

Original article

Residential Energy Consumption Patterns and Efficiency Awareness: A Case Study of Ajelat City

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Abstract

Conserving electricity in homes is a crucial aspect of addressing the challenges of climate change, meeting the need for greater energy efficiency, and avoiding total blackouts caused by excessive electricity consumption. This study aims to evaluate energy conservation and efficiency awareness practices of households in Ajelat City, Libya. The study also examined the level of energy conservation practices and the extent of their variation, as well as the level of awareness and education regarding energy saving among households. Also, the analysis of household characteristics which participate in this study. Data were collected using Google Form through a questionnaire consisting of 16 items. The total number of respondents was 88 male and female households. The data were analyzed by using SPSS program software. Quantitative data were analysed using frequency and percentage (demographic variables). The findings show that most respondents were male and married, and had a higher level of education. The majority of them were government employees. The results also showed that the level of awareness regarding energy conservation among households is low; while some families were able to explain the concept, the vast majority were unfamiliar with it. This is attributed not only to the inadequacy of energy conservation awareness campaigns in the region but also to the methods used to effectively convey this information to households—whether through local outreach or the General Electricity Company.

Keywords. Energy Conservation, Energy Efficiency Practices, Household Appliances, Energy Literacy.

Introduction

Energy conservation in household appliances has become a major concern amidst global challenges related to climate change and the growing need for energy efficiency [1]. With rising energy consumption and an increasing reliance on electricity in daily life, many households face high energy costs and significant environmental impacts [2,3]. In the current era, electricity usage is rising alongside the increasing number of electronic devices in homes [4,5]. The consequences of this increased electricity consumption extend beyond monthly utility bills, leading to serious environmental and economic issues such as climate change, making efforts to conserve electricity, particularly regarding household appliances, critically important [6]. Rising household electricity consumption has become an urgent global issue, as the use of increasingly diverse and complex home appliances drives up energy consumption rates [7]. Consequently, conserving electricity at the household level is a key priority given the high cost of energy and the environmental impacts associated with excessive consumption [8].

Energy conservation efforts aim to reduce the amount of energy required to achieve optimal usage. "Energy efficiency", whose objectives align with those of energy conservation, falls within the scope of rational energy use; this is achieved by improving management systems, altering consumption patterns, and adopting innovative technologies for utilising energy resources and electrical appliances [9]. Electrical energy is integral to all aspects of human life and serves as a fundamental pillar of socio-economic development. According to Comerford [10], the global population is projected to increase by 45% over the next nine decades, necessitating the fulfilment of growing energy demands. This energy must not only be available and affordable but also sufficiently clean to meet carbon neutrality requirements. Saving money is a primary motivation for many households, as reducing energy consumption directly translates to lower household costs. A study by [11] indicates that households implementing energy-saving measures such as using energy-efficient lighting and appliances achieve consistent monthly reductions in electricity bills of up to 20%, thereby easing their financial burdens. According to the study by [12], which expanded the online decision-making model to include the factor of energy savings, the following results were found: (1) Energy savings constitute a key consideration for customers when making purchasing decisions regarding energy-efficient equipment. (2) Consumers do not attach equal importance to energy efficiency when purchasing home appliances. (3) Perceived service benefits, perceived functional benefits, perceived price benefits, and brand trust all positively influence customers' intentions to purchase energy-efficient appliances. (4) Energy savings have a significantly weaker impact on purchase intention regarding energy-efficient appliances in the western region.

This study aims to evaluate energy conservation and efficiency awareness practices of households in Ajelat City, Libya. The study also examined the level of energy conservation practices and the extent of their variation, as well as the level of awareness and education regarding energy saving among households. Also, the analysis of household characteristics which participate in this study. This study offers multiple benefits, including economic advantages for households such as reduced electricity bills, environmental benefits through lower carbon emissions, and social benefits by fostering a culture of sustainability. Furthermore, the study's findings can support government initiatives aimed at improving energy efficiency standards and providing incentives for the use of energy-efficient equipment.

Methodology of The Study

This study employs a descriptive quantitative approach aimed at examining and analysing energy-saving behaviour within households. This approach was selected to gather measurable data regarding household energy consumption patterns and the effectiveness of energy-saving technologies [13].

Survey Design and Data Collection

The questionnaire was designed to measure the level of awareness regarding energy-saving technologies and attitudes toward energy efficiency. Based on a study conducted by [14,15], the researchers utilised the questionnaire implemented in the aforementioned study

The questionnaire is comprised of two sections

- The initial section delineates demographic variables (Gender, Age, Marital Status, Level of Education, Years of Residence, Monthly Expenditure for electricity bill, Income and job).
- The subsequent section encompasses (household size, members, Rate of using electrical tools among households, Awareness of Energy Conservation and energy efficiency labels for Appliances).

Results and Discussion

Respondents' Demographic Profile

The demographic profile of participants serves as an organised summary of the personal, social, and economic characteristics of individuals taking part in a research study, survey, or interview. Researchers collect this data to contextualise survey responses, verify that the sample represents the broader target population, and identify prevailing trends across different groups.

Table 1. Respondents' Demographic Profile

No	Respondent Characteristics		Frequency	Percentage
1	Gender	Male	58	65.9
		Female	30	34.1
2	Age	(30-40)	16	18.2
		(41-50)	20	22.7
		(51-60)	32	36.4
		(60 and above)	20	22.7
3	Marital Status	Single	0	0
		Married	72	81.8
		Widowed	4	4.5
		Divorced	12	13.6
4	Level of Education	without certificate	8	9.1
		primary school	8	9.1
		Secondary school	28	31.8
		Higher diploma, bachelor	34	38.6
		postgraduate	10	11.4
5	Years of Residence	(5-15)	24	27.2
		(16-25)	20	22.7
		(26-35)	28	31.9
		(36-45)	8	9.1
		(45 and above)	8	9.1
6	Expenditure Monthly for electricity bill	0 L.D	21	23.9
		30 L.D	49	55.7
		40 L.D	13	14.8
		50 L.D	5	5.7
7	Income	from 900 to 1500	12	13.6
		from 1501 to 2500	44	50.0
		from 2501 to 4000	16	18.2
		More than 4000	16	18.2
8	job	Government employee	76	86.4
		Freelancer	8	9.1
		Unemployed	4	4.5

First Gender

(Table 1) and (fig 1) show that the majority of respondents are male (65.9%), while female 34.1%.

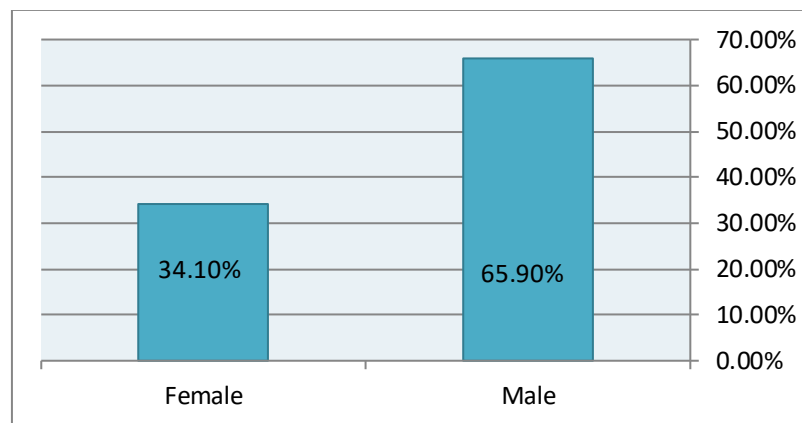


Figure 1. genders participate of the study.

Second Age distribution

Table (1) and Figure (2) show that the majority of the respondents (36.4%) fall within the age brackets (51-60 years), followed by age between (41-50 years) and (60 and above) by (22.7% respectively). Some studies have shown that the adoption of energy-efficient technologies is negatively correlated with age [60], and that older adults are the least likely to adopt energy-efficient appliances [16].

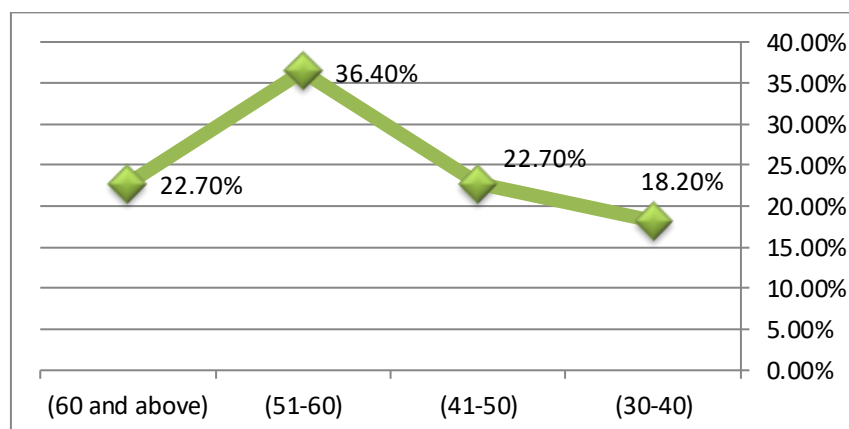


Figure 2. age participate of the study.

Third, marital status of the study

According to (Table 1) and (Figure 3), most participants of this study were married, represented by (81.8). Some studies indicate that social status significantly influences household energy conservation behaviours; this impact is expected to manifest as reduced electricity costs, increased household income savings, and a contribution to mitigating the effects of climate change [17, 18].

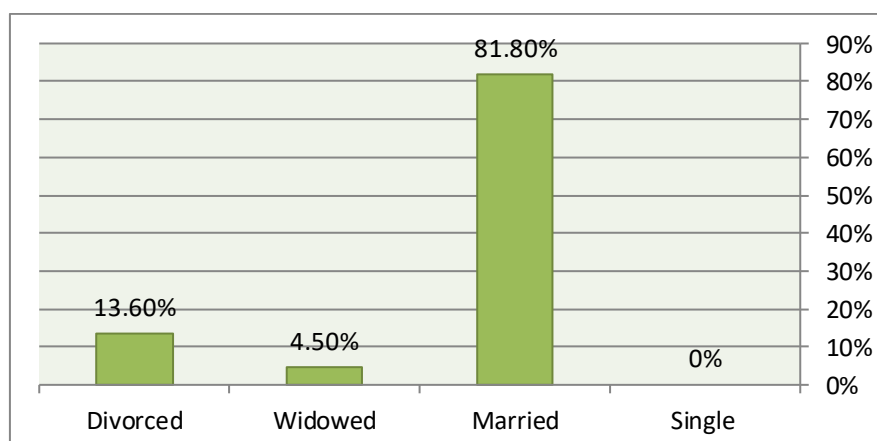


Figure 3. Marital status of participants of the study

Fourth level of education

In line with a study by Prete et al. [19], which demonstrated a positive relationship between the intention to adopt efficiency measures and higher levels of education among households in southern Italy, [20] concluded that higher education among heads of households leads to reduced energy consumption. And according to (Table 1) and (Figure 4), the majority of participants in this study having Higher diploma, bachelor (38.6%) then having Secondary school (31.8%), which indicates they have awareness of dealing with energy conservation.

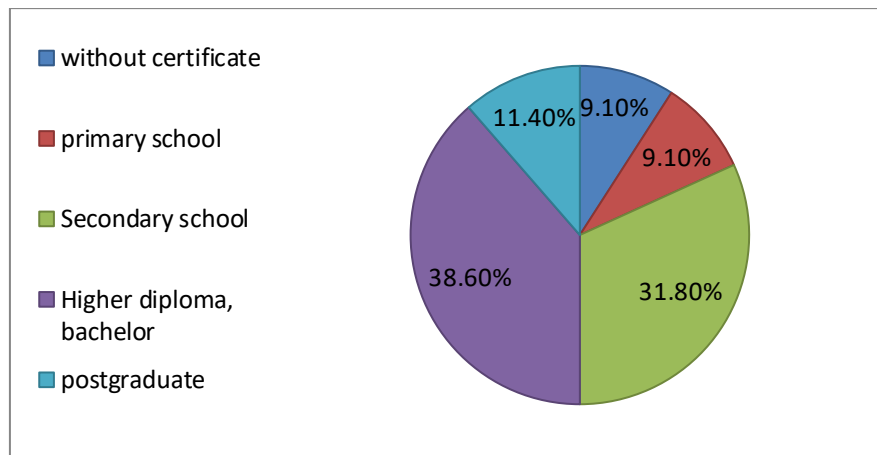


Figure 4. level of education of participants in the study

Fifth Years of Residence of participants in the study

Table (1) and Figure (5) show that 31.9% of respondents live at their home between 26 and 35 years, then the group between 5 and 15 years by (27.2%), followed by the group between (16-25) years, represented by (22.7%). According to the findings of previous studies, the longer a household resides in a single dwelling, the more likely it is to purchase or use energy-efficient appliances [21]. Previous studies also indicate that the older a consumer's home is, the more likely the household is to adopt energy-conservation practices [22, 23]. Owners of older homes may be inclined to adopt more comprehensive conservation measures compared to residents of newer homes.

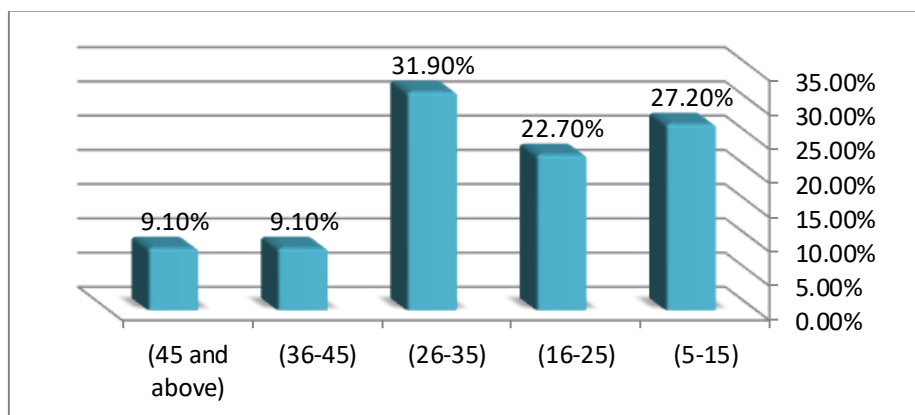


Figure 5. Years of Residence participant of the study

Sixth Expenditure Monthly for electricity bill

(Table 1) and (Figure 6) show that most participants of the study for monthly expenditure on the electricity bill were (30 L.D), represented by (55.7%), indicating their subscription to the prepaid service (smart meters). Also, some of them did not make any payment for the electricity bill, which was represented by (23.9%).

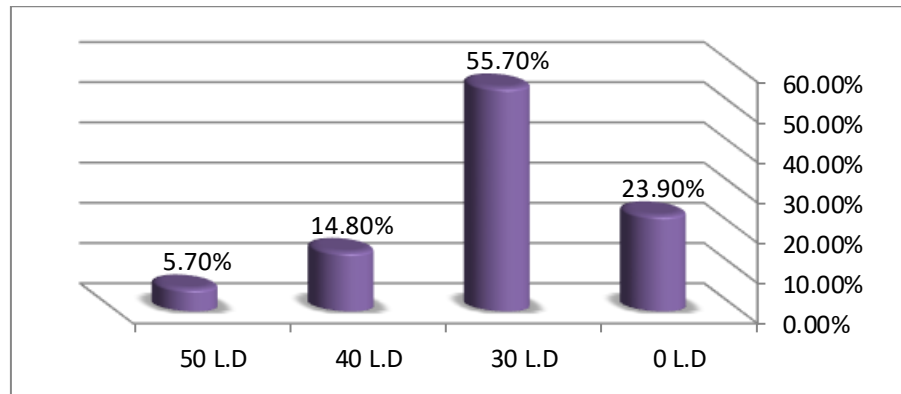


Figure 6. Expenditure Monthly for electricity bill

Seventh Incomes of Participants In The Study

(Table 1) and (Figure 7) shows the 50% of participants in the study have incomes between (1501- 2500) L.D. This refers to the middle class in society; therefore, the higher a household's income, the greater the likelihood of its ability to optimise energy consumption or choose energy-efficient appliances. Then, groups' income between (2501-4000) and more than 4000 L.D represented by (18.2%). which indicates having the power to choose energy-efficient appliances.

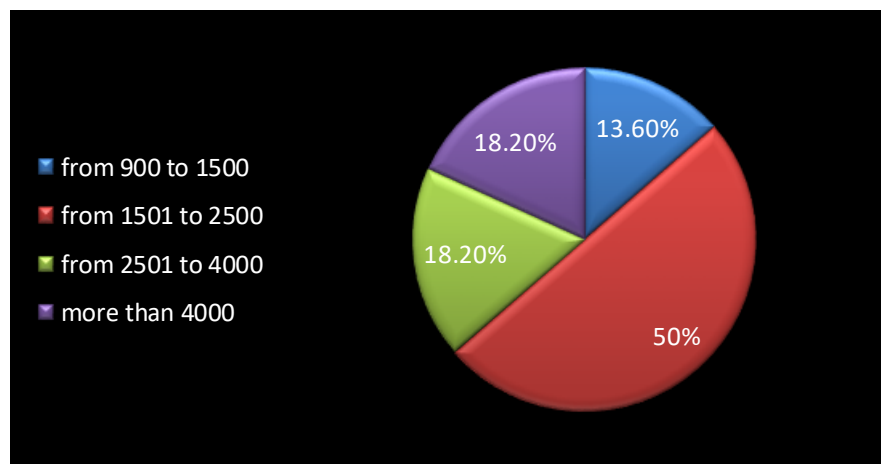


Figure 7. Incomes of participants in the study

Eighth The Work of Householders

As Shown In (Table 1) and (Figure 8), 86.4% of respondents work as government employees, while only 9.1% Freelancer and just 4.5% are unemployed.

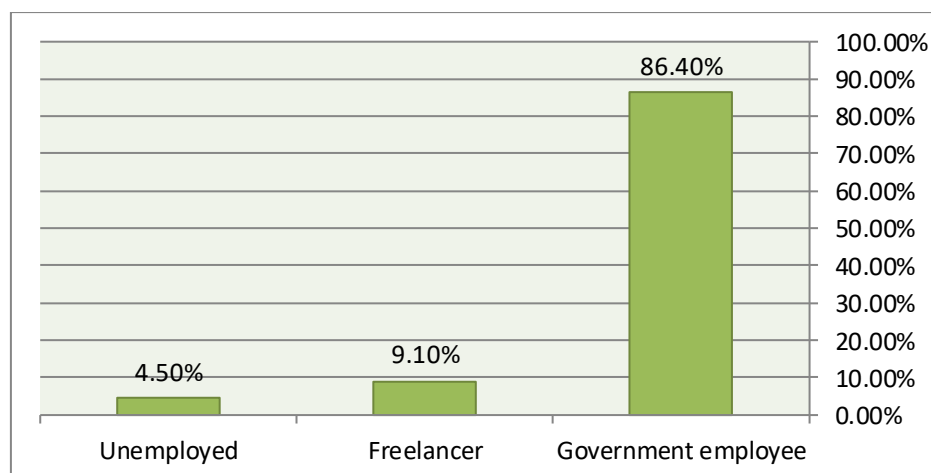


Figure 8. The work of householders

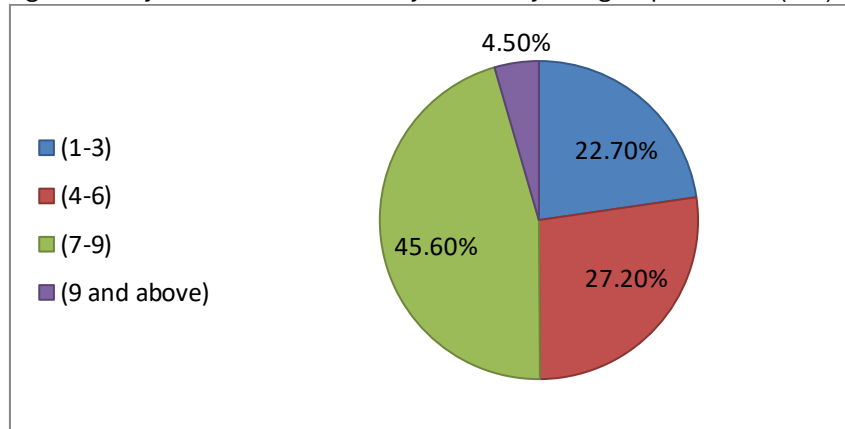
Householders Size

It is a foundational demographic and economic metric used by governments, researchers, and service planners to analyse housing markets. This result is significant, as it can be utilised as statistical data for planning purposes and for identifying patterns regarding the selection and use of electrical appliances by households within the urban area.

Table 2. Householder size

No	Respondent Characteristics	Frequency	Percentage
1	Household Size	(1-3)	20
		(4-6)	24
		(7-9)	40
		(9 and above)	4
			4.5

According to data collected from (Table 1) and (Figure 9), we found that 45.6% of householders' family members are between (7-9) persons. It is higher than the normal range. Then the group between (4-6) persons by (27.2%), which means it is within the normal range of family members. followed by the family size group between (1-3).

**Figure 9. Householder size**

Rate of Using Electrical Tools Among Households

In this section, participants were asked to indicate how often they turn off their electrical appliances to save energy when not in use, based on the following categories: "always," "sometimes," and "rarely." Regarding the practice of turning off electrical appliances when not in use (as an energy-saving measure), the cumulative responses indicate that the options "sometimes" and "rarely" are the least common across all respondents and for all appliances listed in Table 3. We found that (77.3%) of respondents do not use TV. Also, (72.7%) of them using Iron "sometimes" and "rarely". On the other hand, (100%) of them always using Fridge/Freezer, followed by Air conditioning because this study was conducted during the summer season. Then, we found that most of them used a light bulb; finally, half of the respondents used an electrical heater.

Table 3. Rate of using electrical tools among households

No	Items	Always N(%)	Sometimes	Rarely	Mean	St.Dev
1	TV	20(22.7)	28(31.8)	40(45.5)	2.23	0.798
2	Light bulb	60(68.2)	24(27.3)	4(4.5)	1.36	0.571
3	Fridge/Freezer	88(100)	0(00)	0(00)	1	0.000
4	Iron	24(27.3)	36(40.9)	28(31.8)	2.05	0.772
5	Air conditioning	64(72.7)	20(22.7)	4(4.5)	1.32	0.558
6	electric heater	48(54.5)	40(45.5)	0(00)	1.45	0.501

Awareness of Energy Conservation

Households view energy conservation primarily as a financial necessity to lower monthly utility bills and as a practice based on simple habits, such as turning off lights or unplugging unused appliances, rather than as a complex technical strategy to mitigate the effects of global climate change.

Table 4. Energy conservation from the point of view of households

No	Respondent Characteristics	Frequency	Percentage
1	Households perceived meaning of Energy conservation Energy Conservation Response	Don't Know	56
		Using available energy judiciously	24
		Using energy only when needed	8
			9.1

The responses presented in Table (4) and Figure (10) indicate that households in the "Al-Ajaylat" area lack a sufficient understanding of the concept of energy conservation; notably, 63% of respondents answered, "I don't know." This may be attributed to the inadequacy of energy conservation awareness campaigns in the area, as well as issues regarding the

methods used by the General Electricity Company to effectively communicate this information to households. On the other hand, (27.3%) use available energy judiciously. Increasing consumer knowledge through the use of appropriate terminology, language, and communication methods that facilitate the understanding of energy conservation principles can improve household energy saving practices. As noted by Nunoo [24], Amos-Abanyie et al. [25], and others, consumers often engage in energy-wasting behaviours due to a lack of knowledge or awareness regarding energy usage and its associated negative consequences. A case in point is the situation during the summer of 2026, which saw persistent power outages and blackouts across the entire country.

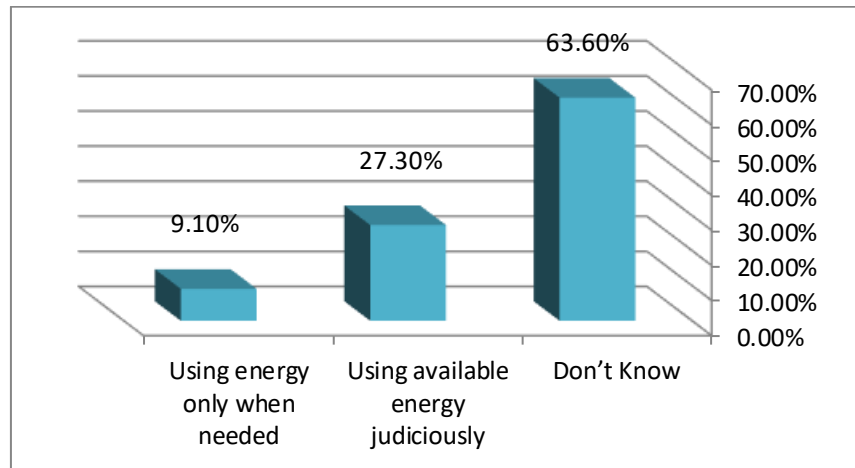


Figure 10. Energy conservation from the point of view of households

Energy Efficiency Label for Appliances

As shown in (Table 5) and (Figure 11) there are 55.7% of respondents do not have informed knowledge of what energy efficiency labels are, which this mean maybe those people buy some electrical machines that consume a lot of electricity, leading to increased demand for electrical power. On the other hand, 44.3% of them having informed knowledge of what energy efficiency labels are.

Table 5. Energy Efficiency Label

No	Respondent Characteristics	Frequency	Percentage
1	Do you have informed knowledge of what energy efficiency labels are	yes	39
		no	49

Labels on electrical appliances must be clearly displayed so that they effectively contribute to the success of household energy conservation and efficiency programs.

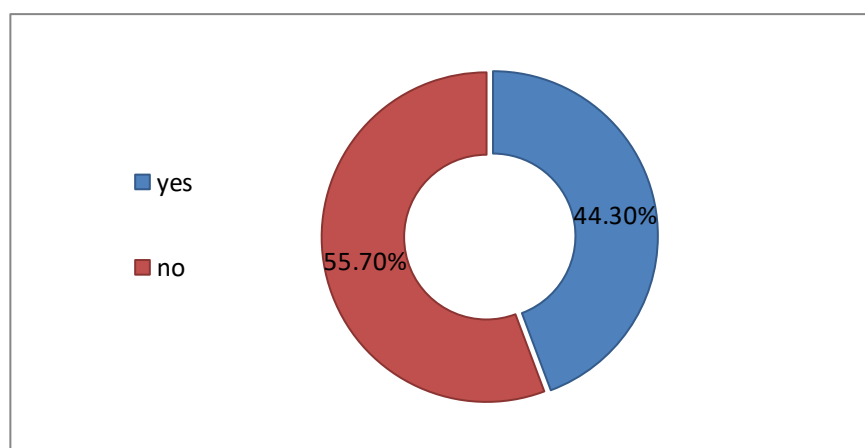


Figure 11. Energy Efficiency Label

Conclusion

One of the fundamental pillars for addressing the challenges of energy depletion is the rationalisation of household electricity consumption, which helps prevent widespread power outages caused by excessive usage. This study aims to evaluate the practices of households in the city of Al-Ajaylat, Libya, regarding awareness of energy conservation and efficiency. It examines the extent and variation of energy-saving practices, as well as the level of household awareness and knowledge concerning energy conservation. The results indicate that the majority of participants were married males with high levels of education, most of whom were employed in the public sector. The findings also reveal a low level of

awareness regarding energy conservation among households; while some families could explain the concept, the vast majority were unfamiliar with it. This is attributed not only to the inadequacy of energy conservation awareness campaigns in the area but also to the methods used to effectively convey this information to households—whether through local awareness initiatives or the General Electricity Company.

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