Domestic Electricity Consumption and the Public Awareness Factor

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ABSTRACT

Access to energy and in particular electricity is viewed as a fundamental right of every household. The accessible source of electricity gets distributed to different electrical loads within the household without people being aware of the individual consumption per load, due to the fact that the overall cost is reported as a single number in the electricity bill.

In this study we investigated the awareness and knowledge of household consumers with regard to issues associated with electricity consumption and cost.

As a first stage, a sample of 300 households all around Cyprus was randomly selected in January 2010. The occupants were asked to provide relevant information about their household as well as answer some survey questions associated with knowledge of electricity consumption. The survey demonstrated clearly that most people are not aware of electricity consumption and cost, indicating a potential for reducing unnecessary consumption.

The second stage was the installation of 50 smart monitors, one per household, with a small display indicating the cost of electricity consumed per hour. The monitor enabled the occupants of the household to identify the cost for appliances, lighting and so forth, by observing the change in the displayed cost when the load was switched on. The device became an effective educational tool that motivated the users to be more alert in switching off unnecessary loads.

The third stage consists of monitoring the consumption of each of the 50 households over a 2 year period 1 year prior to the use of the monitoring device and 1 after. The results so far demonstrate clearly that the information provided by the device led to changes in the use of electrical loads that resulted in an average of 25% savings ranging from a minimum of 10% to a maximum of just over 40%. The study of the 50 households helped to identify some common areas of savings which were verbally communicated to the remaining 250 households participating in the project but did not have access to a monitoring device. In those cases the average savings were about 10%. The study clearly demonstrates that saving electrical energy has a lot to do with education and awareness regarding costs of different electrical loads. The use of a smart device that allows people to observe cost changes for different loads seems to be much more effective than booklets and verbal suggestions regarding energy savings.

In a future study, the analysis of a statistical model on the profile of the average Cypriot household will be attempted. Features like education, financial status, age and other important factors will be tested against different ways of informing and educating people in changing their habits on electricity consumption.

1 INTRODUCTION

Energy efficiency and conservation have numerous benefits for both the environment and human health. These include reductions in air, water and soil pollution, acid rain and global warming, oil spills and water pollution, loss of wilderness areas and biodiversity, construction of new power plants, foreign energy dependence and the risk of international conflict over energy supplies. Furthermore it can reduce the demand for nuclear power (and disposal of high level radioactive waste), as well as for fossil fuels such as coal, oil, natural gas and propane. It is believed the use of fossil fuels as our main source of energy is causing the planet to warm rapidly as a result of a growing concentration of carbon dioxide in the atmosphere [1].

Saving electricity may look like a difficult task due to the nature of electricity, which remains invisible right from its discovery and perhaps due to consumers' attitude and behaviour. Yet it can become a very easy issue if the consumer gains basic knowledge on what electricity is, how it is consumed and, more importantly how energy is wasted. This will drive consumers to pay more attention to unnecessary use of electricity and most probably change their everyday behaviour [2]. Furthermore the implementation of incentives, to motivate consumers, in the form of a necessity relating to social and economic benefits may also have a positive effect. There has been evidence that a combination of feedback with education and incentives interest motivate consumers to reduce electricity use [3].

In Cyprus on July 11, 2011, 13 people lost their life when a depot at the main naval base on the island exploded, sending shock waves across the surrounding area. The nearby power station at Vassiliko, the largest on the island was struck by the blast, knocking out local power supplies disabling, as a result, considerably the generating capability of the Electricity Authority of Cyprus (EAC) from a 1350 MW production to almost half of it. However, even after this catastrophe EAC managed to meet the demand by its consumers for several weeks. Today the production capability of EAC has been restored to 950 MW [4]. Taking into account that during that difficult period, domestic consumers managed to meet their energy needs with no major problems, someone can easily conclude that there is an over consumption of electricity in Cyprus, with households using much more electricity than they actually need. This observation is further verified by the cultural behaviour of the Cypriots who are generally characterised by over-consumption habits in many aspects of their way of living.

In Cyprus, electricity is mainly produced by burning crude oil, exclusively imported from overseas. Statistics indicated that EAC spent around € 440 million for fuel needed in 2010 to meet the needs of consumers (5 205 000 000 KWh) with significant upward trend year after year. Information indicated that compared to 2009 there was an increase of 30%. Regarding the cost of allowances (penalties) for greenhouse gas emissions increased by 24.4% and reached € 6 436 000 [5].

For a potentially successful result in energy saving a firm decision to take actions is necessary to begin with, followed by the application and implementation of specific actions. It is true that there are many ideas and ways on how to save energy, which are available and easily accessible nowadays. For example, the use of best available technology with best practice behaviour has been estimated to reduce consumption by 1300 KWh/year per European households [6]. This however does not make this effort as easy as it sounds unless certain requirements are met. Prior to the implementation of such actions one should succeed in raising the issue of *awareness* as being very essential to consider. This can be achieved through proper education and knowledge on basic features of electricity, combined with a full understanding of other compelling factors of great importance, especially environmental attitudes and beliefs as well as financial considerations [7]. Moreover, the necessity to understand the meaning of each term as well as the importance and weight of each factor affecting the whole system remains still important.

Much work has been done on the specific field, with a considerable number of scientific papers written on methods and factors that are significant on energy conservation. Specific engineering methods are used, such as feedback, which is considered important in order to make

advancements on the particular aspect [8]. The problem is so major that even other sciences unrelated to engineering - psychology and art amongst them - are called in to assist on the solution of the specific problem of conserving energy [9]. Extensive studies and abundance of research is being done globally to determine factors and methods in raising consumers' awareness in domestic installations. Two such typical examples are given below:

(i) In a case study [10], a family game was designed to explore its effectiveness and fun approach for raising the awareness of family members towards their energy use and, in the long run, to provide an effective tool for affecting their habits regarding sustainable behaviour.

(ii) Real-time information feedback delivered via technology, reported to produce up to 20% declines in residential energy consumption is supported in [11], where a monitoring device that recorded electricity consumption (The Energy Detective, TED) was used as feedback technology in conjunction with the Google Power-Meter web application that graphically displayed consumption information in real time.

In these two studies results were indeed encouraging. Someone though must also take into account factors such as cultural and other special characteristics that vary from country to country. For example, in a field experimental approach to study the effects of cost-related feedback on consumer knowledge and consumption behaviour, it was found that Canadians appeared more readily to respond to conservation programs and related products than did their American counter backs [12].

Practically, energy conservation never ends unless a building has become a "zero energy building" [13], so there must be continuous efforts on a scientific level to achieve the upmost in the specific field. Having this in mind, the main objective of this study is to combine existing knowledge on the issue and produce an algorithm, easily understandable and capable in raising awareness and driving people to do their best in energy conservation. For this objective an attempt is made to assess the current status, regarding electricity usage and the Cypriot consumers' level of knowledge on the specific issue. An encouraging factor, established by this study is the fact that a significant proportion (72%) of the respondents, feel that there is a capability in saving electricity at their dwellings.

The paper is organized as follows: In section 2 we present the methodology followed. In section 3 an attempt is made to analyse the data collected and the findings of this study.

2 MATERIALS AND METHODOLOGY

Our methodology consists of three stages, as follows:

2.1 STAGE 1: Establishment of basic characteristics

The first stage of the present study consists of a questionnaire prepared to assess the current situation as far as the electricity needs of the typical Cypriot household are concerned and to establish the level of awareness in relation to electricity consumption of the average consumer. To this end a survey was conducted at the beginning of 2010 through personal contact in a sample of 300 households selected randomly and geographically distributed all over Cyprus. The consumer was asked to provide relevant information about their household as well as answer questions associated with their believed knowledge on what considerably affects electricity Consumption. More specifically the information gathered was separated into two parts. The first part was related to data concerning the occupants of the household, the type and main characteristics of the premises as a building and the installed electrical loads and appliances. The second part was designed to obtain information through a number of questions directly related to the awareness and knowledge of users on basic aspects and issues on the consumption of electrical energy, that are considered as very crucial.

2.2 STAGE 2: Installation of monitoring system

Fifty out of the 300 participant households in the questionnaire of the survey were randomly selected to participate in stage 2 of this research. This stage involved the installation of a monitoring system in the specific household.

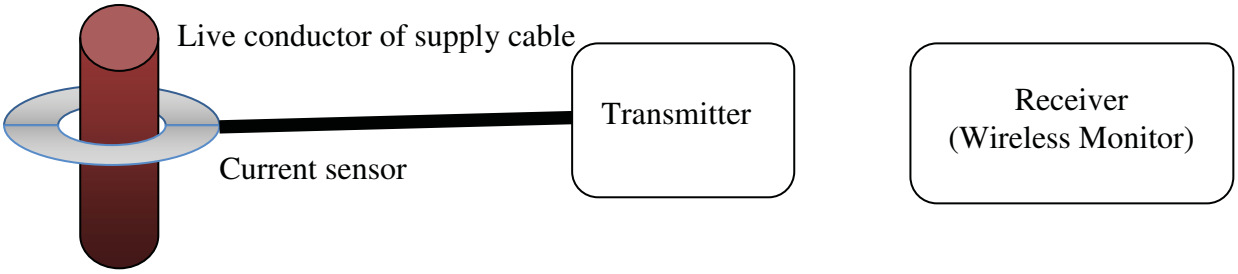

Figure 1: Setup of monitoring system

The monitoring system, shown in Figure 1, consists of a current sensor, a transmitter and a receiver. The installation of the system is very simple. The sensor is clipped directly to the wire of the live conductor of the supply cable and then connected to the transmitter. The wireless receiver, in actual fact a monitor with a display, is positioned within the house as to provide easy access to the consumer – observer. Its position must be prominent so as to provide easy access to the resulting data. In this manner the monitoring device can become an effective educational tool motivating users to be more alert in switching off unnecessary loads. Fifty monitoring systems were installed, in a random pattern as explained earlier, to continuously monitor consumption in the dwelling. The system installed, through the LCD screen of the wireless portable monitor, allowed the occupants to watch continuously, on a real time basis, the actual electricity consumption, its cost and the corresponding amount of carbon dioxide emitted in the atmosphere. The monitor provided in a very simple way the electricity consumption (and its cost) of the individual electrical loads and appliances. Adopting this procedure the house occupants were able to get to know the amount of money that could be saved by turning off a light, switching a TV off instead of leaving it at standby, or boiling less water in a kettle. Additionally the monitor provided information enabling the occupants to see how energy cost accumulates over a period of time of their choice (be that hourly, daily, weekly or monthly, quarterly, yearly). The information clearly shows how electricity is used over a cycle of time such as a 24 hour period and how changing one's lifestyle changes that cost.

2.3 STAGE 3: Analysis and comparison of actual consumption

The third stage of the study concerned only households, at which a monitoring system was installed. For these dwellings, all necessary arrangements were made to gain access to the actual consumption of the particular households prior and after the installation of the smart electricity monitor. Specifically the data collected directly from EAC, through the written permission of the specific consumers, covered a period of two years of consumption, one year before the installation of the monitoring system and one after. These data were used to analyse each case separately and make a comparison of the consumption of the two different periods: (i) one year prior to - and (ii) one year after the installation of the monitoring system.

3 RESULTS AND FINDINGS

3.1 STAGE 1: Establishment of basic characteristics

The analysis of the data collected from the questionnaires answered by the occupants of 300 randomly selected dwellings provided information that evidently leads to an important observation, that domestic consumers use much more electrical energy than they truly need.

It was important for this research to establish initially the basic characteristics of the typical Cypriot household. Information as to the number of occupants, facilities available and electrical appliances and loads installed were considered essential so as to lead properly the study to safe conclusions. The demographic characteristics along with the house features of the typical household are shown in Table 1.

Table 1: Basic Characteristics of a typical household

Description	Average Value
Members of Family	4.06
Age of Family Members	32.20
Male Members of Family	2.08
Age of Male Members	33.08
Female Members of Family	1.98
Age of Female Members	31.27
Housemaids	0.19
Floors	1.50
Bedrooms	3.36
Toilets and bathrooms	2.69
Swimming pool	0.10
Garden	0.81

Beyond the static details for the building itself with respect to number of bedrooms and bathrooms, it was established that 19% of the households have a permanent housemaid and 10% have a swimming pool, two factors that prove to be very important as far as electricity consumption is concerned. The typical Cypriot house has 3 to 4 bedrooms, 2 to 3 toilets and bathrooms, with 4 to 5 people living in it, including housemaid and almost equal numbers of male and female. The average age of family members is 32.20 years.

Table 2 covers the issue of installed electrical loads in the typical house. The picture given by these data is that in each house there are about 56 light bulbs installed with 80% of these being the traditional type of incandescent lamps. There is a personal computer and more than one television for every two persons. Almost everyone has access to internet. All houses seem to have a washing machine but only half of them use a dryer. Dish washers are at a high rate of 70%. There is almost an air-conditioner in each room. As far as cooking is concerned it seems that the vast majority is preparing food using electricity since around 80% have an electric cooker and a microwave and 93% an electric oven. For refrigeration facilities there are 1.5 fridges in each household with combined compartment for freezing, while 50% of the households have an additional freezer. Around 80% of the dwellings in the study have a garden; half of them have an electric water pump installed for watering purposes. Almost 85% of houses have an electric heater, rarely used though as household owners stated that hot water facilities are almost fully met by solar water heating systems. It seems that 41% of households use a pressurised water system, with 59% using the simple gravity system (with zero electricity consumption).

Table 2: Electrical loads and appliances installed in a typical household

No.	Description of Electrical Loads	Average [Pieces]
1	Tungsten light bulbs installed in interior areas	32.56
2	Compact fluorescent light bulbs installed in interior areas	8.06
3	Tungsten light bulbs installed in exterior areas	10.83
4	Compact fluorescent light bulbs installed in exterior areas	3.73
5	Personal computers	2.07
6	Televisions	2.79
7	Burglar alarm	0.04
8	Fire alarm	0.03
9	Internet	0.89
10	Water heater	0.84
11	Dish washer	0.72
12	Clothe dryer	0.48
13	Washing machine	1,02
14	Microwave	0.79
15	Electric oven	0.93
16	Electric cooker	0.83
17	Freezer	0.55
18	Fridge	1.52
19	Water pressurised system	0.41
20	Water pump	0.44
21	Air-conditioning units	3.63

As far as electricity consumption is concerned, the average monthly consumption during the four seasons in a year based on a three-year period (2009–11) average of the actual consumption of the selected dwellings is shown in Table 3. The overall monthly average is also shown. It can clearly be seen that summer is at a much higher level and may be considered as the "high season" in Cyprus in terms of domestic electricity. The other three seasons are at lower levels, similar to a certain extend and thus could be characterised as "low season".

Table 3: Average values of monthly electricity consumption in year seasons

Year Season	Monthly Consumption (KWh)
Autumn	478.840
Winter	577.785
Spring	500.905
Summer	779.260
Average	584.220

The actual consumptions of the participating houses are distributed in the histogram shown in Figure 2. The picture that emerges out of this characteristic slope is that around 35% of the consumers exceed the average consumption and 43% exceed the limit of 1000 KWh bimonthly, which is the average of the bimonthly consumption of the households, a year *after* the installation, at which a monitoring device was used. The average prior to installation was over 1300 KWh bimonthly for these specific cases.

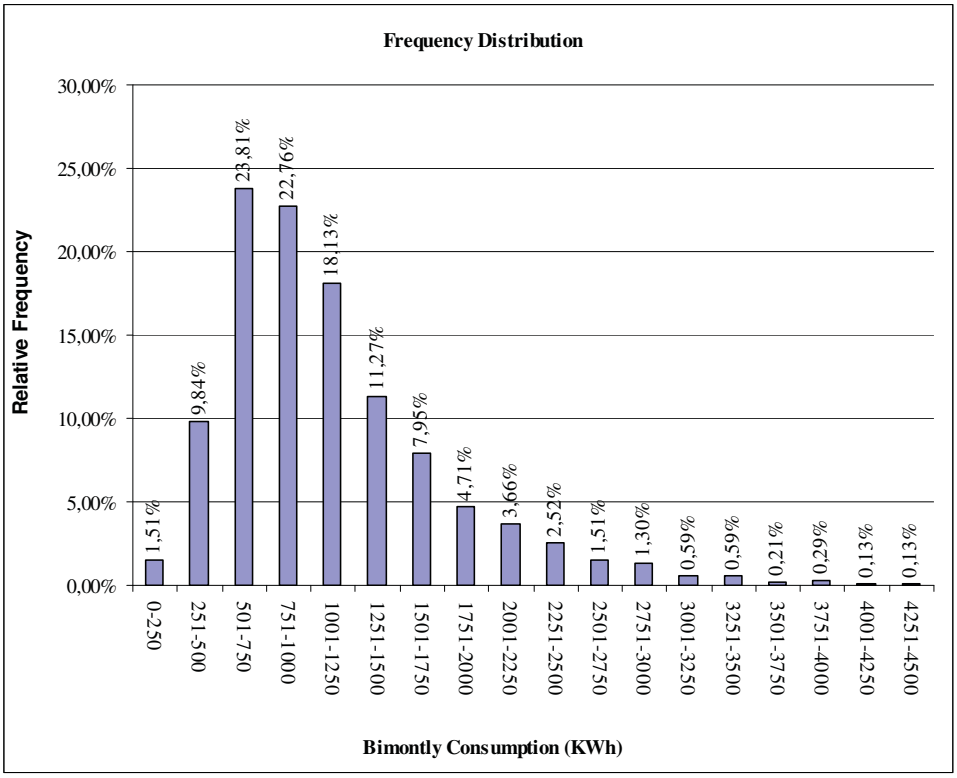

Figure 2: Frequency Distribution of bimonthly electricity consumption

Two factors that seem to affect adversely the total consumption of households are (i) the presence of a swimming pool, and (ii) the employment of a housemaid. Preliminary results in figure 3 show the negative effect of the two factors, alone or combined, with respect to energy consumption. In the case where a permanent housemaid is employed the consumption increases by a third, while in the case where a swimming pool is also present the electricity consumption doubles up. Further statistical analysis is to be done that will study this behaviour in relation to other factors (e.g. house size, number of tenants, and so forth) as well.

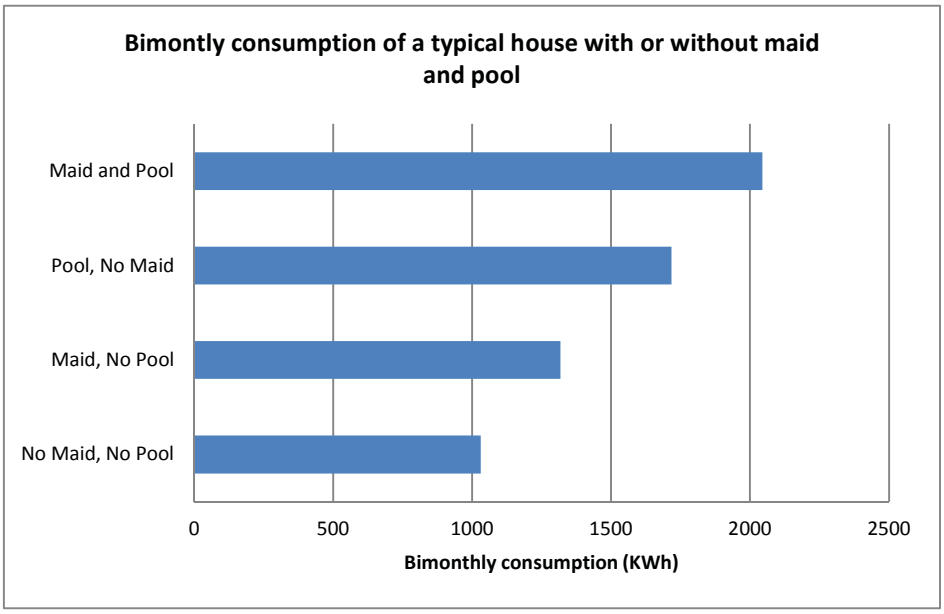

Figure 3: Consumption in a house with or without housemaid and swimming pool

The most worrying issue that comes out of this research and that may be responsible for considerable contribution to over-consumption is the ignorance of consumers on key issues and terms that are directly related to consumption of electricity. The second part of the questionnaire, which was designed to check this awareness, indicated a rather negative picture as far as the average consumer awareness. The "knowledge on basics" based on the answers given by respondents is shown in Table 4.

Table 4: Knowledge of consumers on basic concepts

No.	Question	Answers given by respondents (%)	
		Yes	No
1	Do you know how electricity is generated in Cyprus?	65.95	34.05
2	Do you know if electricity causes pollution to the environment?	73.28	26.72
3	Do you know how the Authority charges electricity consumption?	30.60	69.40
4	Do you know the term Tariff in relation to the consumption of electricity?	38.79	61.21
5	Do you know the meaning of the term KWh?	57.76	42.24
6	Do you know how much a unit of electrical energy costs?	14.22	85.78
7	Do you pay your electricity bill cash?	47.84	52.16
8	Do you pay your electricity bill through direct debit?	52.16	47.84
9	Do you find electricity expensive?	66.38	33.62
10	Do you believe that you can reduce electricity consumption?	71.55	28.45

A major percentage of consumers, around 70%, completely ignore the expenditure on electricity bills, with an even worse picture for those consumers who pay electricity bills through a bank direct debit. Only a very limited number of consumers have the impression that they really know the way EAC charges the final amount for their electricity bill. This fact is further reinforced by the findings of the responses of consumers on key terms and concepts related to electrical energy as a product. Normally consumers are expected to know at least the unit of measurement and the cost price for a product. In this case, although 57% of the participants know the term kilowatt-hour, only 14% know its cost. It is generally observed that awareness and basic knowledge on electricity consumption are rated at low levels amongst consumers. This deficit leads the consumer to misconceive important factors with regard to the usage of electrical energy and as a result over-consumption is caused unnecessarily and non-purposely. It is therefore assumed that is very likely that ignorance on basic issues and terms is responsible for the excessive use of electricity. The vast majority of respondents, over 70%, believe that it is possible to reduce consumption, yet when it comes on ways how this can be achieved they find it difficult to propose effective ways beyond the fact that they should switch off lights and replace ordinary tungsten light bulbs with other more energy efficient types. Regarding the structure of the EAC bill, consumers are really confused on how the electricity bill ends up in the specific total. This must be partly due to the complexity of the calculation of the final unit price of a KWh, which is based on various parameters. There is no doubt that consumers consider electrical energy as being one of the most expensive products. They are very aware of the fact that Cyprus is perhaps the dearest country in Europe as far as electricity is concerned. Besides, this is clearly stated in statistical reports issued by EUROSTAT [14].

A problem though that arises out of this issue is the fact that even under these circumstances consumers do not consider the reduction of energy as an alternative. Instead they continue to over-consume and choose to pay their bills in monthly instalments, a method promoted recently by EAC.

It is believed that there is an immediate need, to at least enlighten the consumer and educate them on basic concepts and terms that are directly related to electricity consumption. Simultaneously there is an imperative need for a review of the billing policies of EAC, which must also account for a more environmentally friendly philosophy and approach.

Regarding environmental aspects, the vast majority of the consumers have full or partial knowledge of the ecological impacts as a result of the production of electricity from crude oil. However, it seems that the vast majority of consumers consider electricity consumption as a human right, overlooking their share of moral obligation towards the protection and preservation of the environment.

To study further the awareness of consumers, as to the relation of electrical loads and energy demand, consumers were also asked, to make a list of the 3 most energy-demanding appliances and spaces in their household during summer and winter separately. It seems that consumers have reasonably a good sense as far as electrical demand is concerned. They overwhelmingly showed that they understand the great need in demand by air-conditioners during the summer period. This is the case, since in this particular period consumption increases considerably because of the wide use of air conditioners owing to the dramatic increase in ambient temperature in the island. Rightly heating was placed on the top of the list in winter season. In a similar approach the fact that many consumers rank refrigerator as one of the most energy-demanding appliances in summer is correct to a certain extent, as someone would expect the particular appliances to work heavily to meet the large temperature difference in summer-time.

The rating however at low levels in their list for lighting, washing machine and other useful loads as far as consumption is concerned, causes some questions as to whether consumers have a clear picture on the aspect of the most energy demanding electrical loads and appliances. For winter, consumers have the impression that the washing machine is one of the most energy-demanding appliances and ignore the dryer or the water heater, loads which are both known by engineers as the most energy-demanding appliances, responsible for a big share in consumption, especially when not properly used. Another important observation that emerges out is the ignorance shown by consumers on the fact that although some appliances or electrical loads are of low wattage, their long usage proves them to be very consuming. Television and lighting for example are low at the preferences of consumers and yet they have a large share on consumption since their use is sustainable and continuous. In particular for lighting, it is very wrong to ignore its considerable share since it is an outcome of the overwhelming (80%) use of traditional incandescent bulbs, which consume energy 5 times and perhaps more than new efficient types of lamps.

The analysis of these observations leads someone to suggest that generally consumers need to be educated as to understand the actual contribution of the various appliances and electrical loads to the overall consumption of a household and understand that usage time is equally – if not more – important than wattage size.

3.2 STAGE 2: Installation of monitoring system

The ignorance of consumers on aspects of electricity consumption was confirmed from the observations made during the second stage of this research. In this stage the monitoring system was installed in a smaller number, 50 in all, of households that took part in this experiment. The general principle of operation of the monitoring system was explained and instructions were given to the tenants as to its proper use. The system is simple to understand and its use requires no special skills or knowledge. The only action needed by the user was to watch closely the difference in “money spent” shown on the screen of the monitor when a number of appliances were switched on or off. This action offered the opportunity to consumers to become very aware on the hourly cost of consumption of each one of the appliances or electrical loads in their dwelling. The monitoring system was left in the particular houses for a very long period (over six months in all cases) in order to cultivate the consciousness of consumers and to give them to understand every single load in their installation.

The effect of the feedback provided by system on the occupants of each dwelling was monitored trough actual visits or telephone communication contact. Trough this manner it was established that consumers did gain important knowledge on electrical loads as far as consumption is concerned. They were in a position to identify the share in cost, of each individual appliance and by extend its contribution on the overall consumption in the household. This affected the consumers to be more cautious when using specific appliances and avoiding completely others which they considered as unnecessary. This is clearly shown by the comments made by consumers during this contact.

Amazed themselves from this outcome the participants made the following comments:

(i) "The installation of this device proved beyond doubt that there is major waste of electricity."

(ii) "This device makes consumer to become more energy conscious."

(iii) "Consumers are much more careful as to the usage of electrical appliances."

(iv) "Consumer learns in a very short time, what electricity an appliance consumes."

(v) "Consumer gets used into switching off standby appliances that are not in used."

(vi) "Consumption is reduced considerably."

(vii) "Cultivation of environmental awareness and consciousness is achieved through this device."

(vii) "The display offers the opportunity to immediately observe unusual and bizarre cases."

The results of this experiment, which in a way exceeded our expectations, were further verified through the comparison between consumption after the installation of the monitoring system and consumption prior to its installation, a procedure which was established by the third stage of this study.

3.3 STAGE 3: Analysis and comparison of actual consumption

In this stage the yearly consumption of each of the 44 households for a one-year period, prior to the use of the monitoring device, was compared with the overall consumption a year after. The results demonstrated clearly that the information provided by the device let to changes that had beneficial effects in the final outcome. As shown in figure 4, the consumption saving was quite dramatic. The average saving was 23.2%, with a standard deviation of 9.7. It is important to state that no other extra investment was made in the particular houses beyond the installation of the monitoring system. It is clarified that out of the 50 households only 44 were compared as in six cases the number of electrical loads changed dramatically in the particular houses.

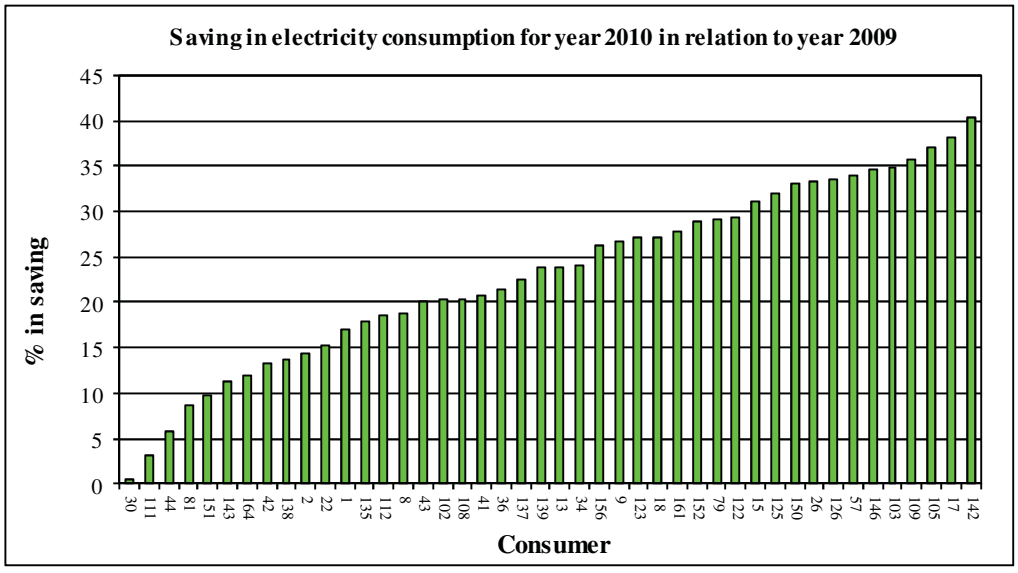

Figure 4: Percentage saving in electricity consumption for year 2010 in comparison to 2009

It can be safely stated that these encouraging results were simply result of the raising of consumers' awareness and the knowledge they gained through the monitoring system for proper usage of electrical loads and appliances in the house. It is worth mentioning that, identified common areas of saving electricity, established during stage 2 of the study, were verbally communicated to the remaining households participating in the project but had no access to the monitoring device. Even in those cases an average saving, about 10%, was accomplished.

The results obtained by this investigation allows someone to assume with reasonable certainty, that as far as residential consumption is concerned, significant power savings can be achieved, capable of reaching amazing percentages which in some cases exceed 40% per household. This means that the achievement of the average 23% power saving will have a corresponding saving, on national scale, which will exceed the amount of €90 million yearly, with prices of 2010, given the fact that the expenditure for fuel used for electricity consumption in that period was around € 440 million In 2010, the Electricity Authority of Cyprus served around 400 thousand households with an annual distribution close to 1.8 MWh [5].

4 CONCLUSIONS AND DISCUSSION

The current study proves beyond doubt that there is a great potential in saving electricity in Cypriot households and probably, with minimum investment. Generally households consume much more electricity than of they really need, especially in cases where there are housemaids and swimming pools. Regarding proper perception of heavily energy demanding appliances, despite the fact that consumers in their vast majority understand the key factors that adversely affect consumption, they still ignore the negative contribution of appliances of light loads of continuous and prolonged use. For the most energy consuming electric loads especially swimming pools, water heaters, clothes dryers the EAC must find proper ways in encouraging consumers to operate such loads at "off-peak" periods. Furthermore the Authority must find ways to educate people on basics but important issues that are affecting consumption of electricity. Every consumer must understand that by reducing his energy needs helps national economy, contributes to reduction of the environmental impact of pollution, adds to the lengthening of stocks of raw materials, protect his health, and offers a more hopeful future to younger generations. There is an imperative need for the State and EAC to find ways to convince and encourage consumers to save energy by implementing policies that reward such efforts either financially or otherwise. A continuous real time monitoring system definitely helps raising the awareness of consumers providing also additional benefits. Monitoring can even prevent unwanted situations though the information provided for an abnormal or strange reading.

This study has shown that significant power saving can be achieved in residential installations. For this very reason prior to any implementation of renewable energy recourses methods, which in comparison may be economically non viable at this stage, it may be a very good practice if investment is made in order to educate properly consumers and raise to acceptable levels their awareness on consumption of electrical energy, through methods that have insignificant investment costs.

Further study remains to be made on additional characteristics that govern electricity consumption, so that a statistical model is established for the average Cypriot household. In the future, features like education, financial status, age and other important factors will be tested against different ways in order to identify relative data affecting consumers' habits on electricity consumption and by extend awareness factor.

REFERENCES

[1] A. Longo, A. Markandyac and M. Petrucci, The internalization of externalities in the production of electricity: Willingness to pay for the attributes of a policy for renewable energy, Ecological Economics, 67.1 (2008) 140–152

[2] J. Thogersen and A. Gronhoj, Electricity saving in households- Asocial cognitive approach, Energy Policy, 38 (2010) 7732-7743

[3] J. Petersen, V. Shumturov, K. Janda, G. Platt and K. Weinberger, Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives, International Journal of Sustainability in Higher Education, 8.1 (2007) 16-33

[4] http://www.dsm.org.cy/nqcontent.cfm?a_id=2741&tt=graphic&startdt=01%2F03%2F2013&type=15&submit=Go

[5] http://www.eac.com.cy/GR/CustomerService/Documents/2010%20eac%20ANNUAL%20REPORT%20ENG.pdf (Table 4 P76)

[6] A. de Almeida, P. Fonseca, B. Schlomann and N. Feilberg, Characterization of the household electricity consumption in the EU, potential energy savings and specific recommendations, Energy and Buildings 43 (2011)1884-1994

[7] G. Brandon and A. Lewis, Reducing household energy consumption: A qualitative and quantitative field study, Journal of Environmental Psychology 19 (1999) 75-85

[8] C. Fischer, Feedback on household electricity consumption: a tool for saving energy?, Energy Efficiency,1(2008) 79–104

[9] T. Holmes, Eco-visualization: Combining art and technology to reduce energy consumption, Proceedings of the 6th ACM SIGCHI conference on Creativity & cognition, 153 – 162

[10] P. Shrubsole, T. Lavrysen, M. Janse and H. Weda, Flo: Raising Family Awareness about Electricity Use (2011) Proc; CHI EA '11 CHI '11 Extended Abstracts on Human Factors in Computing Systems (2011) 669-672.

[11] S. Houde, A. Todd, A. Sudarshan, J. A. Flora, and K.C. Armel, Real-time feedback and electricity consumption: a field experiment assessing the potential for savings and persistence.(2011) http://www.stanford.edu/~shoude/FieldExperimentPowermeter_vfinal_July2011.pdf

[12] R.B. Hutton, G.A. Mauser, P. Filiatrault and O.T. Ahtola, Effects of Cost-Related Feedback on Consumer Knowledge and Consumption Behavior: A Field Experimental Approach, Journal of Consumers Research, 13.3 (1986) 327-336

[13] A.J. Marszal, P. Heiselberg, J.S. Bourrelle, E. Musalc, K. Voss, I. Sartori and A. Napolitano, Zero Energy Building – A review of definitions and calculation methodologies, Energy and Buildings 43 (2011) 971–979

[14] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00115&plugin=1