



## Conference Paper

# Residential Consumers Awareness of Energy Conservation Practices in Saudi Arabia

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## Abstract

Energy efficiency and conservation are significant policy tools that can be introduced by governments to reduce electricity demand. The kingdom of Saudi Arabia possesses a wealth of energy resources. The exploitation of these resources has allowed the country to keep domestic energy prices low, through a system of direct and indirect subsidies. Saudi Arabia boasts of having the world's largest proven oil reserves and being among the world's largest producer and consumer of electricity. However, Saudi Arabia is facing unrestrained domestic fuel consumption, which has increased by more than 30% since 2000. This increased and inefficient consumption is causing environmental pollution and costing the country's budget in subsidizing electricity price that may add pressure on government. This study aims to measure the residential sector knowledge and awareness about energy conservation, which is the biggest sector in power consumption. The study uses questionnaire surveys containing quantitative and qualitative questions focused mainly on consumers' awareness in billing, efficient appliances and lighting systems. Results suggest that Saudi consumer behaviors in energy consumption are influenced by social, cultural, educational and economic factors.

**Keywords:** Energy Conservation, Energy Efficiency, Electricity Demand, Saudi Arabia

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## 1. Introduction

Although Saudi Arabia is one of the largest world oil and gas producers, it is also the largest oil consuming nation in the Middle East. The country consumed approximately 3 million barrels of oil per day in 2012 [1–3]. According to the latest Saudi energy efficiency report, "Saudi Arabia's primary energy consumption per capita is 3.6 times higher than the world average, at 6.7 toe in 2010" [4, 5].

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The Kingdom of Saudi Arabia is known for its fast economic growth, mainly caused by the discovery of oil and natural gas. However, relying only on fossil fuels for generating electricity will cause many problems in the long run. On a per capita rate, Saudi Arabia has high electricity consumption. Some causes for that high consumption is the improvement in living standards, which leads to the increasing usage of house appliances, the low electricity prices which recently increased but still consider low, the non-existence of building codes regarding power containing and isolation of existing buildings, and the consumers habits (e.g. keeping the lights, ACs, and TVs on) [6-11].

Saudi Arabia is among the largest countries in supplying the world with oil and gas. However, the area is experiencing both population and industrial growth, causing a huge demand for power and especially electricity which may create some energy crisis. As a consequence of the high oil and gas per capita consumption rate, the emission of CO<sub>2</sub> in the region is unfortunately very high [1, 4]. It is also volatile in terms of prices and production rates [11], therefore depending on it economically is a challenge that the country should change.

In other words, the high demand for energy, the environmental impact of burning fossil fuels, and the economic need to depend on other sources of income than only oil leads Saudi Arabia to benefit from energy efficiency and conservation in addition to use renewable and green energy resources. Although some research has been conducted on energy efficiency in Saudi Arabia, some issues remain unclear. Samar et al [12] have conducted similar research in 2014 to investigate the reasons behind the lack of energy efficiency practice amongst Saudi Arabia's consumers and how consumer behavior may be changed to reduce energy waste and increase efficiency. Their study was on survey questions mostly with open ended where some respondents might found it hard to express their answers.

Recent reports highlight that Saudi Arabia's "electricity consumption has been growing rapidly since 1990 (+6.2 percent/year) and that surge was propelled by demand in the residential and service sector" [13]. This study focuses on the housing sector, with the aim of providing a better understanding of the reasons behind the lack of awareness on energy consumption in Saudi Arabia.

This research explores what could be changed about Saudi consumer behavior that may help increase energy efficiency, reduce energy consumption and cut on (CO<sub>2</sub>) emissions. It also explores the effects of enhancing energy efficiency practice on energy security in the country.

## 2. Energy Efficiency Initiatives

In recent years the government of Saudi Arabia has taken strong measures towards energy efficiency programs by introducing some initiatives. Those programs are planned, implemented and followed up by the Saudi Standards, Metrology and Quality Organization (SASO) and The Saudi Energy Efficiency Center (SEEC).

### 2.1. The Saudi standards, metrology and quality organization (SASO)

In 2010, the SASO has issued this regulation which aims to rationalize the consumption of electric energy in order to preserve the national economy as well as reduce consumption to the average consumer, by providing scientific and practical means based on standards, with taking advantage of the international practice in this area, and to set areas of standardization in the service of all interested parties, especially the average consumer who needs a practical, simple and reliable way from a neutral party to be able to compare different electrical products in terms of efficiency in the electric consumption by the label installed on each device, to have the ability to acquire devices with high efficiency in the electric consumption without incurring conformity expenses by testing, or the need to go into the standards technical details, which is handled by (SASO) on his behalf [14].

The energy efficiency label for electrical appliances is a label to educate the consumer attached on the electrical appliances such as (air conditioners, refrigerators and other) includes clarification of the appliances' performance and efficiency in the electric energy consumption and providing some necessary information before buying in a clear, simple and easy way, see Fig 1. Applying of this label will contribute to rationalize the electricity consumption on the country and the consumer in general, which leads to reduce the burden of monthly expenses.

### 2.2. The Saudi energy efficiency center (SEEC)

The center responsible for the development of energy efficiency and conservation policies targeting all sectors. (SEEC) was created by the Council of Ministers in October 2010, based on a Royal Decree and currently operating under the umbrella of King



**Figure 1:** A sample of energy efficiency label used in Saudi Arabia [15].

Abdul Aziz City for Science and Technology (KACST) and teamed up with major players such as ministries and other governmental entities as well main energy companies in the country to provide particular services and solutions, resulting in reduced costs and better quality by setting up national program for rationalization and enhance energy consumption efficiency, as well the required plans [16]. Currently, the program is establishing initiatives for the most important three sectors, which its consumption represents more than 90% of the total local energy consumption, i.e. construction, land transportation, and Industry sectors.

As in this research the focus is on the residential energy consumption sector and in this the program studied the best international practices to specify the standards which provide best energy efficiency in air conditioning, thermal insulation materials, lighting, and home appliances. The program develops new systems and mechanisms to monitor air conditions and insulation materials whether imported or manufactured in Saudi Arabia, to ensure compliance with the Saudi metrics and specifications. As far as the Saudi code concerned, the program, in coordination with the National building code committee updates and simplifies the standardized criteria and procedures mentioned in the code which related energy efficiency, in addition to setting mechanism that guarantee implementing the code.

The program is developing initiatives for the new buildings, starting with the units being developed by governmental financing (Ministry of Housing: half million unit, Aramco: 7000 units, SABIC: 4000 unit) [15], and the new governmental buildings, including mosques, schools, and hospitals, and reaching the private buildings not being constructed yet, to ensure compliance with program's objectives, and to be a role model for the people.

In regard to the existing buildings, the program will execute some projects to modify some of the existing governmental buildings, and launch a lead to encourage people to modify their houses, and use high energy efficiency appliances to rationalize and enhance energy consumption efficiency.

### 3. Methodology

#### 3.1. Outline of the questionnaire

A survey has been designed to investigate the public awareness on energy conversion, and willingness to use energy efficient appliances in their houses. The survey was handed in hardcopy and distributed among participants. The form consisted of a short description of the research topic, assurance of confidentiality (names, addresses and phone numbers), and the contact information for researchers.

The survey mainly consisted of three parts: first of all, demographic questions; secondly, questions measuring the public's knowledge energy billing including tariff used and bill information. Thirdly, questions measuring the public's willingness to start using energy efficient appliances in their households.

#### 3.2. Study area and samples

A total of 528 interviews were conducted, with inhabitant of the three major cities in the Kingdom, Riyadh city, the capital of Saudi Arabia, Dammam city in the eastern province and Jeddah in the western province. 58% of participants were in Dammam area as it is the residing area of the research team, 28 % of participants from Riyadh area and 16% from Jeddah area.

The majority of the participants (60%) are in their early twenties to early forties (Fig.2), all employed and have their independent incomes, with an average age of

approximately 35 years. Figure 3 demonstrates the level of education for the participants, 19.7% of the participants hold diploma, 49.4% hold a bachelor’s degree and 8.2% have postgraduate degrees, which means that the sample is considered an educated sample.

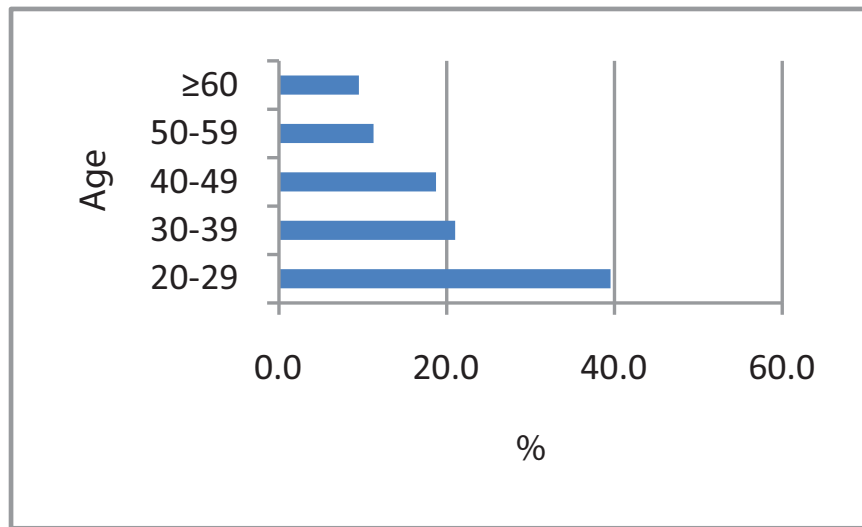


Figure 2: Participants according to their age groups.

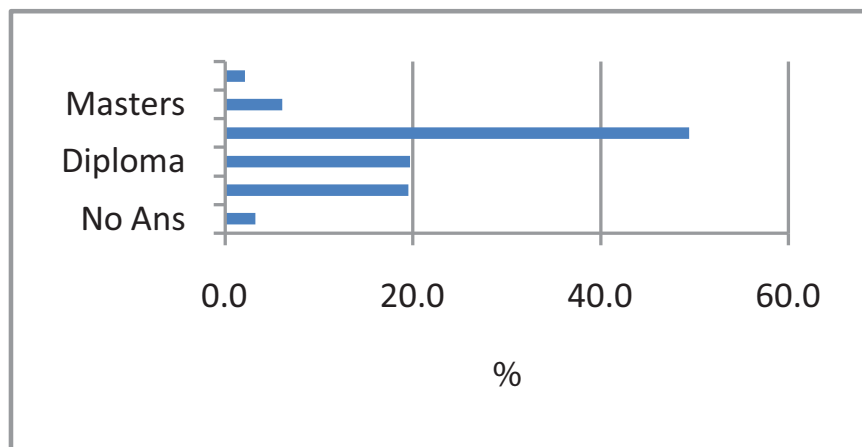


Figure 3: Participants according to their education.

Regarding the samples housing status, 41% of the participants lived in rented houses, meanwhile 50% owned their own homes, and 9% gave no answer to this question, see Fig. 4. This indicates a fairly wealthy sample.

The annual income of the participants is shown in Fig. 5. According to General Authority for statistics in Saudi Arabia, that in 2013, the household monthly income was 13,610 Saudi Riyal [7]. After observing the results of this survey it was found that

46% of the sample has an income approximately equal to and higher than the average income of household in the kingdom.

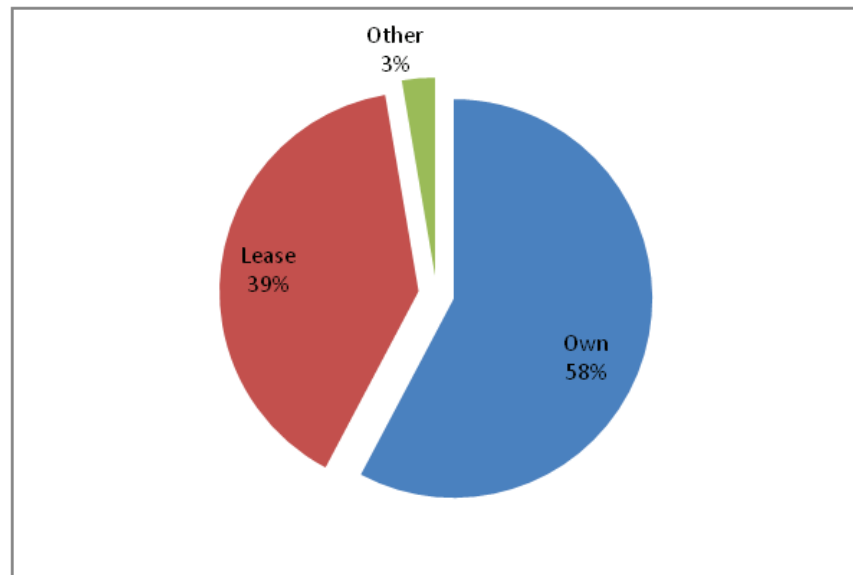


Figure 4: Participants according to their type of housing.

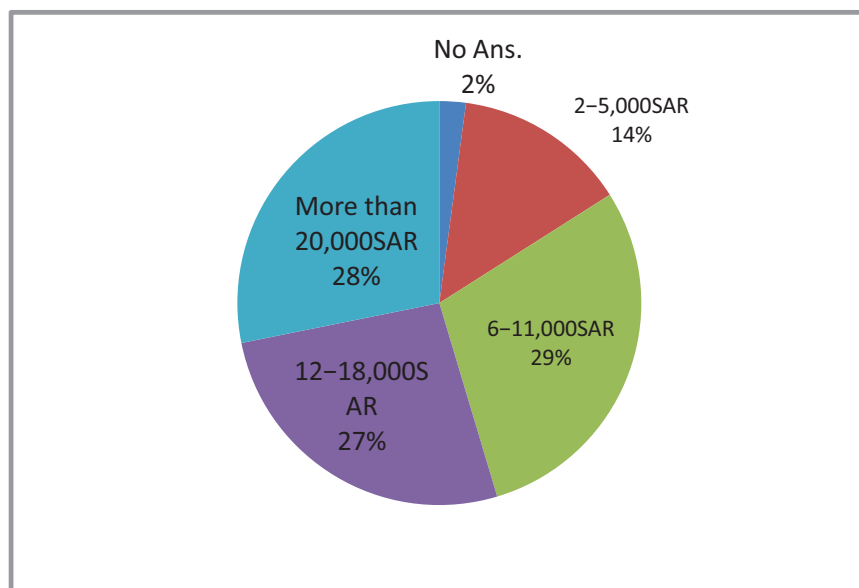


Figure 5: Participants according to their annual household income.

The average electricity cost per month for participants is shown in Fig. 6. 40% of participant paying up to 200 Saudi Riyals which is considered really cheap. 31% of participants pay between 200 and 500 Saudi riyals whereas 29% of participants pay approximately of more than 500 SA.

## 4. Results

### 4.1. Knowledge of electricity bill

In an attempt to measure the participants' knowledge of the electricity bill they were asked to identify which of the following information that they are aware of: electricity cost. 47.7% considered electricity is expensive, 30.1% think it is not Where 21.6% are not sure of their answers as shown in Figure. 7. Although electricity tariff in Saudi Arabia is among the lowest rate in the world due to the high government subsidy people get used to this rate for years and obviously they rely on government support.

Regarding the electricity block tariff system, 38.3% of participants are aware of the tariff system used in calculating their electricity bill where is 60.8 % have no idea about tariff system and electricity rate on their bill, see Fig 8. This can tell that the high majority that they do not look at the tariff system that shown on the electricity bill that the electricity price is cheap otherwise they will carefully look at the bill.

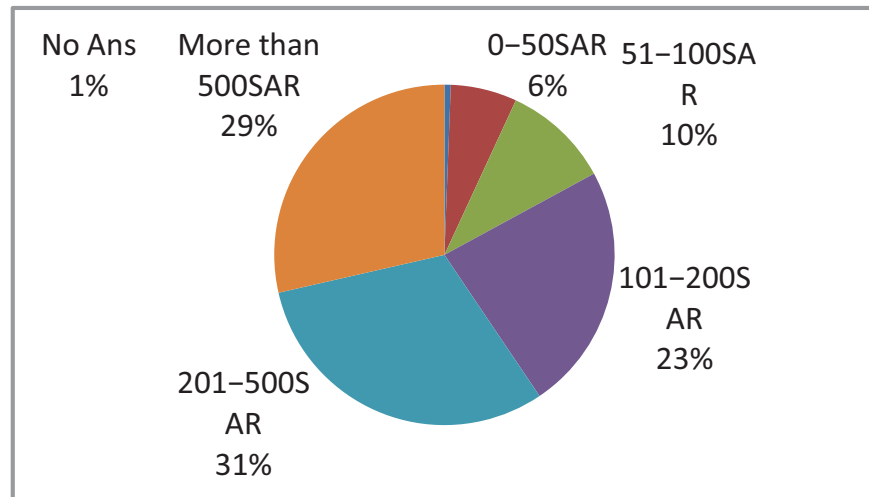


Figure 6: Average electricity cost per month.

Whether participants look carefully at the electricity bill: 50.5% they do look at their energy consumption on the electricity bill where is other do not as shown in Fig. 9.

Obvious those who do not look they must consider the electricity price is too cheap otherwise they would look and check the amount they have to pay.



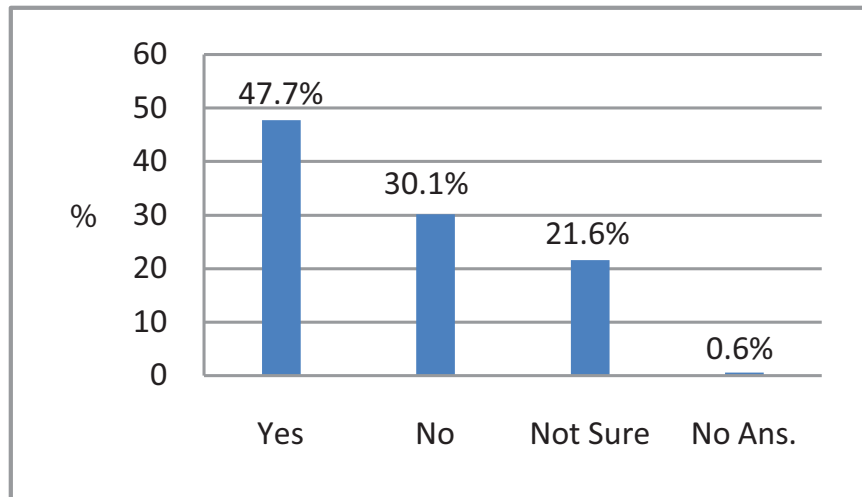


Figure 7: Do you think electricity is expensive?

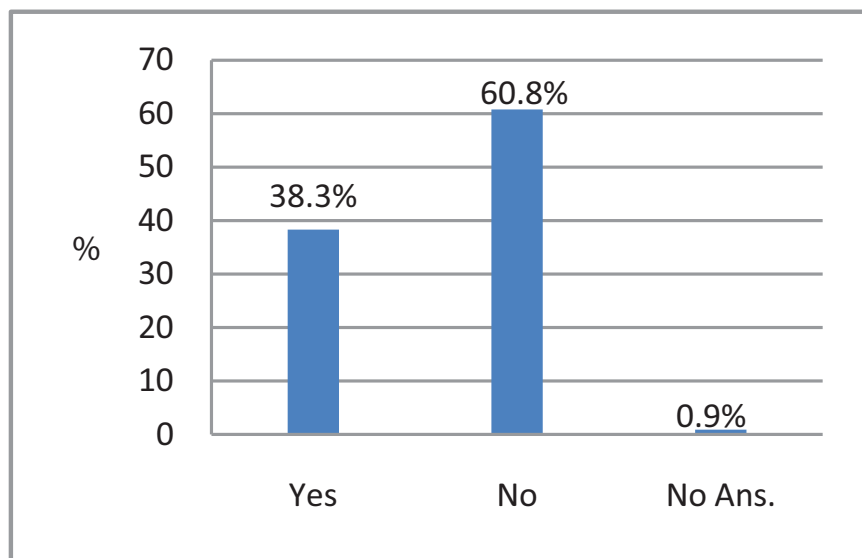


Figure 8: Awareness of electricity block tariff.

#### 4.2. Knowledge and willingness to use energy conservation

Regarding the main concern of this research, 83.7% of the participants considering electricity conservation important where for 16.3% of the participants is not important. See Fig. 10. It is obvious that major numbers of participants are in favor of energy conservation even if some of them do not apply it.

Whether participants are aware of energy efficiency label (star rating) system for electric appliances, 57% of participants are aware where is 42% have no idea, see Fig. 11. This indicates that 57% of the participants are aware and know what does it mean regardless that they are using star system or not in their homes.

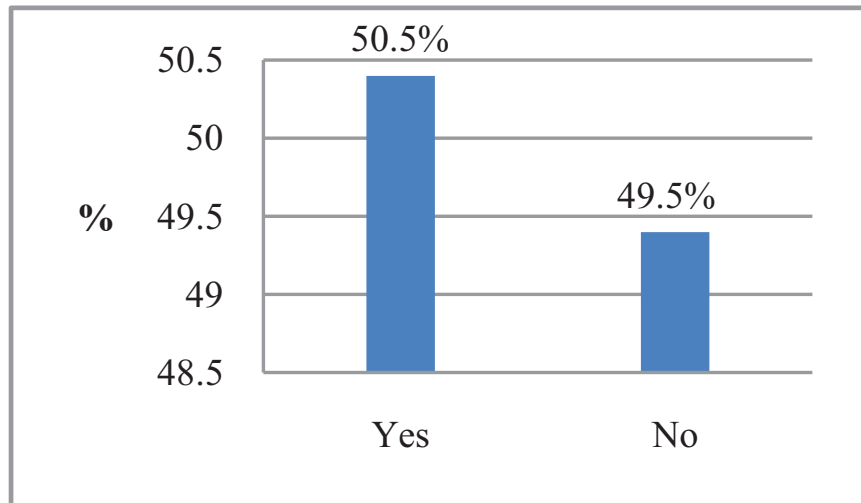


Figure 9: Do Participants read electricity bill carefully?

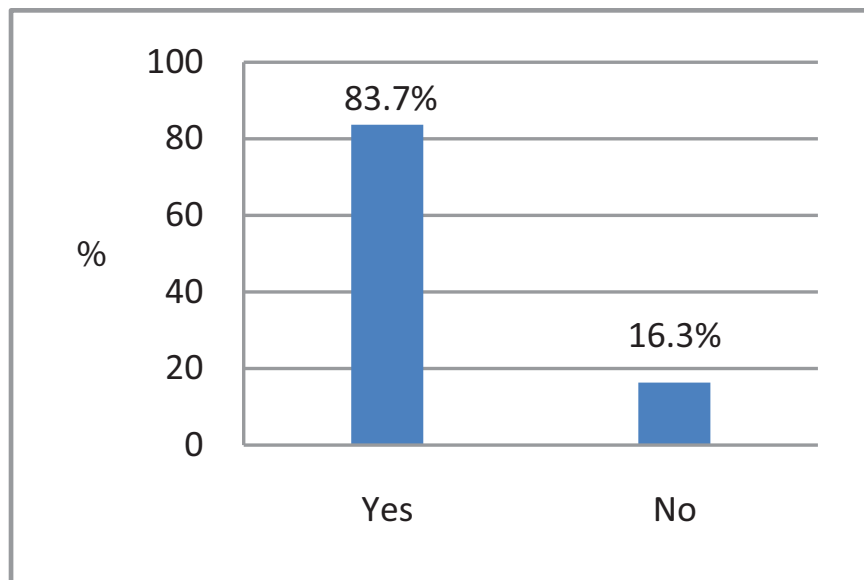


Figure 10: Is electricity conservation important?

Regarding if participants would check the appliances energy efficiency label before purchasing, 52% of participants are to look at labels before purchasing where 47% do not look, see Fig. 12. Of course the higher number of stars the appliance has the more efficient in power consumption. Customers who are not too familiar with star system can get help from sales people at selling outlets.

The next question in the survey is what is the star rating for the appliances in the participants' houses? This will include different home appliances such as refrigerator, oven, microwave, washing machine, dryer and dishwasher.

The participants required to answer that how many stars on the appliances efficiency card that they are using. Table 1 shows the percentage of participants' response to different appliances with stars rating from one to seven. Between 53 to 81 % of participants that they do not have efficiency cards on their home appliances. The remaining percentages of stars usages are mainly range from one star to 5 stars. Six and seven stars appliances are too low, Fig. 13 shows the percentage of stars used in different appliances. The highest number of participants that they have star labels in their home are when using refrigerators which represent 47% of participants.

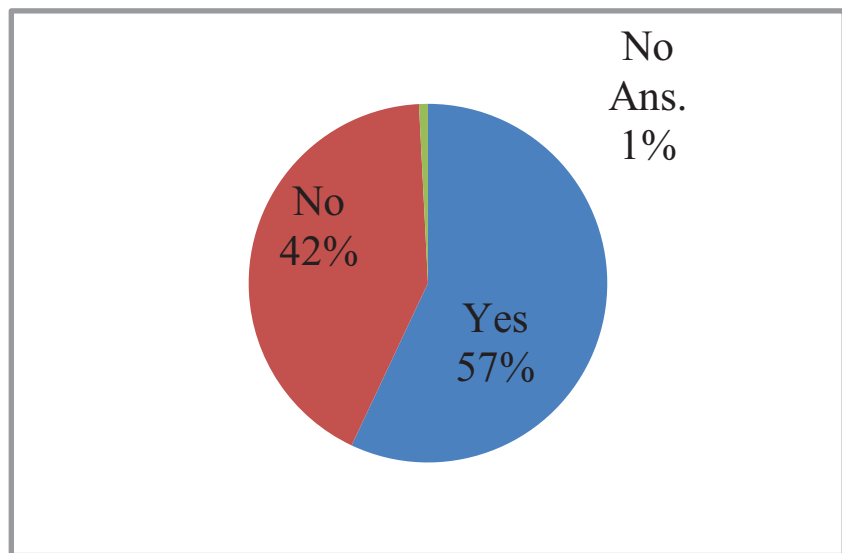


Figure 11: Participants Awareness of star rating system.

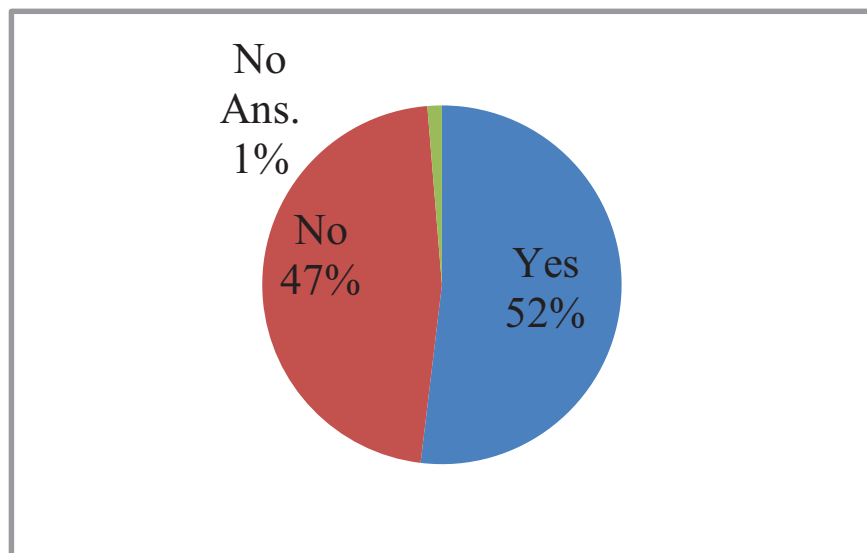


Figure 12: If Participants would check the appliances energy efficiency label before purchasing.

TABLE 1: Percentage Of Participants' Response To Appliances.

	Refrigerator	Oven	Microwave	Washing Machine	Dryer	Dishwasher
None	53.0	72.7	75.0	68.2	76.3	81.8
1 Star	14.0	6.1	5.7	7.0	6.3	4.9
2 Stars	1.5	2.3	2.7	1.1	0.6	1.9
3 Stars	6.4	4.4	6.6	4.0	4.4	2.8
4 Stars	11.4	6.1	4.9	9.7	5.5	4.2
5 Stars	11.6	7.8	4.0	8.5	5.5	3.6
6 Stars	1.7	0.4	0.6	0.9	0.6	0.6
7 Stars	0.4	0.4	0.6	0.6	0.8	0.2

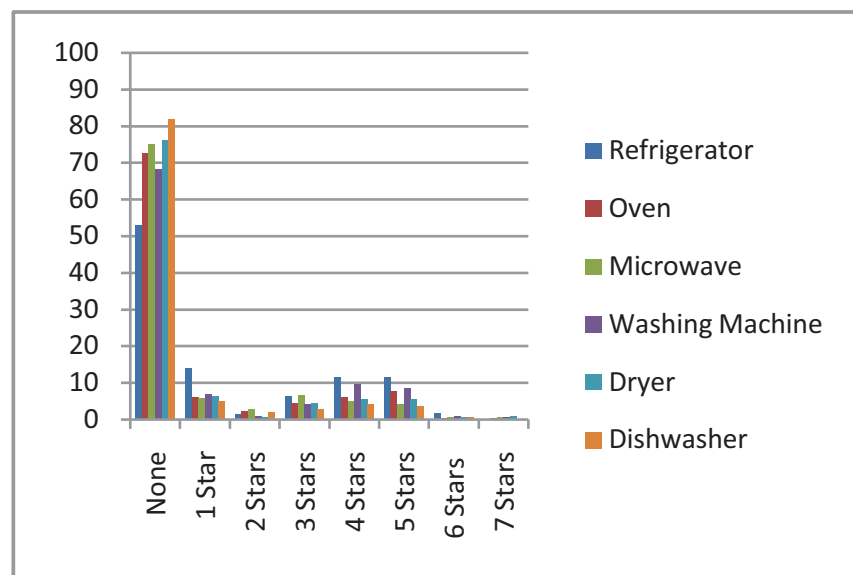


Figure 13: Percentage of stars used in different appliances.

Table 2 showing the final part of the survey questions dealing with the participants' knowledge and usage of efficient lighting systems. The question to participants whether if they have an efficient lighting system used in their homes and what type of lightings are using such as fluorescent tubes, compact fluorescent tubes CFL, LED and motion sensors. If we exclude motion sensors as only 4.4 % of participants are using it and this is justifiable as it probably exists in some participants trying to live in smart home. 20 to 38% are using fluorescent tubes, CFL and LED but there are high percentage of participants 61.7 to 79.7% has no answers at all which can be considered as no answer, see Fig. 14.

TABLE 2: Percentage Of Participants’ Knowledge And Usage Of Efficient Lighting Systems.

	Fluorescent Tubes	CFL	LED	Motion Sensors
No Ans.	72.0	79.7	61.7	95.3
Yes	27.8	20.1	38.1	4.4
No	0.2	0.2	0.2	0.4

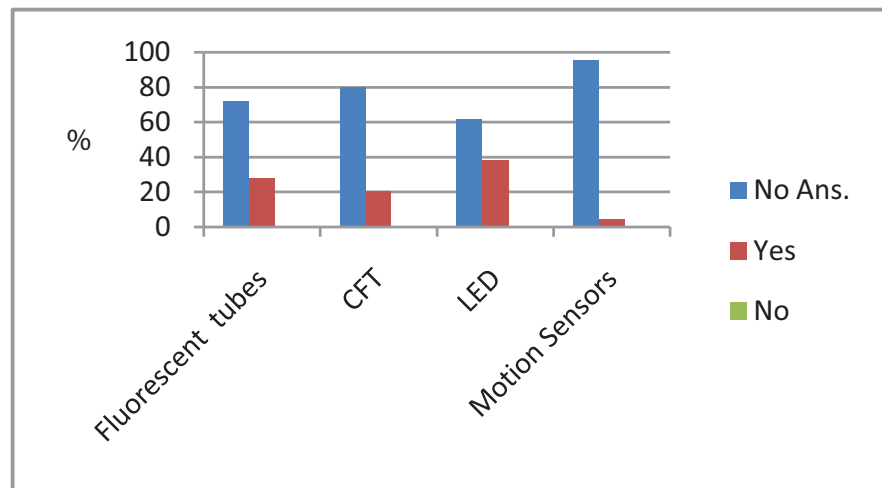


Figure 14: Using efficient lightings system.

## 5. Conclusion and Recommendation

As a continuously growing country, Saudi Arabia should always prepare for the increase in power demand. Consumers’ energy conservation and the use of efficient appliances at homes is becoming a must. This has many benefits to consumer by reducing the electricity bill and to the country by saving on fossil fuel, less subsidy and cleaner environment.

This study has attempted to bring facts regarding consumer awareness and behavior towards energy efficiency in Saudi Arabia. The key assertion highlighted in this study is that there are major problems relating to consumer behavior in Saudi Arabia, especially with low income and undereducated individuals. However, even well educated people who demonstrate some awareness of energy efficiency measures do not appear to follow energy efficiency habits in their daily life. In order to tackle the risk of increased energy consumption, a number of measures can be taken at a residential level.

Despite government efforts in response to the increasing energy demand, bad consumer habits remain. Consequently, the authors propose a number of recommendations to improve energy efficiency and to increase consumers’ positive attitudes towards energy consumption.

These recommendations are: Focus on consumer education through SEEC and media, market efficiency for people at work, schools, universities and mosques. It will be good idea to add it to school curriculum to educate children about energy efficiency. Energy efficiency programs must be accelerated and campaigned by government. Finally, this research recommends that the country may use a balanced system of energy subsidies which has risen early this year but still consider cheap comparing to other countries in the region, the government planning to review regularly the energy price over the next 5 years which is a necessary measure has been waited for many years.

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