Environmental or Energy (or both))	**Students with Environmental Lectures (ONLY!)**	**107**	***M***	**10.60**	**9.65**	**81.83**	**41.51**	**22.49**
			SD	2.48	2.55	30.46	28.57	**16.97**
			N	107	107	106	106	**105**
	Students with Energy Lectures (ONLY!)	**107**	***M***	**10.89**	**10.32**	**76.85**	**45.96**	**17.84**
			SD	**2.39**	**2.44**	35.72	**35.30**	18.45
			N	**107**	**107**	106	**104**	104
	Students with Environmental or Energy (or both) Lectures	**107**	***M***	**10.54**	**9.73**	**82.36**	**44.91**	**19.63**
			SD	2.58	2.72	**35.79**	32.19	22.55
			N	106	106	**106**	105	104
Second Group (The "Others")	**More than once per week**	**107**	***M***	**10.4**	**9.88**	**81.88**	**40.05**	**20.90**
			SD	2.44	2.26	32.19	33.13	17.95
			N	105	107	105	105	105
	Once or zero times per week	**107**	***M***	**10.7**	**9.65**	**77.25**	**41.65**	**21.58**
			SD	2.71	2.69	30.05	30.05	21.80
			N	107	107	106	107	106

Table 20. Results from Group Comparisons of Energy or Environmental lectures (or both) and Energy Saving advice from Television on Students Intention to Perform Energy Saving Behavior

6.4. Price influence in Purchase Decision

Section 4.6 identified factors influencing the students' buying decision. The majority of the students choose an energy saving bulb against a traditional bulb because of its efficiency, quality, expected life or eco-friendliness. Price and design are less important in the buying decision. In what follows we will analyze the influence of price on the intention to save energy. In other words, we will answer the question "How does the price of electricity influence students' intention to save energy?" From the statistical analysis on the

general group (N = 1446), the covariate (or the outcome variable), the price of the energy saving bulb was significantly related to the participants' attitude towards energy saving, multivariate $F(2,1453)=9.679$, $p< .001$ and subjective norm, multivariate $F(2,1451) = 5.144$, $p<.05$. This indicates that the price of the energy saving bulb has an effect on the TpB components.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
INTENTION	Between Groups	28.813	2	14.407	2.281	.103
	Within Groups	9234.234	1462	6.316		
	Total	9263.047	1464			
BEHAVIOR	Between Groups	2.814	2	1.407	.240	.787
	Within Groups	8595.047	1465	5.867		
	Total	8597.861	1467			
ATTITUDE	Between Groups	22099.819	2	11049.910	9.679	.000
	Within Groups	1658835.064	1453	1141.662		
	Total	1680934.884	1455			
SUBJECTIVE_NORM	Between Groups	9583.803	2	4791.902	5.144	.006
	Within Groups	1351694.956	1451	931.561		
	Total	1361278.760	1453			
PBC	Between Groups	1325.259	2	662.630	1.642	.194
	Within Groups	584706.201	1449	403.524		
	Total	586031.460	1451			

Table 21. One –Way ANOVA- Price Influence on Energy Saving Intention

Question twenty-one asked "If yes (if you have bought energy saving bulbs), compared to traditional light bulbs, do you think energy-saving light bulbs are cheaper?" Based on the answers we constructed two groups. The first group consists of students from the "Environmental or Energy (or both)" group; they are divided in two groups: one who responded positively ("Disagree") to the question and one with students who responded with "Undecided" or negatively ("Agree") to the question. We will follow the same methodology for the construction of the second group ("Others" Group).

The sample size of the two groups differs significantly. However, each subgroup was computed based on TpB components.

The table above (Tabel 22.) summarizes our findings:

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Environmental or Energy (or both))	**Agree and Undecided**	**361**	***Ms***	**10.72**	**9.83**	**82.38**	**45.22**	**20.85**
			SD	2.48	2.48	33.74	30.21	21.13
			N	360	361	358	358	356
	Disagree	**219**	***M***	**11.07**	**10.07**	**81.23**	**43.07**	**18.22**
			SD	**2.48**	2.51	32.67	33.25	19.13
			N	**219**	219	217	216	215
Second Group (The "Others")	**Agree and Undecided**	**537**	***M***	**10.7**	**9.95**	**83.1**	**42.92**	**20.28**
			SD	2.47	2.37	35.16	29.73	20.17
			N	537	537	533	637	639
	Disagree	**320**	***M***	**10.6**	**9.86**	**79.44**	**39.25**	**19.71**
			SD	**2.61**	**2.40**	**32.68**	**30.34**	**19.67**
			N	**320**	**320**	**318**	**317**	**318**

Table 22. Results from Group Comparisons on the Cost of an Energy Saving Light

The two groups cannot be compared (the sample size is not adequate), but some interesting trends can be seen.

In the case of the first group ("Environmental or Energy (or both)" Group) we observe that students who responded correctly to the question have higher intention and behavior to perform energy saving measures than the others.

In case of the second group (The "Others" Group) the sample sizes differ significantly; hence a different approach will be used.

In the following section two equal sized sample groups are considered: a set of randomly selected 200 replies from the first group ("Environmental or Energy (or both)" Group) and another of 200 replies from the second group (The "Others" Group).

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
First Group (Environmental or Energy (or both))	**Agree and Undecided**	**200**	***M***	**10.62**	**9.8**	**80.69**	**41.89**	**20.43**
			SD	2.54	2.55	33.61	29.70	**20.78**
			N	199	200	198	199	**197**
	Disagree	**200**	***M***	**11.08**	**10.10**	**81.17**	**42.27**	**18.15**
			SD	2.51	2.57	33.20	33.49	19.41
			N	200	200	198	197	196
Second Group (The "Others")	**Agree and Undecided**	**200**	***M***	**10.62**	**9.87**	**81.83**	**41.94**	**21.45**
			SD	2.51	2.46	37.58	30.36	19.41
			N	198	200	196	198	198
	Disagree	**200**	***M***	**10.56**	**9.91**	**77.84**	**40.30**	**20.19**
			SD	2.57	2.38	33.27	30.08	19.32
			N	200	200	200	200	198

Table 23. Comparisons of Equal Groups Means on the Cost of an Energy Saving Light Bulb

Hypothesis 4: In case of the First Group ("Environmental or Energy (or both)" Group) students who responded correctly (with "Disagree") feel the strongest social pressure, attitude, behavior and intention to engage in energy saving behavior. Students who responded negatively with "Agree" or "Undecided" have the highest confidence to engage in energy saving. Hypothesis four is accepted.

In the case of the second group, ("The Others" Group) we conclude that students who responded incorrectly have the strongest intention to engage in energy saving behavior.

Hence price and energy saving information is a powerful tool to strengthen student's subjective norm. But as the social pressure increases student's confidence to perform energy saving measures decreases.

6.5 Changes in Energy Saving Intention over the Years

We analyzed the influence of the university environment on students' energy saving behavior. In other words, we will answer the question: "How does university environment influence students' energy saving behavior?"

Hypothesis 5: To have large sample sizes we decided not to split the groups. We constructed a table based on TpB components: with students who started their studies at the university between 2007 and 2010. The results are as follows:

		N		Intention	Behavior	Attitude	Subjective Norm	Perceived Behavioral Control
General Group	**2007**	**168**	***M***	**10.81**	**9.98**	**79.45**	**41.69**	**21.77**
			SD	2.57	2.32	36.00	29.42	18.88
			N	168	168	168	168	168
	2008	**168**	***M***	**10.68**	**9.75**	**76.49**	**39.70**	**21.15**
			SD	2.41	2.48	33.52	28.35	19.32
			N	168	168	168	166	166

Table 24. Results from Group Comparison of Beginning of Education at the University.

Thus the results are as follows (Table 24.): We identified that students' intention, behavior, attitude towards energy saving, subjective norm and perceived behavioral control increases as students tend to be more advanced in their curriculum. As students "grow older", their confidence and attitude toward energy saving, perceived social pressure to perform energy saving measures increases. From the statistical analysis on the general group (N = 1391), the covariate (or the outcome variable), the beginning of the study at the university, was significantly related to the participants' perceived behavioral control, multivariate $F(46,1394)=1.563$, $p<.05$.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
INTENTION	Between Groups	312.363	47	6.646	1.051	.380
	Within Groups	8887.164	1406	6.321		
	Total	9199.527	1453			
BEHAVIOR	Between Groups	200.978	47	4.276	.724	.919
	Within Groups	8330.534	1410	5.908		
	Total	8531.512	1457			
ATTITUDE	Between Groups	63940.838	47	1360.443	1.157	.219
	Within Groups	1641541.912	1396	1175.890		
	Total	1705482.750	1443			
SUBJECTIVE_NORM	Between Groups	53075.347	46	1153.812	1.247	.127
	Within Groups	1290989.155	1395	925.440		
	Total	1344064.502	1441			
PBC	Between Groups	28546.619	46	620.579	1.563	.010
	Within Groups	553330.716	1394	396.937		
	Total	581877.335	1440			

Table 25. One- Way ANOVA - Beginning of the Study Influence on Energy Saving Behavior

This indicates that the variable beginning of the study has an effect on the TpB components.

Our assumption was verified, by analyzing students' intention from the second group ("The Others") who consider graduating between 2011 and 2012.

The results are as follows in Table 26.:

		N		**Intention**	**Behavior**	**Attitude**	**Subjective Norm**	**Perceived Behavioral Control**
General Group	**2011**	**168**	***M***	**10.43**	**9.67**	**79.39**	**41.87**	**16.95**
			SD	2.47	2.47	36.94	**29.92**	19.26
			N	168	168	166	**167**	166
	2012	**168**	***M***	**10.79**	**10.03**	**80.38**	**41.78**	**20.09**
			SD	2.68	2.55	34.60	31.11	18.68
			N	167	168	165	166	163

Table 26. Results from Group Comparison of University Graduation

Hence students' attitude, confidence and subjective norm increases with the years of study at the University. From the statistical analysis on the general group (N = 1410), the covariate (or the outcome variable), the conclusion of the study at the university, was significantly related to the participants' perceived behavioral control, multivariate $F(30, 1413)=1.800$, $p<.05$

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
INTENTION	Between Groups	250.746	30	8.358	1.336	.107
	Within Groups	8921.788	1426	6.257		
	Total	9172.534	1456			
BEHAVIOR	Between Groups	178.863	30	5.962	1.010	.451
	Within Groups	8439.356	1430	5.902		
	Total	8618.219	1460			
ATTITUDE	Between Groups	35692.665	30	1189.755	1.018	.440
	Within Groups	1655226.534	1416	1168.945		
	Total	1690919.198	1446			
SUBJECTIVE_NORM	Between Groups	38312.113	30	1277.070	1.387	.080
	Within Groups	1301944.285	1414	920.753		
	Total	1340256.399	1444			
PBC	Between Groups	21373.477	30	712.449	1.800	.005
	Within Groups	559387.783	1413	395.887		
	Total	580761.260	1443			

Table 27. One- Way ANOVA - End of the Study Influence on Energy Saving Behavior

This indicates that the variable completing the study has an effect on the TpB components; Hypothesis five is accepted.

6.6. Conclusions

First the TpB belief components were analyzed based on their statistical significance to the intention to save energy. The analyses identified that the indirect measurement of Attitude towards Behavior showed significance to the energy saving intention, multivariate $F(13,1530)=4.57$, $p<.001$. The direct measures of the Attitude toward behavior showed significance to the intention to save energy, multivariate $F(13,1530)=1.75$, $p<.05$. Hence the belief based measurements are more reliable than the direct measures.

Secondly the subjective norm was analyzed based on their statistical significance to the intention to save energy. The analyses identified that the indirect measurement of the subjective norm showed significance to the energy saving intention, multivariate $F(13,1527)=3.30$, $p<.001$. The highest significance with the intention to save energy had the "parents", multivariate $F(13,1514)=4.15$, $p<.001$ and "professors" variables multivariate $F(13,1496)=1.75$, $p<.05$. Hence they are relevant normative referents for the students in pursuing energy saving behavior.

Finally the perceived behavioral control was analyzed based on their statistical significance to the intention to save energy. The analyses identified that there is no significant relationship between the perceived control variable with the energy saving *intention,* multivariate $F(13,1525)=1.27$, $p>.05$, *n.s.*; but with energy saving *behavior* the purchase variable was significant, multivariate $F(13,1493)=2.87$, $p<.001$.

These beliefs can provide a basis for future study; for constructing a new standard questionnaire!

Further the two groups of students were compared analyzing their intention to save energy. Statistically it was found a significant relationship between Energy lectures and students' intention to save energy *Wilks'* Lambda=0.99, multivariate $F(5,1496)=3.42$, $p<.05$. Considering equal sample sizes for the first group (The "Environmental or Energy (or both)" group) it was identified that students who had one or more Energy lectures had the highest intention to save energy, followed by students who had Environmental lectures.

Three equal sample sizes ($N = 619$) were constructed with students from the first group ("Environmental or Energy (or both)" Group) and students from the second group (The "Others" Group) and the means of the TpB components were analyzed. It was found that students who had access to Environmental or Energy (or both) lectures have higher intention to engage in energy saving measures as the others.

It was concluded that students' access to Environmental or Energy (or both) or Energy lectures (or both) increase their intention to engage in energy saving measures.

Statistical analyzes of the influence of the television on the students from the second group (The "Others" group) were significant, multivariate $F(4,875) =2.75$, $p<.05$ Comparing two equal size samples

from the second group showed that with the increase in frequency of the energy saving advice from television students' subjective norms and perceived behavioral control decreases. Hence the television has a negative effect on their intention to pursue energy saving measures.

Also it was identified in the case of the first group (The "Environmental or Energy (or both)" Group) statistically the television showed significance, multivariate $F(4,593)=2.80$, $p<.05$ with students intention to save energy.

Analyzing the price influence on students' intention to save energy, it was found that the price of the energy saving bulb was significantly related to the participants' attitude towards energy saving, multivariate $F(2,1453)=9.679$, $p< .001$ and subjective norm, multivariate $F(2,1451) = 5.144$, $p<.05$.Further it was identified that students who known the prize and hold information on energy saving light bulb have higher intention to save energy than the others.

Statistical analysis showed significant relationship between students' admission (or study start) to the perceived behavioral control, multivariate $F(46,1394)=1.563$, $p<.05$ Students' attitude, confidence and subjective norm increases with the years of study at the University.

Chapter VII- Energy Efficiency at European Universities

This last section outlines the situation at European Universities relating electricity saving incentives and metering systems. Interviews were conducted (via email; from 1st October 2010 until 1st November 2010) with 30 European Universities[40]. Specific questions were asked about the university electricity consumption and infrastructure, National Electricity Market and Tariff Systems, and on the University incentives and metering system.

The findings were grouped into three different categories:

1. Implementation of low cost measures, or "passive" measures.
2. The use of metering systems and implementation of an incentive system.
3. Changes in the building's infrastructure.

7.1. Implementation of Low Cost Measures

Universities use low cost measures to reduce their electricity consumption, such as energy efficient light bulbs, installation of timers, movement detectors, use of LED technology for lighting, purchase of low carbon technologies and others. These measures require none or little interaction with the energy consumer. Hence the switching on or off (lights, ventilation) can be managed by automation. In what follows we will mention some low cost university-specific measures:

- Replacement of energy-intensive (e.g. halogen lamps) lamps by low-energy lamps. (e.g. T5 lights). T5 lights save around 70% energy costs and increase illumination but they are expensive.
- Inverter control of electric motors. Inverter is an electrical tool that converts direct current to alternative current. In practice a frequency inverter or (AC drive) is used for speed control to decrease the energy of the fan and pump. The driving force can be reduced when the speed of the fan and pump is reduced hence the air volume and the flow rate can be controlled. Frequency inverters are installed usually on the following equipments: feed water pump, air conditioning pump, boiler water pump, ventilation fan, etc. [INVERTER]
- Investment in reactive power compensation and harmonic filtering to save energy and to improve power quality. The amortization period of such an investment is about one year.
- Boiler optimization. Today there are several intelligent boiler management systems. The system reacts to changes in temperature, "automatically manages the boiler output to meet the demanded in the most efficient manner possible"[SOLAR] reducing fuel consumption and greenhouse gas emissions.

[40] Additional information available on CD (Folder: Chapter VII- Energy Efficient Measures at European Universities)

- Lagging, isolation used to prevent heat diffusion from a steam pipe. Studies suggest that this way heat loss can be cut up to 70%. Several universities adopted the use of thermal isolation jackets (or removable insulation covers) to save between 25%-40% of their energy bill.
- Replacement of thermostatic valve heads (to avoid manual temperature changes). Thermostatic radiator valves measure the air temperature around them. They work by managing the flow of water through the radiator which they are connected to. This measure can save up 10% on energy costs.
- Use of carbon-dioxide sensors to control ventilation system. The initial cost (cost of sensors and control system) is the main disadvantage of these demand controlled ventilation systems.
- Warwick University (United Kingdom) uses "free cooling" technologies so called "eco evaporative cooling". The evaporative coolers function is based on the principle of air change. Hence cool air is used to cool buildings; the building cooling system is used only on the hottest days. In the case of Warwick University the electricity use was reduced by 58,824 kWh/year and financial savings were £5,000 per year[41].
- Motion detectors can automatically switch light on or off, depending on the presence of people in the room. Motion detectors can be easily installed, they are inexpensive but they are not suitable for energy saving bulbs, and their use is limited due to small detection range.
- Controlling the power utilization of personal computers. Unfortunately there are only few initiatives to adjust personal computers for minimal power consumption, although computers have a high consumption in a stand-by state.

Several studies proved that these low cost, automation and information measures alone result low energy savings. In order to be successful, energy conservation requires awareness and effort. Therefore it should be combined with consumer awareness measures.

7.2. The Use of Metering Systems and the Implementation of Incentive Systems

In order to identify changes in energy savings, the energy consumption in buildings must be measured as detailed as possible. Usually measuring is done by low-cost non-calibrated meters or small measuring devices. These devices function without a building control system. This data is collected locally or it can be transmitted to a central device. In United Kingdom usually electricity is measured by sub meters half-hourly meters and fiscal meters. In the case of sub meters universities own their meters and the costs are allocated on the base of the usage measured by a sub meter installed in each unit. In the case of half-hourly metering the electricity meter "records a reading each half hour through a year." [HALF HOURLY METERING] Fiscal metering is defined by the Metering Regulation as "Metering related to the purchase and sale and calculation of taxes"[FISCAL METER]. There are different systems (applications) for data processing:

[41] Warwickshire Energy Advisors http://www.warwickshire.gov.uk/web/corporate/pages.nsf/Links/668BA650CCF32DE28025764F003BC722

- University of Tampere (Finland) developed an online, web based application to visualize its energy consumption.
- University of Cambridge (United Kingdom) uses a sophisticated building energy management system which enables *"its staff to play a key role in energy saving and carbon reduction."*[42]
- University of Stavanger (Norway) owns a private metering system, but the data processing was awarded to a local company.
- University of St. Gallen (Switzerland) uses a very expensive metering system based on the buildings CO_2 footprint.

HAGEN (1985) characterizes initiatives as intrinsic and extrinsic motivators. The intrinsic motivation increases the person's environmental and energy awareness. They address the person's attitude and conscience; hence it is a powerful to influence people's energy saving behavior.

In the following section I will review university-specific intrinsic motivation initiatives:

- Online web based applications indicating student and staff energy consumption and savings in kWh as in price.
- Striking posters, drawings next to often used electrical devices. Their purpose is to indicate the environmental impact of the electrical device.

Commitments made to reduce energy consumption. In United Kingdom University divisions, departments are responsible for their energy consumption. They publish their energy consumption and set targets to staff and students. Also Environmental and Energy Policy can act as a commitment to reduce energy use and protect the environment.

- Roksilde University (Denmark) encourages staff and students to become "Green Ambassadors". Hence students are encouraged to lower their energy consumption and act eco friendly (plant trees; consume organic food, recycle, etc.).
- Manifestations (workshops, meetings), Campaigns (Earth Hour, Earth Day, Energy Saving Weeks, Switch and Save) are used to:
    - show and educate staff and students how to save energy,
    - inform students and staff on the latest green energy project,
    - promote the use of sustainable form of travel and transport, etc.

The disadvantage of these incentives is that they require "trained mind" as well as time and money.

Other possibilities are the national-wide or European-wide competitions to energy savings:

- "People & Planet Green League Table" ranks United Kingdom Universities based on their environmental performance, is credited "putting climate change on the desk of every Vice-Chancellor in the UK."[43]

[42] Cambridge University https://www.trendcontrols.com/en-GB/Pages/EngCSCambridgeUniversity.aspx
[43] People and Planet Green League http://peopleandplanet.org/greenleague

- London's "Green500" awards organizations for their carbon reduction initiatives. In 2010 the Golden Awards was given to University of East London (United Kingdom)[44].

Extrinsic motivation refers to motivation which comes from outside of an individual. Common extrinsic motivations are monetary rewards, restraints or punishments. In the following I will review university-specific extrinsic motivational initiatives:

- Energy saving competition between University Halls of Residence. Halls within each University compete against each other to reduce their energy consumption from the current year. Prizes include: Money, Eco-gadgets, Club tickets, Ice-cream etc.
- Profit sharing on the saved electricity. The reward is the cash savings from the saved electricity. If the budget for electricity and for the acquisition of electric appliances remains on a constant level, then less electricity consumption generates more money for acquisition. Hence this results in acquisition of more energy-efficient appliances.

There are many different types of grants or discount to help universities to finance their energy saving measures:

- Low Carbon Building Programme (United Kingdom)
- Salix Funds (United Kingdom)
- Fonds Belval (Luxembourg)
- Government Funds
- University Estate Funds

7.3. Changes in Building Infrastructure

The following actions are taken to make university buildings "green":

- University of Luxembourg (Luxembourg) conducts feasibility studies on estate buildings to ensure that buildings meet eco-certifications for energy efficiency and environmental responsibility.
- Some consider refurbishment of buildings as an alternative to energy saving. This measure also accounts changes in building infrastructure such as installation of solar panels or small wind mills on buildings. University of East London (United Kingdom) Dockland Campus uses a wind turbine to generate electricity and to reduce carbon dioxide emissions.
- Not every university generates electricity by its own, but several universities use combined heat and power (CHP) plants to produce electricity with lower heat temperature. University of Warwick (United Kingdom) implemented the combined heat and power technology and today 50% of the Campus' annual

[44] London Green 500 http://www.green500.co.uk/cms/about/)

electricity consumption is supplied by CHP engines. The installation of combined heat and power solutions requires massive changes in the infrastructure. University of Bradford (United Kingdom) estimates the total cost of the project to £4.5million. More than half of the investment is funded by Salix fund (£2.4m) and the remaining by University Funds. The long term savings rise up £400,000/year[45].

- University of Graz (Austria) considers building insulations (such as of double glass windows, PHV systems) as a method to reduce demand for heat, to save more energy.
- A more "drastic measure" is to reduce the number of buildings. Manchester Metropolitan University (United Kingdom) considers replacing of old buildings with new ones, reducing the number of campuses from seven to three.

The majority of universities consider in case of refurbishments the installation of building automation systems for heat, lights, ventilation and energy demand management systems. The advantage of these systems is that data can be linked with energy management systems to monitor the energy consumption of cost centers. This system requires an adequate building fabric because space is needed for data storage and for the meters.

7.4. Conclusions

Surveying several European universities we identified three measures used to improve energy efficiency: (1) Implementation of low cost measures, or "passive" measures; (2) The use of metering systems and implementation of an incentive system; and (3) Changes in the building's infrastructure.

Several measures showed high efficiency, long-term energy savings. Almost all European Universities account with energy saving policy and measures. Moreover their uses specific energy management programs to manage energy demand.

However it is difficult to define a measure that fits the best for University Environment, metering system proved to be the most efficient measure in reducing energy demand.

[45] University of Bradford http://www.brad.ac.uk/chp/faqs/

Chapter VIII – Conclusions and Recommendations

8.1. Conclusions

Higher education plays a critical role in sustainable education. Universities educate students on sustainability through a variety of programs and activities. Students' energy use impacts the national energy consumption; therefore it should be analyzed and measures identified to influence their energy consumption behavior.

The key elements of this thesis are sustainable consumption, individual behavior and decision in different context, energy consumption behavior, determinants of student energy savings (analyzing students' intention, behavior, attitude, subjective norm and perceived behavioral control based on TpB) and investigation of the application of the energy efficient measures at universities.

The first chapter presented the structure of the Portuguese electricity market.

In the second chapter we investigated the relationship between individual decision and sustainable energy consumption. Consumption is fundamental factor in achieving a sustainable development: unsustainable consumption is one of the causes of the climate change and pollution.

We investigated the behavioral studies on energy consumption, particular focus was on different intervention measures such as: commitments[KATZEV et al., 1983] goal settings [BECKER, 1978]information [GELLER, 1981] workshops, mass media campaigns [STAATS et al., 1996a] TV [WINETT et al., 1985] feedback [VAN HOUWELINGEN et al., 1989] , Eco Teams[STAATS et al., 2004b] and master meters [McCLELLAND et al., 1980] Also sociological investigation on energy conservation was presented; specifically eco-labelling, lifestyle (AUNE (1998), [GRAM et al., 2004] , [McMAKIN et al., 2002] , purchase [PEDERSEN, 2000] and the environment effect [RUBIK et al., 2006] Based on the literature review we identified the following factors influencing energy consumer behavior:

1. Characteristics of the households: influenced by age, family members and size, ownership, income, education etc;
2. Characteristics of the building: influenced by the age of the building and location (urban versus rural);
3. Information: energy bills or energy labels encourage energy saving behaviors. Information credibility is higher if it is administrated by state agency than by utility company;
4. Economic factor: energy price has a strong influence on reducing energy use. It is suggested that higher prices encourage consumers to save more energy (or to purchase higherenergy saving technology).and

5. Attitudes, beliefs, norms: are important, but nobody proved that these factors are determinants of energy consumption.

In the third chapter of this research, the objective was to review the Theory of Planned Behavior. First the application of the TpB was presented followed by the definition of its components and the computation of the belief based measures.

In the fourth chapter, we constructed two sample sizes used to test the hypotheses and we analyzed the two groups based on the frequency of the energy saving information, electricity bill payment and purchase decision. First, based on the first twelve questions, we could characterize the two sample sizes as: the "Environmental or Energy (or both) Student" studies at Faculty of Science and Technology, the student is a 23 years old male, single, started its studies in 2007 and in this year he will graduate. His last year average was 13 and he lives off-campus. The "Other Student" studies at Faculty of Economics, the student is a 21 years old female, single, started her studies in 2009 and she assumes that she will graduate in 2011. Her last year average was 13 and she lives off-campus.

Secondly, based on the demographics, we were interested to find out from where and how much energy saving information receives the two sample groups. In the case of the first group ("Environmental or Energy (or both)" Group), students had never received energy saving advices from billboard or from brochures. They receive energy saving information from television, person or from the Internet every day. During the week they receive advice on energy saving from television, from a person or from a newspaper.

However considering the long term, the highest number of energy saving advices is collected from flyers, brochures or from newspapers. The second group of students had never received energy saving advices from a billboard, brochure or flyers. They receive energy saving information every day from the television, a person or from the radio. Once per week they receive advice from the television, newspaper or from the Internet. During the week they receive at least two-three times advice from the television, from the radio or from the newspaper. However, on the long term the biggest amount of energy saving advice is collected from flyers, brochures or persons. Both groups of students receive few advices with daily frequency.

Thirdly, based on the electricity bill payer, we identified that: for the first group student ("Environmental or Energy (or both)") the electricity bill is paid by a family member, but he is familiar with the electricity bill expense. In the case of the second group student (The "Other Student"), he also leaves off-campus residence, the electricity bill is paid by a family member, and he has a relative idea on the rate of their electricity bill in his expenses.

And finally analyzing the choice between traditional light bulb and energy saving bulb we identified that the first group's ("Environmental or Energy (or both)" Group) choice for an energy saving light bulb is influenced by the product environmental performance, efficiency and expected life. Price or designs are

secondary factors that influence the choice for an energy saving light bulb. In the case of the second group (The "Others" Group), students' choice for an energy saving light bulb is influenced by the product environmental performance, efficiency and expected life. Price, designs or quality are secondary factors that influence the choice for an energy saving light bulb.

In the fifth chapter, we investigated if students' intention in energy saving can be broken down into specific forms of attitudes, norms or beliefs. Using SPSS 17, the correlation between TpB components was assessed; intention and behavior did not correlate with the perceived behavioral component indicating low interest to pursue energy saving intention.

In the sixth chapter we analyzed the following 5 hypothesis.

Hypothesis 1: Students from the first group ("Environmental or Energy (or both)" Group) have a favorable attitude and subjective norm, a higher perceived control than the students from the second group; hence a stronger intention to perform energy saving behavior.

Hypothesis 2: The belief-based measures of attitude provide a more accurate measure of intention than the direct ones.

Hypothesis 3: Advice from the television has a significant influence on the students from the second group (The "Others" Group); they have a favorable attitude and subjective norm, a higher perceived control to perform energy saving behavior.

Hypothesis 4: In the case of the first group ("Environmental or Energy (or both)" Group) the price has a significant influence on the students' intention to save energy. Those students who can estimate exactly the cost of energy saving light bulb have a favorable attitude and subjective norm, a higher perceived control to perform energy saving behavior than the others.

Hypothesis 5: Students' attitude, confidence and subjective norm increases with the years of study at the University.

The findings were as follow:

1. The TpB belief components were analyzed based on their statistical significance to the intention to save energy. The analyses identified that the indirect measurement of Attitude toward Behavior showed significance to the energy saving intention, multivariate $F(13,1530)=4.57$, $p<.001$.The direct measures of the Attitude toward behavior showed significance to the intention to save energy, multivariate $F(13,1530)=1.75$, $p<.05$. Hence the

belief based measurements are more reliable than the direct measures; Hypothesis two is accepted.

2. The subjective norm was analyzed based on their statistical significance to the intention to save energy. The analyses identified that the indirect measurement of the subjective norm showed significance to the energy saving intention, multivariate $F(13,1527)=3.30$, $p<.001$.
3. The perceived behavioral control was analyzed based on their statistical significance to the intention to save energy. The analyses identified that there is no significant relationship between the perceived control variable with the energy saving intention multivariate $F(13,1525)=1.27$, $p>.05$; but with energy saving *behavior* the purchase variable was significant multivariate $F(13,1493)=2.87$, $p<.001$.

Further the two groups of students were compared analyzing their intention to save energy. Statistically it was found a significant relationship between Energy lectures and student intention to save energy *Wilks'* Lambda=0.99,multivariate $F(5,1496)=3.42$, $p<.05$.

Considering equal sample sizes for the first group (The "Environmental or Energy (or both)" group) it was identified that students who had one or more Energy lectures had the highest intention to save energy, followed by students who had both Environmental lectures.

Two equal sample sizes (N =619) were constructed with students from the first group ("Environmental or Energy (or both)" Group) and students from the second group (The "Others" Group) and the means of the TpB components were analyzed. It was found that students who had access to Energy or Environmental lectures (or both) have higher intention to engage in energy saving measures as the others.

It was concluded that students' access to energy and Energy or Environmental lectures (or both) increase their intention to engage in energy saving measures; Hypothesis one accepted.

Statistical analyzes of the influence of the television on the students from the second group (The "Others" group) was significant multivariate $F(4,875)=2.75$, $p<.05$. Comparing two equal size samples from the second group showed that with the increase in frequency of the energy saving advice from television students' subjective norms and perceived behavioral control decreases. Hence the television has a negative effect on their intention to pursue energy saving measures; Hypothesis three accepted.

Also it was identified in the case of the first group (The "Environmental or Energy (or both)" Group) statistically the television showed relations with students intention to save energy, multivariate $F(4,593)=2.80$, $p<.05$.

Analyzing the price influence on student intention to save energy it was found that the price was significantly related to the participants' attitude towards energy saving, multivariate $F(2,1453)=9.679$, $p< .001$ and subjective norm, multivariate $F(2,1451) = 5.144$, $p<.05$.Further it was identified that students who are familiar with the costs and with the product have higher intention to save energy then the others; Hypothesis four accepted.

Statistical analysis showed significant relationship between to the perceived behavioral control, multivariate $F(46,1394)=1.563$, $p<.05$. It was found that student' attitude, confidence and subjective norm increases with the years of study at the University. Hypothesis five accepted.

In chapter seven we surveyed several European Universities asking questions about the University electricity consumption and infrastructure. The findings were grouped into three different categories:

1.) Implementation of low cost measures: (a) replacement of energy intensive lamps by low-energy lamps; (b) inverter control of electric motors; (c) reactive power compensation and harmonic filtering; (d) boiler optimization; (e) lagging; (f) replacement of thermostatic valve heads; (g) use of carbon-dioxide sensors to control ventilation system; (h) "eco evaporative cooling"; (i) motion detectors and (j) controlling the power utilization of personal computers.

2.) Use of metering systems and implementation of incentive systems.

Usually measuring is done by low-cost non-calibrated meters or small measuring devices. These devices function without a building control system. There are different systems for data processing: web based applications or metering systems based on the buildings CO_2 footprint.

We identified the following University-specific intrinsic motivation initiatives:

i. Online web based applications indicating student and staff energy consumption and savings in kWh as in price.

ii. Striking posters, drawings next to often used electrical devices. Their purpose is to indicate the environmental impact of the electrical device.

iii. Commitments made to reduce energy consumption.

iv. Encouragements of staff and students to become "Green Ambassadors"

v. Manifestations (workshops, meetings), Campaigns (Earth Hour, Earth Day, Energy Saving Weeks, Switch and Save) are used to:
    a. show and educate staff and students how to save energy,
    b. inform students and staff on the latest green energy project,
    c. promote the use of sustainable form of travel and transport, etc.

vi. "People & Planet Green League Table" ranks United Kingdom Universities based on their environmental performance,

vii. London's "Green500" awards organizations for their carbon reduction initiatives.

viii. Energy saving competition between University Halls of Residence. Halls within each University compete against each other to reduce their energy consumption from the current year. Prizes include: Money, Eco-gadgets, Club tickets, Ice-cream etc.

ix. Profit sharing on the saved electricity. The reward is the cash savings from the saved electricity. If the budget for electricity and for the acquisition of electric appliances remains

on a constant level, then less electricity consumption generates more money for acquisition. Hence this result in acquisition of more energy-efficient appliances.

These measures are supported by different types of grant for instance Salix Funds (United Kingdom) or Low Carbon Building Programme (United Kingdom).

3.) Changes in building infrastructure: buildings eco-certifications, refurbishments, building insulations and reduction of the number of the estates buildings.

However the metering systems proved to be the most efficient measure in reducing energy demand it is difficult to define measure that fits the best for University Environment.

8.2. Recommendations and Limitations

The first hypothesis demonstrated that people from the first group ("Environmental or Energy (or both)" Group) have a favorable attitude and subjective norm, a higher perceived control than the students from the second group; hence a stronger intention to perform energy saving behavior. Hence the Energy or Environmental (or both) lectures have a positive effect on students' intention to save energy.

However the big majority of students don't have access to Environmental or Energy (or both) lectures. One should question, is there a method (or measure) to influence these students to save more energy? Or could all the students be influenced to save more energy at the University?

In the following we will present four measures which could be applied to influence energy savings at the University.

First, measure is a competition between different departments. A competition between different departments of the University could be organized to encourage energy savings. Group of students and staff members (N = 10) from different departments (is important!) should compete with each other in an energy saving championship during one academic year.

At the beginning of the scholar year (September) recruitment of teams with ten members should be made. The teams should be formed by students from different departments (two groups of students from the same department is not allowed; but two teams from the same Faculty, with different specialization is allowed). Also a jury formed from the organizers and academic staff should be selected to define the task and judge the competition.

The groups receive a workbook with energy saving tasks. The tasks are identical to all groups; moreover groups can help each other; they can ask for assistance from academic department. The task should consist of realistic, low cost and easy to implement measures. At the end of each month the groups should present their findings and the jury should elect the winner.

At the end of each month an Eco Champion is elected and rewarded.

Secondly, competition between residences on energy saving should be organized. This measure is applied only to students. The recruitment of the Eco Rangers is made at each residence at the beginning of the scholar year (September). These are students who intend to save energy.

Each Eco-Ranger must encourage students from the residence to act in energy efficient way. This could be done by using different actions (some of these actions were already applied at different universities): (1) picture competitions to raise awareness on energy saving; (2) movie nights on climate change, recycling or energy saving (screening movies like Fuel; Age of Stupid; Gasland; Tapped); (3) parties with organic food; (4) climate quiz competition or (5) creation of social groups (Facebook, Hi5, etc.)

At the end of the month energy consumption should be measured and the most efficient residence should be named as Eco-efficient and rewarded with different prizes.

After each week the Eco-Rangers should report their findings or the planned activities to the organizers.

Thirdly, academic departments should be advised to use railway for official trip as transportation instead of airplane (directive of University of Zurich). There is no time-related disadvantage; moreover the railway can be used as labor time (e.g. by working with a laptop), whereas working in the airplane is more difficult.

And finally, Energy Saving Days or the so-called One Hour Switch Off days should be held. The University of Leeds promotes measures such as Earth Hour Campaign or Heater Amnesty. During one hour students are advised to switch off their computers, laptops, printers, phone chargers etc. to save energy. In 2011 during one hour they saved 12,442kWh. Further measures include the promotion of a short period of time of coffee machines, microwaves, and kettles.

As in any research, there are some limitations to this study which should be considered.

Firstly, it would have been more advantageous a more focused research one the main behaviors. For instance for the “turn-off the lights behavior” very few students measure (or are aware of) the time spent outside of the room and therefore may not know exactly how long the lights in their room remain on. It is possible that students who did report that they are turning off the lights if they are leaving the room for more than five minutes, may not be true. In addition, if somebody performs this behavior periodically as a habit the importance of the other factors may be irrelevant!

Secondly, usually TpB components are evaluated using the direct methodology. This study did not assess the TpB components using the direct methodology; instead a more complicated indirect measure was used. The main advantages of the direct assessment are: (1) eliminates the optimal scaling issue and (2) reduces the size of the questionnaire. Using direct assessment the TpB approach may have resulted higher predictive power. However, Ajzen [2002] considers that “belief-based measures have the advantage of providing insight into the cognitive foundation underlying perceptions of behavioral control.”

Thirdly, we observed that several students agreed to complete the questionnaire as a course requirement, hence they are not highly motivated to report accurate responses.

Finally, TpB is used to predict and understand human behaviors not as a methodology for guiding intervention development.

With the changes in technology the energy consumer behavior of people changes rapidly. *Future research should reexamine these behaviors; interventions must be updated to reflect the current energy consumption behavior: for instance the computer shut-down behavior may soon no longer be a reasonable behavior to target within an intervention.*

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Annex

Annex 1-Correlations between TpB Components

Correlations

		INTENTION	BEHAVIOR	ATTITUDE	SUBJECTIVE_NORM	PBC
INTENTION	Pearson Correlation	1	.627**	.163**	.104**	.047
	Sig. (2-tailed)		.000	.000	.000	.067
	N	1555	1554	1544	1541	1539
BEHAVIOR	Pearson Correlation	.627**	1	.097**	.054*	.031
	Sig. (2-tailed)	.000		.000	.033	.231
	N	1554	1558	1544	1541	1539
ATTITUDE	Pearson Correlation	.163**	.097**	1	.294**	.100**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	1544	1544	1544	1538	1538
SUBJECTIVE_NORM	Pearson Correlation	.104**	.054*	.294**	1	.138**
	Sig. (2-tailed)	.000	.033	.000		.000
	N	1541	1541	1538	1543	1537
PBC	Pearson Correlation	.047	.031	.100**	.138**	1
	Sig. (2-tailed)	.067	.231	.000	.000	
	N	1539	1539	1538	1537	1539

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

*. Correlation is significant at the 0.05 level (2-tailed).

Index