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# Electricity conservation behaviors: Evidence from Kuwaiti households*

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## Abstract

**Objectives**: This study examined households' electricity conservation behavior in Kuwait by estimating models for 8 curtailment and 8 efficiency measures using data from a 2017 household survey. The objective was to determine factors driving household curtailment and efficient electricity conservation measures. **Method:** Given Kuwait's demographic composition, separate econometric models were used for Kuwaitis and expatriates. **Results:** The different models suggest that households engaged in conservation efforts by investing in efficient technologies and by changing habits and practices with more profound effects among expatriate households. The models for efficiency measures were found to exhibit better fit compared to the curtailment measures. Among the different explanatory variables, dwelling and households' socioeconomic characteristics were found to have limited bearing on conservation behavior. **Conclusion:** The results provide some evidence in favor of the theory of planned behavior where there was a relationship between environmental awareness and social interaction, and electricity conservation was established as expatriates and, to a

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lesser extent, nationals were more likely to adopt conservation measures in response to public campaigns.

***Keywords:*** conservation, curtailment, efficiency, households, planned behavior

# السلوك التوفيري لاستهلاك الكهرباء: أدلة من الأسر الكويتية*

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## ملخص

**الأهداف:** قامت هذه الدراسة باستقصاء السلوك التوفيري لاستهلاك الكهرباء من قبل الأسر في دولة الكويت وقد تم ذلك باستخدام 8 مقاييس مختصة بتقليص الاستهلاك و8 مقاييس خاصة بكفاءة الاستهلاك باستخدام بيانات من استطلاع ميداني للأسر تم اجراؤه في العام 2017. وهدفت الدراسة للتعرف على العوامل المؤثرة في الأسر للتوفير في استهلاك الكهرباء بنوعيه. **المنهج:** تم استخدام نماذج اقتصادية قياسية منفصلة للكويتيين والوافدين وذلك لاختلاف الخصائص السكانية بين المجموعتين. **النتائج:** كشفت نتائج النماذج المختلفة أن الأسر قد قامت بجهود لتوفير الكهرباء وذلك عن طريق الاستثمار في تقنيات تعزز من كفاء استخدام الكهرباء وعن طريق تغيير سلوكيات الأسر وكان ذلك أكثر وقعاً بالنسبة لأسر الوافدين. وقد تبين أن النماذج المستخدمة لتقييم مقاييس كفاءة الاستهلاك كان لها دلالة إحصائية أفضل من نظيرتها المستخدمة لتقييم المقاييس الخاصة بتقليص الاستهلاك. وقد تبين أن المتغيرات التي تتعلق بخصائص المسكن والخصائص الاجتماعية

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والاقتصادية للأسر كان لها تأثير محدود على باستقصاء السلوك التوفيري لاستهلاك الكهرباء. **الخاتمة:** توفر نتائج الدراسة بعض الدعم لنظرية السلوك التخطيطي حيث وجدت الدراسة صلة ما بين الوعي البيئي والتفاعل الاجتماعي بين الأفراد وسلوك توفير الكهرباء حيث كان الوافدون وبدرجة أقل المواطنون أكثر قابلية لتوفير الكهرباء عند التعرض لحملات توعية.

***الكلمات المفتاحية***: التحفظ، التقليص، الكفاءة، الأسر، السلوك التخطيطي

# Introduction

Energy conservation has become a matter of research interest since the early 1970s. This was first motivated by the energy crisis and rising concerns about possible resource depletion. Recently, the interest has moved to other issues, like global warming and concerns regarding biodiversity. Conservation research has focused on the household sector, which consumes secondary energy and accounts for a somewhat great share of total energy used. This is because the household sector is regarded as an energy sink due to various causes, including the differences in building attributes, differences in tenants' behavior, limitations associated with collection and distribution of data on energy use by households, and the high-priced costs of comprehensive metering of household end-uses. One of the main focuses of empirical research on energy conservation has been the determinants of conservation behavior. Most household energy conservation studies cover developed countries and differ in analytical background, focus, methodology, measures, and estimation technique (see, for example, Abrahamse & Steg, 2009; Banfi et al., 2008; Brounen et al., 2013; Kuai et al., 2022; Kumar et al., 2023).

Most of the studies attempted to investigate validity of the theory of planned behavior (TPB), a theoretical framework proposed in psychology to examine conservation behavior (Ajzen, 1985; 1991). Some of the key causes identified to be connected with energy conservation include dwelling features, household socioeconomic attributes, obstacles to energy conservation, environmental behaviors and inclinations, environmental awareness and responsibility, and ownership of energy-efficient machines. The effect of these factors on conservation behavior was found to vary across studies and

countries, underlying the importance of country-specific studies for effective policies to encourage energy conservation.

Despite the significance of household energy conservation, there are a small number of studies for oil rich economies such as countries in the Gulf Cooperation Council (GCC) (Alawadhi et al., 2022; Lin & Azar, 2019; Nahiduzzaman et al., 2018; Ouda et al., 2017). The GCC is a unique region. Firstly, since the 1970s the GCC countries went through exceptional socioeconomic development including high rates of income per capita, and high energy consumption. Secondly, GCC countries have had high population growth with its population consisting of two distinctive groups of nationals and expatriates. The expatriate group comprise the majority of the population, and each group differs in their socioeconomic dynamics. Thirdly, in most GCC countries, the electricity industry is owned by the government with a high subsidy on electricity consumption (the electricity tariff for residential electricity in Kuwait stood at flat rate of 2 fils/kWh between 1963 and 2018). This study investigates drivers of electricity conservation in Kuwait using data from a household survey that was completed in 2017 by Kuwait Institute for Scientific Research (KISR). To the best of our knowledge, this is the first study that evaluates electricity conservation based on population groups (nationals vs. expatriates) for Kuwait and the GCC countries and investigates the drivers of electricity conservation for Kuwait or GCC. The findings of the study are expected to be useful for the countries that share Kuwait's socioeconomic characteristics. The results give some support to TPB, which relates conservation to a series of factors including environmental awareness and social interaction. Additionally, the study finds significant differences in conservation measures among nationals and expatriates.

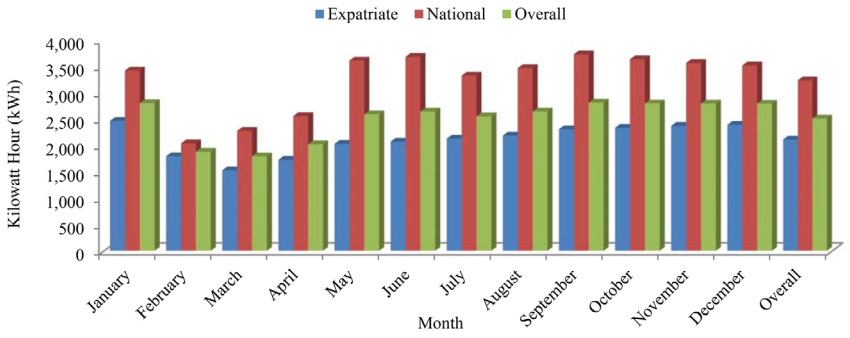
## Overview of Electricity Consumption and Conservation in Kuwait

Since the 1960s, the total consumption of electricity has grown exponentially for Kuwait. While population growth was the main driver behind this growth, constant increases in the per capita electricity consumption unveil the part of other causes, such as a high electricity subsidy, better living standards, and changes in lifestyles. According to Kuwait's Ministry of Electricity and Water (MEW), in 2018, the per capita consumption of electricity was 14,236, in comparison to 12,677 kWh for the year 2001 and around 8000 kWh in the 1980s (MEW, 2019).

Residential electricity consumption has the largest share of electricity consumption in Kuwait, amounting to 65% of total consumption in 2018 (MEW, 2019). Because of weather conditions, there are large seasonal fluctuations in electricity consumption. The main reason behind these fluctuations is the demand for air-conditioning (AC). A few studies have examined determinants of electricity consumption in Kuwait (Al-Enzi et al., 2004; Al-Qudsi et al., 1987). These studies stressed the importance of rationalizing the exiting electricity prices. Due to the lack of household level electricity consumption data, little is known about the electricity consumption dynamics for Kuwait, including the effect of different conservation measures. According to the survey, an average household in Kuwait consumes 2,510 kWh per month as shown in figure 1. Variations in electricity consumption were found between nationals and expatriates. An average expatriate household consumed 2,111 kWh of electricity compared to 3,235 kWh for an average national household.

## Figure 1

*Average Monthly Household Electricity Consumption*




The survey inquired about energy-efficiency features of dwellings, energy consumption and conservation habits, and other relevant data. Table 1 shows relevant survey results regarding efficiency features for dwellings. Assuming that it took a few years to fully implement the energy code, then housing units built in the 1990s onwards would be fully compliant; yet, only 37% of the housing units could be in conformity with the energy codes. This suggests that more than fifty percent of residential buildings in Kuwait are energy inefficient. The number and types of ACs owned by a household in Kuwait are considered to be a key influential conservation measure. Among AC types, package units (PU) have the utmost electricity efficiency, while window units (WUs) have the lowest electricity efficiency. Also, newer ACs and appliances are more efficient.

## Table 1

*Characteristics of Electric Energy Efficiency for Residential Buildings in Kuwait*

| Characteristic | % |
|---|---|
| Building Built after the Year 1990 | 37.2 |
| One Thermostat per Central AC | 49.7 |
| Thermostat is Digital or Programmable | 39.6 |
| Double Glazed Window | 25.1 |
| Tainted Window Glass | 26.1 |
| Roof Insulated | 53.5 |
| AC Duct Insulated | 76.5 |
| Building has a Central AC | 61.0 |

An average household in Kuwait has 3.2 ACs Table 2. A national household had an average of 5.3 ACs, while an expatriate household had 2 ACs. 82% of the ACs were purchased after the year 2000. 27% of the ACs had an energy-saving logo. An average household in Kuwait used 11 appliances, as Kuwaiti households used twice as many appliances compared to expatriate households. 95% of appliances were purchased in the last 15 years. 35% of the appliances had an energy-saving logo. Finally, 25.5% and 54% of the national and expatriate households reported using energy-efficient bulbs. The amount of electricity consumed depends on how ACs and appliances are used. The most important indicators are duration of AC use and thermostat setting. 81% of households reported using ACs for 7 or more months Table 3. For the summer, about 52% of nationals and 42% of expatriates reported maintaining the AC at 18–20°C. Overall, households either turn off the ACs during the non-summer months or raise the thermostat settings.

## Table 2

*Characteristics of Electric Energy Efficiency of ACs and Appliances*

| Characteristic | Expatriate | National | Overall |
|---|---|---|---|
| Average Ownership of Equipment | | | |
| ACs | 2.0 | 5.3 | 3.2 |
| PU | 0.6 | 1.7 | 1.0 |
| Other Type of AC | 1.4 | 3.6 | 2.2 |
| Appliances | 7.9 | 15.7 | 10.8 |
| Equipment Purchased Post 2000 (%) | | | |
| ACs | 33.8 | 48.6 | 82.4 |
| PU | 8.1 | 13.0 | 21.1 |
| Other Type of AC | 25.7 | 35.6 | 61.3 |
| Appliances | 97.5 | 93.6 | 95.4 |
| Equipment with Energy-saving Logo (%) | | | |
| ACs | 9.8 | 16.7 | 26.5 |
| PU | 3.9 | 5.3 | 9.2 |
| Other Type of AC | 5.9 | 11.4 | 17.3 |
| Appliances | 36.8 | 33.7 | 35.1 |
| Lighting (% of Households) | | | |
| Fluorescent | 53.7 | 25.5 | 43.2 |
| Mixed | 44.9 | 70.9 | 54.5 |

## Table 3

*Households' Practices by Population Group Associated with the Use of ACs and Appliances*

| Practice | Expatriate | National | Overall |
|---|---|---|---|
| Use of Air-conditioners: (Months) | | | |
| Six | 20.7 | 10.5 | 19.9 |
| Seven or more | 79.3 | 89.5 | 81.1 |

## Cont. Table 3

*Households' Practices by Population Group Associated with the Use of ACs and Appliances*

| Practice | Expatriate | National | Overall |
|---|---|---|---|
| AC Thermostat Setting (°C): Summer (May – August) | | | |
| 18–20 | 41.7 | 52.3 | 45.6 |
| More than 20 | 58.3 | 48.7 | 54.4 |
| AC Thermostat Setting (°C): Non-summer | | | |
| 20 – 24 | 20.2 | 25.0 | 22.0 |
| 24 + | 23.3 | 32.3 | 26.7 |
| Turnoff AC | 46.9 | 33.9 | 42.7 |
| Washing Machine Use | | | |
| Once a Week | 26.9 | 10.0 | 20.6 |
| Twice a Week | 60.1 | 48.0 | 55.6 |
| More than Twice | 13.0 | 42.0 | 23.8 |

## Literature Review

Energy conservation includes adoption of any action/measure that results in the use of less energy. The energy conservation literature identifies two main categories of conservation behaviors: the first is purchase-related (efficiency behavior), and the second is usage-related (curtailment behavior). Efficiency behavior involves adoption of technologies requiring less electricity to perform the same function. The adoption of new technology involves buying decision and introducing energy-efficient equipment (such as electric appliances), which reduce electricity consumption without changing the habits and practices of using them. Curtailment behavior is about to decrease in the usage of existing equipment/appliances by behavioral changes and involves decreasing energy consumption without changing equipment (see; Fujii & Mak, 1984; Martiskainen, 2008; Poortinga et al., 2003).

There are many studies that investigated the determinants of energy conservation behavior among households. Most of the studies attempted to investigate the validity of the TPB as proposed by Ajzen (1985) and Ajzen (1991) as a driver of household electricity conservation (Abrahamse & Steg, 2009; Banfi et al., 2008; Brounen et al., 2013; Charlier, 2013; Hori et al., 2013; Hua & Wang, 2019; Kuai et al., 2022; Kumar et al., 2023; Matsukawa, 2004; Mizobuchi & Takeuchi, 2015; Tanaka & Ida, 2013; Umit et al., 2019, Wang et al., 2011; Yue et al., 2013). For example, Abrahamse and Steg (2009) examined the impact of sociodemographic and psychological variables on a sample of Dutch household energy use. They found that energy use is determined by sociodemographic variables, whereas changes in energy use were influenced by psychological variables. Umit et al. (2009) find that, for 22 European countries, most sociodemographic variables positively affect curtailment and efficiency (education, age, household size); they also found that environmental concerns had the highest positive impact on conservation. Kumar et al. (2023) found, using US household data for the year 2015, a positive relationship between the household income and the efficiency measures, while the results are mixed with respect to the role of annual income on curtailment measures. Niamir et al. (2020) explored electricity consumption practices and their behavioral aspects on three venues: investments in house insulation, solar panels, and energy-efficient appliances, habit related conservation of electricity such as switching off unused devices, and switching to green electricity sources. They utilized a sample of 1790 households in Netherlands and Spain; using a probit regression method, they found a positive relation between awareness, social responsibility, and conservation. They also found significant effects of education and dwelling attributes with electricity conservation.

The role of environmental awareness and social interactions has been found to vary across studies. Abrahamse & Steg (2009) have shown that electricity-saving behavior depends on psychological and sociodemographic variables. Wang et al. (2011) emphasized the importance of culture to predict electricity saving behavior. Furthermore, Hua and Wang (2019) found that subjective norms, perceived behavioral control, and attitude affected buying decisions for electricity saving equipment. Chwialkowska et al. (2020) argue that understanding the role of cultural norms helps in encouraging pro-environmental attitudes. Finally, Carrus et al. (2021) used a meta-analysis of 67 studies to assess the associations among attitudes, intentions, values, awareness, and emotions and energy-saving behavior. They found positive associations between psychological determinants and energy-saving.

The empirical literature on electricity conservation behavior shows that factors influencing households can be grouped into dwelling characteristics, household head characteristics, household characteristics, awareness and attitudes toward conservation, and institutional/structural variables. The impact of conservation behavior drivers varies across studies and countries, underlying the importance of country-specific studies. Despite the significance of household electricity conservation, there are a small number of studies for oil rich GCC countries, which have extremely high per capita electricity consumption (Alawadhi et al., 2022; Lin & Azar, 2019; Nahiduzzaman et al., 2018; Ouda et al., 2017). All the studies have investigated the role of conservation on consumption rather than the drivers of electricity conservation; all found some positive effects between conservation behavior and reduction in consumption.

# Methodology

## Sample Frame and Enumeration Procedure

The household survey data were collected using a specially designed survey of a randomly representative sample of 1512 households, which was completed in 2017 (1,177 households used for estimation). The questionnaire consisted of a few modules related to households' electricity conservation. The sample was based on three main attributes of the household's nationality (national and expatriate), location (governorate), and dwelling type (villa/house, apartment). The sample was distributed across the three attributes based on approximate shares of each group in the total number of households in Kuwait. The distribution of the sample according to population group, dwelling type, and Governorate is shown in Table 4. The average age, income, and family size are reported in Table 5.

**Table 4**

*The Sample by Population Group, Dwelling Type, and Governorate*

| Governorate | Villa or House | | Apartment | | Total | |
|---|---|---|---|---|---|---|
| | Expatriate | National | Expatriate | National | National | Total |
| Aasimah | 42 | 58 | 14 | 20 | 78 | 134 |
| Ahmedi | 66 | 47 | 101 | 71 | 118 | 285 |
| Farawaniya | 99 | 38 | 173 | 66 | 104 | 376 |
| Hawally | 80 | 28 | 274 | 96 | 124 | 478 |
| Jahra | 70 | 49 | 17 | 13 | 62 | 149 |
| Mubark Al-Kabir | 16 | 66 | 1 | 7 | 73 | 90 |
| Total | 373 | 286 | 580 | 273 | 559 | 1512 |

## Table 5

*Average Household Size, Average Family Size, and Average Income*

| Nationality | Expatriate | | | National | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| Governorate | Female | Male | Total | Female | Male | Total | Female | Male | Total |
| Aasimah | 10 | 8 | 9 | 16.1 | 14.7 | 15.4 | 12.3 | 10.8 | 11.6 |
| Ahmedi | 15.6 | 14.7 | 15.2 | 21.4 | 23 | 22.2 | 17.7 | 18.1 | 17.9 |
| Farwaniya | 25 | 28.8 | 26.9 | 19.4 | 21.7 | 20.6 | 22.9 | 25.9 | 24.4 |
| Hawally | 29.9 | 31.5 | 30.6 | 16.7 | 17.9 | 17.3 | 25 | 25.9 | 25.4 |
| Jahra | 14.7 | 14.7 | 14.7 | 15.1 | 14 | 14.5 | 14.8 | 14.4 | 14.6 |
| Mubark Al-Kabir | 4.9 | 2.3 | 3.6 | 11.3 | 8.7 | 10 | 7.2 | 4.9 | 6.1 |
| Total (Individuals) | 3,111 | 2,680 | 5,806 | 1,835 | 1,877 | 3,720 | 4,946 | 4,557 | 9,526 |
| Age (Year.) | 27.6 | 27.4 | 27.5 | 27.8 | 27.2 | 27.5 | 27.4 | 27.6 | 27.5 |
| Household Size | | | 4.9 | | | 8.6 | | | 6.3 |
| Family Size | | | 4.8 | | | 6.7 | | | 5.5 |
| Income (KD) | 219.2 | 496 | 369.9 | 922 | 1,238 | 1,103 | 450 | 758 | 621 |

## Household Conservation Model

TPB hypothesizes that behavior is closely related to intentions, which indicate the extent of willingness to perform the behavior in question and are decided by attitudes, subjective norms, behavioral control, and residue effect. Attitudes denote the extent to which an individual has a favorable/unfavorable assessment of a given behavior and is influenced by environmental awareness and information. Subjective norms refer to individual perceptions of the extent to which significant others would endorse a given behavior and motivations to comply with this social pressure decided by social settings and environment. Behavioral control refers to the perceived level of ease or difficulty associated with performing a specific behavior, and economic benefits and costs are its main factors, whereas information, policy and social norms, past experiences, and economic benefits are

postulated to positively influence people's willingness to perform the behavior in question, and inconveniences have negative influence. The effects of environmental awareness and social interactions to perform a certain behavior are not always anticipated. Abrahamse and Steg (2009) have shown that electricity-saving behavior depends on psychological and sociodemographic variables. Wang et al. (2011) emphasized the importance of culture to predict electricity saving behavior. Furthermore, Hua and Wang (2019) found that subjective norms, perceived behavioral control, and attitude affected buying decisions for electricity saving equipment. Finally, Chwialkowska et al. (2020) argue that understanding the role of cultural norms helps in encouraging pro-environmental attitudes.

The empirical literature on electricity conservation behavior shows that factors influencing households can be grouped into dwelling characteristics, household head characteristics, household characteristics, awareness and attitudes toward conservation, and other related variables. Thus, a model is needed to explain household electricity conservation as a function of the factors (determinants) identified by the empirical literature to influence household electricity conservation. The following model was used to examine determinants of households' electricity conservation:

$$H_i = f(D, Z, Y, W, X, e_i)$$

where $i$ denotes different conservation measures practiced by households to conserve electricity; $H$ is a variable that represents households' electricity conservation when the households save electricity through the $i^{th}$ measure; $D$ is a vector of dwelling characteristics; $Z$ is a vector of household head attributes; $Y$ is vector of households' socioeconomic attributes; $W$ is a vector of variables on households' awareness to electricity conservation issues; $X$ is a vector

of other related determinants; $e_i$ are the error terms. The dependent variables covered 6 curtailment measures (CM) and 7 efficiency measures (EM). Table 6 lists all the measures used. An ordered logit estimator was used for CM1, CM2, EM2, and EM7 since they have on an ordinal scale, while CM3, CM4, CM5, CM6, EM1, EM3, EM4, EM5, and EM6 were estimated using logit estimator as they take values of 1 and 0 (see Maddala & Lahiri, 2009, and Greene, 2017, for limited dependent variable estimation techniques). Table 7 lists the explanatory variables that are chosen from a longer list of survey variables guided by literature and excluding variables if collinearity existed, and the independent variables used in this study have a correlation coefficient of 0.66 and below; correlation results are available upon request. Since Kuwait's population comprises of two distinctive clusters (nationals and expatriates), with variant social, economic, and demographic attributes, the model was estimated for two population groups.

## Table 6

*List and Description of Dependent Variables*

| Category/Variable | Description |
|---|---|
| Curtailment Measures (CM) | |
| Switch off Light when not in Room (CM1) | Discrete (0 to 2): 0=Never, 1=Sometimes, 2=Always |
| Daytime Use of Lights (CM2) | Discrete (0 to 2): 0= Always, 1=Sometimes, 2=Never |
| Adjust AC Thermostat when not in Room (CM3) | Dummy (0, 1): 0 = Raise/No Change, 1=Switch-off |
| Adjust AC Thermostat when Travelling (CM4) | Dummy (0, 1): 0 = Raise/No Change, 1 = Switch-off |

## Cont. Table 6

*List and Description of Dependent Variables*

| Category/Variable | Description |
|---|---|
| AC Thermostat Setting: Winter (CM5) | Dummy (0, 1): 0 = Up to 24C, 1 = More than 24C/Switch-off |
| Time of Use: Washing Machine (CM6) | Dummy (0, 1): 0 = Peak, 1 = Off-peak Time (12 pm to 6 pm) |
| Efficiency Measures (EM) | |
| Fluorescent Lights (EM1) | Dummy (0, 1): 0 = No, 1 = Yes |
| Energy-efficient AC Ownership (EM2) | Discrete (0 to 6): 0 = If all ACs WU, 1 = WU+SU, 2 = WU+PU, 3 = WU+SU+PU, 4 = All ACs SU, 5 = SU+PU, 6 = All ACs PU. |
| Ownership of Energy-efficient Appliances (EM3) | Dummy (0, 1): 0 = any major appliances purchased before 1999, 1 = all major appliances purchased after 1999. |
| Window Glazing (EM4) | Dummy (0, 1): 0 = Single, 1 = Double/Triple |
| Roof Insulation (EM5) | Dummy (0, 1): 0= No/Do Not Know, 1 = Yes |
| AC-Duct Insulation (EM6) | Dummy (0, 1): 0 =No/Do Not Know, 1 = Yes |
| Number of AC Thermostat Controls (EM7) | Discrete (1 to 3): 1 = One Central/One each Apartment/House, 2 = One each floor, 3 = Two each floor/Three each floor/One each room/Other |

## Table 7

*Independent Variables Description*

| Variable | Description |
|---|---|
| Dwelling Attributes | |
| Geographic Location | Five Dummy Variables (0, 1) for Six Governorates. Reference Region: Aasimah |
| Type of Dwelling | Discrete (1 to 5): 1=Annex, 2=Apartment, 3=Part of Villa, 4=Traditional House, 5= Villa |
| Number of Rooms | Discrete. Average = 5.0 |
| Number of Appliances | Discrete. Average = 11.0 |
| Occupancy Status | Discrete (1 to 5): 1 = Other, 2 = Provided by Employer, 3 = Rented, 4 = Family Owned, 5 = Owner Occupant |
| Average Monthly Electricity Bill | Average = 25.90 Kuwaiti Dinar (KD) |
| Number of ACs in House | Average = 3.2 |
| Characteristics of Head of Household | |
| Age | Average = 48.5 |
| Education | Dummy (0, 1): 0=Less than Bachelor, 1= Bachelor or Higher |
| Monthly Salary | Average = 872.5 Kuwaiti Dinar |
| Characteristic of Household | |
| Household Size | Discrete. Average = 6.3 |
| Proportion of Family below Age 12 | Continuous: Average = 22.9% |
| Awareness: Conservation Campaign | Dummy (0, 1): 0=No, 1=Yes |
| Discuss Conservation with Family | Dummy (0, 1): 0 = No, 1 = Yes |
| Discuss Conservation with Non-Family | Dummy (0, 1): 0 = No, 1 = Yes |

# Results

The conservation literature identifies two main categories of conservation behaviors: the first is purchase-related (efficiency behavior), and the second is usage-related (curtailment behavior). Before estimating the models, the Chow test was used to decide if the differences in conservation behaviors across the two population groups were statistically significant. The results of the Chow test are reported in Table 8. Except for CM6, EM3, and EM5 for all other regressions, the null hypothesis of "no difference" in the coefficients of Kuwaitis and expatriates is rejected as the p-value is less than or equal to 0.05, which provides statistical evidence that the models for nationals and expatriates should be estimated individually. Failing to reject the null hypothesis does not necessarily entail that the population groups cannot be treated separately. This is key to consider since the testing implemented limited the group parameters to only what was common among the two groups. For those reasons, we estimated the regressions for all conservation measures for those where the null hypothesis cannot be rejected. We also conducted a likelihood ratio (LR) test (Table 9) comparing a full model that contains a nationality dummy with the two nationality groups (with no nationality dummy). For the CM, we found that the LR test confirms the decision of Chow test for CM1–CM4 and CM6 and suggests that CM7 should be treated as two nationality models. For EM, the LR test suggests that only EM3 should not be treated as two groups, yet since the Chow test is borderline, we decide to keep EM3.

## Table 8

*Chow Test Results*

| Measure | Test Statistic | *P*-Value | Estimated as Two Groups |
|---|---|---|---|
| CM1 | 44.85 | 0.001 | Yes |
| CM2 | 43.06 | 0.001 | Yes |
| CM3 | 44.63 | 0.001 | Yes |
| CM4 | 48.31 | 0.001 | Yes |
| CM5 | 34.63 | 0.011 | Yes |
| CM6 | 19.72 | 0.289 | No |
| EM1 | 41.77 | 0.003 | Yes |
| EM2 | 294.26 | 0.001 | Yes |
| EM3 | 28.7 | 0.052 | No |
| EM4 | 33.53 | 0.030 | Yes |
| EM5 | 28.91 | 0.090 | No |
| EM6 | 51.22 | 0.001 | Yes |
| EM7 | 68.41 | 0.001 | Yes |

## Table 9

*LR Test Results*

| Measure | Test Statistic (LR chi^2) | P-Value | Estimated as Two Groups |
|---|---|---|---|
| CM1 | 39.53 | 0.002 | Yes |
| CM2 | 43.95 | 0.001 | Yes |
| CM3 | 39.46 | 0.001 | Yes |
| CM4 | 46.66 | 0.001 | Yes |
| CM5 | 28.69 | 0.026 | Yes |
| CM6 | 26.40 | 0.034 | Yes |
| EM1 | 40.47 | 0.001 | Yes |
| EM2 | 300.62 | 0.001 | Yes |
| EM3 | 20.15 | 0.170 | No |
| EM4 | 29.06 | 0.048 | Yes |
| EM5 | 30.86 | 0.030 | Yes |
| EM6 | 44.19 | 0.001 | Yes |
| EM7 | 58.43 | 0.001 | Yes |

The full results for the models are presented in Appendix Tables 1 and 2, while a summary of the most important results is shown in our online appendix(1). In general, pseudo-R2 results suggest that efficiency measures have a better fit compared to CM. Furthermore, irrespective of the conservation measure, the absolute values of the measure of fitness of the models for expatriates were always larger than those for the nationals, suggesting that the former showed better fit than the latter. As the conservation behavior of national and expatriate households was found to be different, the results corresponding to full sample are omitted. Our results provide support to the claim of TPB on the effect of environmental awareness (weak for social interaction) on energy conservation. The results show different conservation patterns among the population groups with expatriates being more pro-conservation. Additionally, the results show differences in the determinants of conservation among nationals and expatriates. Among the nationals, the variables that affect conservation include education and household size, while for expatriates, the variables that affect conservation include education, number of appliances, awareness of conservation campaigns, and social interaction.

Non-consistent patterns were found to exist between dwelling characteristics and CM reported by the households. The geographic location of the households' dwelling, which is considered a proxy of households' socioeconomic affluence, was found to have mixed bearing on household CM. In general, expatriate households in Aasimah were found to be more likely to switch off lights when not in room (CM1) and use washing machine during off-peak hours

(1) https://www.dropbox.com/scl/fi/j7i85gngqr0tvyikyg96b/online-app-jgaps.docx?rlkey=oux8ito8u7wjj760zdy5jfwq2&st=98ia5dsw&dl=0

(CM6). Also, expatriate households living outside Aasimah were relatively more likely to raise AC thermostat (CM2) setting or switch off AC during winter (CM5). For most CM, the coefficient with respect to the type of dwelling was insignificant. Kuwaiti households in smaller dwellings were likely to switch off ACs when traveling abroad (CM4), while expatriate households in smaller dwellings were likely not to use lights during daytime (CM2) and switch off ACs during winter (CM5). At the same time, expatriate households living in villa/traditional house were likely to switch off AC when not in room (CM3).

Kuwaiti households living in dwellings with more rooms were likely to use washing machines during off-peak hours (CM6), while Kuwaitis living in dwellings with less rooms were likely switch off ACs when not in room (CM3). Expatriate households living in dwellings with less rooms were likely to switch off ACs when not in room (CM3) and while travelling (CM4). Expatriates living in dwellings with more rooms were more likely to switch off lights during daytime (CM2). Kuwaiti households owning fewer appliances were more likely to switch off light when not in room (CM1). Expatriate households with fewer appliances were more likely to switch off lights when not in room (CM1), switch off lights during daytime (CM2), switch off ACs in winter (CM5), and use washing machine during off-peak hours (CM6).

Household characteristics were found to have limited bearing on CM. The household head age was insignificant for almost all CM. Household head education was found to influence the adoption of some of the CM. Household head salary had limited bearing on the CM for Kuwaiti households. However, expatriate households with higher incomes were found to more likely conserve electricity by

switching off lights when not in room (CM1), switching off ACs in winter (CM5), and washing laundry during off-peak hours (CM6). Households' size had limited bearing CM, which is consistent with the findings of Sardianou (2007), Tanaka & Ida (2013), and Umit et al. (2019). Kuwaiti households with larger families were likely to switch off ACs when not in room (CM3). In contrast, expatriate households with more members were likely not to switch off lights during daytime (CM2) and switch off ACs when not in room (CM3). At the same time, expatriate households with fewer members were more likely to switch off lights when not in room (CM1). Households' age composition had limited bearing on CM for expatriate households and no effects on CM by Kuwaiti households. Expatriate households with less children were likely not to use lights during daytime (CM2) and switch off ACs when not in room (CM3).

As predicted by TPB, awareness about environmental issues is a determinant of households' conservation. The results suggest that awareness about conservation campaign influences households' decision to adopt electricity CM and is consistent with findings from Sardianou (2007), Hori et al. (2013), and Umit et al. (2019). For instance, in response to public awareness campaigns, Kuwaiti households were more likely to switch off ACs during winter (CM5) and use washing machines during off-peak hours (CM6), while expatriate households were likely to turn off lights when not in room (CM1), turn off lights during the daytime (CM2), and switch off ACs during winter (CM5). As for the influence of social interaction on conservation, the results suggested that they were not very effective at promoting CM among households.

No specific patterns were found to exist between different EM and dwelling characteristics. The estimated coefficients with respect to dwelling characteristics were significant in many cases, but with no

clear pro-conservation pattern. Kuwaiti households living in Aasimah were more likely to conserve energy by installing fluorescent lights (EM1) and AC-duct (EM6) insulations, while Kuwaiti households living in Hawally and Mubark Al-Kabir were more likely to conserve electricity by installing double/triple glazed windows (EM4). As for expatriates, the most apparent conservation effect was for those households living in Aasima, Ahmadi, and Mubark Al-Kabir, who were more likely to install double/triple glazed windows (EM4). Kuwaiti and expatriate households living in villas and traditional houses were more likely to install roof insulation (EM5). Additionally, expatriate households living in villas and traditional houses were more inclined to own energy efficient ACs (EM2), while expatriates living in smaller dwellings were more likely to have insulation for AC ducts (EM6). Kuwaiti Households living in self-owned dwellings were more likely to have multiple AC thermostat controls (EM7), while expatriates living in dwellings owned by their families were more likely to install double/triple glazed windows (EM4) and roof insulation (EM5). Furthermore, expatriate households living in rented dwellings were likely to install fluorescent lights (EM1), install insulation for AC ducts (EM6), and have multiple AC thermostat controls (EM7). The average monthly electricity bill had no bearing on almost all EM (except EM2) for Kuwaiti households. In the case of expatriate households, those who consumed more electricity were more likely to install fluorescent lights (EM1) and install roof (EM5) and AC-duct (EM6) insulations. Kuwaiti households who had fewer ACs in the house were more likely to use energy efficient ACs (EM2), own energy-efficient appliances (EM3), and install roof insulations (EM5), while Kuwaiti households who owned more ACs were more likely to have more AC thermostats (EM7). As for expatriate households, those with fewer ACs in the house tended to own/use

energy efficient ACs (EM2) and install double/triple glazed windows (EM4) and roof insulations (EM5), while expatriate households having more ACs in the house tended to install AC-duct insulation (EM6). As for appliances ownership, Kuwaiti households with fewer appliances were more likely to install fluorescent lights (EM1) and own energy-efficient appliances (EM3), while expatriate households with fewer appliances were likely to install fluorescent lights (EM1), use energy-efficient appliances (EM3), and install roof (EM5) and AC-duct (EM6) insulations. Additionally, expatriates with more appliances were likely to use energy-efficient ACs (EM2) and install double/triple glazed windows (EM4).

Household's characteristics had mixed bearing on EM. For both groups, household head age, monthly salary, and household age composition were found to have no bearing on EM. Charlier (2013) found similar results on some EM. However, both Kuwaiti and expatriate households whose heads' educational level was at least bachelor's degree were likely to own energy efficient appliances (EM3) and install roof insulation (EM5), while expatriate households with higher educational level were likely to have energy efficient ACs (EM2), double/triple glazed windows (EM4), and ACs duct insulation (EM6). Rich Kuwaiti households were likely to install fluorescent lights (EM1). At the same time, rich expatriate households were likely to have energy efficient ACs (EM2) and multiple AC thermostat (EM7). Larger Kuwaiti households were more likely to own energy efficient ACs (EM2) and install double/triple glazed windows (EM4), while smaller-sized Kuwaiti households were more likely to install florescent lights (EM1). Additionally, large size expatriate households were more likely to use energy efficient appliances (EM3) and install AC-duct insulations (EM6).

As predicted by TPB, the results confirmed a relationship between environmental awareness and EM, similar to Sardianou (2007), Hori et al. (2013), Umit et al. (2019), Li et al. (2021), and Kuai et al. (2022); this was particularly the case for expatriate households where their awareness of conservation campaigns has positively affected all EM with the exception of EM3. On the contrary, Kuwaiti households' response to public awareness campaigns was limited to EM1 and EM6. Social interaction was not very effective at influencing EM among Kuwaiti households. However, expatriates who discussed energy conservation with others were more likely to install florescent lights (EM1), use energy efficient ACs and appliances (EM2, EM3), install AC duct insulation (EM6), and have multiple AC thermostats (EM7).

Moreover, marginal effects were calculated for the logit-based measures only since, for ordered logit measures, the margins would vary with each independent variable. For brevity, only statistically significant margins of independent variables are discussed (results shown in the online appendix)[(2)]. For Kuwaiti households, the CM margins of governorates were significant for CM4, CM5, and CM6 and ranged between -0.516 and 0.614, indicating that, for example, the change in probability of adopting CM6 when a household is located in Aasima compared to a household located in Mubark Al-Kabir decreases by 0.516. Significant margins for CM of Kuwaiti households were found in household size (CM3), number of rooms (CM3, CM6), dwelling type (CM4), awareness of conservation campaign (CM5, CM6), household head salary (CM6), and discussing conservation with non-family (CM6), with the highest margin found attributed to awareness of conservation campaign for CM6, which

(2) https://www.dropbox.com/scl/fi/j7i85gngqr0tvyikyg96b/online-app-jgaps.docx?rlkey=oux8ito8u7wjj760zdy5jfwq2&st=98ia5dsw&dl=0

indicates that the change in probability of adopting CM6 when awareness of conservation campaign changes to non-awareness is decreased by 0.39.

For expatriate households, the CM margins of governorates were significant for governorates and significant for CM3, CM5, and CM6 ranging between -0.459 and 0.440, indicating that, for example, the change in probability of adopting CM3 when a household is located in Aasima compared to a household located in Mubark Al-Kabir decreases by 0.459. Significant margins for CM of expatriate households were found in household size (CM3), number of rooms (CM3, CM4), dwelling type (CM3, CM5), awareness of conservation campaign (CM3, CM5, and CM6), household head salary (CM3, CM4, CM5, and CM6), household head education (CM3), having more children under 12 in the family (CM3), having a higher number of appliances (CM5, CM6), and discussing conservation with family (CM4, CM5, and CM6) and discussing conservation with non-family (CM4), with the highest margin found attributed to the number of appliances in household for CM5, which indicates that the change in probability for one instant change in number of appliances is decreased by 0.263.

For Kuwaiti households, the EM margins of governorates were significant for EM1, EM3, EM 4, EM5, and EM6 and ranged between -0.828 and 0.722, indicating that, for example, the change in probability of adopting EM6 when a household is located in Aasima compared to a household located in Jahra decreases by 0.828. Significant margins for EM of Kuwaiti households were found in household size (EM1, EM4), household head education (EM1, EM3, and EM5), household head age (EM3), dwelling type (EM5), having more children under 12 in the family (EM3), number of appliances (EM1, EM3), number of ACs in the house (EM3, EM4), and

awareness of conservation campaign (EM6), with the highest margin found attributed to household size for EM4, which indicates that the change in probability for one instant change in house hold size is increased by 0.296.

For expatriate households, the EM margins of governorates were significant for governorates for EM4, EM5, and EM6 ranging between -0.939 and 0.376, indicating that, for example, the change in probability of adopting EM6 when a household is located in Aasima compared to a household located in Mubark Al-Kabir decreases by 0.939. Significant margins for EM of expatriate households were found in household size (EM6), dwelling type (EM5, EM6), occupancy status (EM1, EM5, and EM6), awareness of conservation campaign (EM1, EM4, EM5, and EM6), house hold head age (EM4), household head education (EM4, EM5, and EM6), having number of appliances (EM1, EM4, EM5, and EM6), number of ACs in house (EM4, EM6), average electricity bill (EM1, EM5, and EM6), discussing conservation with family (EM1, EM6), and discussing conservation with non-family (EM41, EM5, and EM6), with the highest margin found attributed to occupancy status, which indicates that the change in probability of adopting EM6 when occupancy status changes from owner to other is decreased by 0.846.

## Discussion, Conclusion, and Policy Implications

Based on data from a 2017 survey of Kuwaiti households, this paper studied households' electricity conservation in Kuwait by estimating models for 6 CM and 7 EM. Prior to estimation, statistical tests were done to decide whether population groups should be treated separately. The test results implied that the models should be estimated separately across the two population groups. The models for EM had better fit compared to CM models. Estimated models for the expatriates

had better fit compared to those for nationals. Dwelling characteristics were found to have mixed association with CM and EM. Dwelling and households' socioeconomic characteristics were found to have mixed and limited bearing on CM and EM. Generally speaking, Kuwaiti households were indifferent towards conserving electricity whether through CM or EM, with some patterns of CM related to number of rooms, lower income, household size, appliances ownership, and knowledge of awareness campaigns, while some patterns of EM by Kuwaiti households were associated to lower AC ownership and larger household sizes. Expatriate households showed stronger conservation behavior compared to Kuwaitis. The results suggest that expatriate households practice conservation more through EM. The most relevant variables affecting expatriates' EM include renting the dwelling, lower AC ownership, higher appliances ownership, higher education levels, knowledge of awareness campaigns, and discussion of conservation with others. Alternatively, CM adopted by expatriate households were associated with lower appliances ownership, higher income, larger household sizes and knowledge of awareness campaigns. The results confirmed relationships between environmental awareness and social interactions with the adoption of conservation measures, especially for EM adopted by expatriates, findings that are consistent with the predictions of TPB. As indicated by Streimikiene et al. (2022), environmental awareness is essential for encouraging sustainable energy consumption.

Income and consumption levels had almost no impact on conservation; this is attributed to very low electricity tariff in Kuwait. When consumers endure the full cost, the inclination to minimize electricity cost is a main driver to conserve. Under the current price structure, any likely savings from conservation are expected to benefit the public sector. Additionally, because of incomplete

metering, monitoring, and billing systems, the consumers are not always aware of their electricity consumption. For now, there seems to be no self-benefits to conserve energy. Based on such conditions, the matter is how to persuade consumers to adopt conservation behavior. Thus, for managing electricity demand and controlling environmental pollution, along with energy conservation and environmental awareness campaigns, it is imperative that authorities should rationalize the electricity tariff and impose the use of efficient building/appliance technologies. Awareness campaigns should be modified to entice Kuwaiti households to conserve electricity as our results suggest a failure to do so, and price and conservation policies should be tailored differently for the two population groups. We acknowledge that a major drawback of our research is that it depends on 2017 data and may not reflect the current status of households, yet with lack of more recent data, we believe that documenting our results would serve as a good comparison base for future research on electricity conservation in Kuwait and GCC countries.

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# Appendix

## Appendix 1

*CM Models*

| Explanatory Variables | CM1 | | CM2 | | CM3 | | CM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Governorate (Ahmedi) | -1.594 | -4.320*** | -0.996 | -0.220 | 0.370 | -2.309*** | 2.780* | |
| | (1.188) | (1.538) | (0.891) | (0.640) | (0.957) | (0.851) | (1.463) | |
| Governorate (Farwaniya) | 1.518 | -1.585 | 0.854 | 1.049** | 0.880 | -0.317 | 1.757*** | 0.531 |
| | (1.605) | (1.386) | (0.825) | (0.512) | (0.697) | (0.549) | (0.678) | (0.922) |
| Governorate (Hawally) | -0.912 | -3.249** | -0.433 | 0.322 | -0.896 | -1.234** | -0.650 | -0.247 |
| | (0.874) | (1.299) | (0.603) | (0.437) | (0.671) | (0.502) | (0.663) | (0.735) |
| Governorate (Jahra) | -2.490*** | -1.955 | -0.496 | 1.973** | 0.889 | -0.258 | 2.456*** | 1.781 |
| | (0.832) | (1.215) | (0.735) | (0.926) | (0.746) | (0.604) | (0.735) | (1.090) |
| Governorate (Mubark Al-Kabir) | -1.328 | -2.764 | 2.603** | 1.588*** | | -0.779 | -2.237*** | |
| | (0.853) | (1.717) | (1.208) | (0.853) | | (0.796) | (0.796) | |
| Dwelling Type | 0.127 | -0.289 | -0.203 | -0.583* | -0.0715 | 0.687** | -0.556*** | -0.247 |
| | (0.275) | (0.369) | (0.239) | (0.315) | (0.218) | (0.291) | (0.214) | (0.484) |
| Number of Rooms | 0.0420 | 0.151 | 0.00436 | 0.295* | -0.117* | -0.365*** | -0.0740 | -0.453** |
| | (0.0808) | (0.163) | (0.0613) | (0.164) | (0.0584) | (0.125) | (0.0570) | (0.188) |
| Number of Appliances | -1.798** | -1.057* | -0.463 | -2.073*** | -0.122 | -0.315 | -0.296 | 0.00311 |

## cont. Appendix 1

*CM Models*

| Explanatory Variables | CM1 | | CM2 | | CM3 | | CM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| | (0.762) | (0.580) | (0.758) | (0.531) | (0.784) | (0.384) | (0.681) | (0.692) |
| Age: Household Head | -0.598 | 0.0204 | 0.797 | -1.058 | 0.977 | 0.210 | -0.371 | -0.00918 |
| | (1.018) | (0.647) | (0.861) | (0.675) | (1.055) | (0.567) | (0.984) | (0.688) |
| Education: Household Head | -1.068 | -1.320** | 0.163 | 0.51 | 0.358 | -0.863** | -0.466 | -1.111 |
| | -0.86 | -0.542 | -1.082 | -0.507 | -0.913 | -0.402 | -1.03 | -0.764 |
| Monthly Salary: Household Head | 0.65 | 0.796** | 0.742 | 0.107 | -0.182 | -0.787*** | -0.336 | -1.154*** |
| | -0.519 | -0.36 | -0.511 | -0.345 | -0.501 | -0.25 | -0.515 | -0.324 |
| Household Size | 0.991 | -1.354*** | 0.842 | 0.984** | 1.365** | *** | -1.03 | 0.198 |
| | -0.745 | -0.462 | -0.686 | -0.487 | -0.651 | -0.382 | -0.627 | -0.679 |
| Proportion of Family Members < 12 | -1.752 | 0.749 | 0.0914 | -2.409*** | 0.474 | -1.276** | 0.892 | -0.688 |
| | -1.077 | -0.732 | -1.07 | -0.833 | -0.989 | -0.622 | -1.1 | -0.904 |
| Awareness of Conservation Campaign | 1.211** | 2.977*** | 0.704 | 2.903*** | 0.132 | -0.405* | 0.512 | 0.245 |
| | -0.494 | -0.523 | -0.447 | -0.368 | -0.495 | -0.235 | -0.429 | -0.405 |

## cont. Appendix 1

*CM Models*

| Explanatory Variables | CM1 | | CM2 | | CM3 | | CM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Discuss Conservation: Family | 1.888*** | -0.287 | -0.101 | -1.727*** | -0.425 | 0.314 | 0.334 | 2.673*** |
| | -0.684 | -0.374 | -0.801 | -0.434 | -0.619 | -0.274 | -0.666 | -0.59 |
| Discuss Conservation: Non-Family | -1.706** | 0.582* | -0.549 | 0.384 | -0.646 | -0.265 | -0.747 | -1.103** |
| | -0.712 | -0.313 | -0.667 | -0.298 | -0.521 | -0.249 | -0.513 | -0.51 |
| Cut-1 | -4.484 | -5.690* | 5.381 | -8.879*** | | | | |
| Cut-2 | -2.041 | -2.994 | 6.486 | -7.820** | | | | |
| Intercept | | | | | -4.498 | 4.009* | 9.715 | 10.65*** |
| Observations | 245 | 560 | 248 | 560 | 180 | 560 | 245 | 523 |
| Prob>Chi^2 | 0.001 | 0.001 | 0.006 | 0.001 | 0.036 | 0.001 | 0.001 | 0.001 |
| R-squared/Pseudo-R-squared | 0.1815 | 0.2623 | 0.1406 | 0.254 | 0.1358 | 0.158 | 0.4158 | 0.2399 |
| Log-L | -102.645 | -218.668 | -114.983 | -294.971 | -84.814 | -314.137 | -97.92 | -139.607 |
| AIC | 245.289 | 477.336 | 269.967 | 629.942 | 205.628 | 666.274 | 233.84 | 313.215 |
| BIC | 315.068 | 563.715 | 339.992 | 716.322 | 262.799 | 748.334 | 300.13 | 385.465 |

## cont. Appendix 1

*CM Models*

| Explanatory Variables | CM5 | | CM6 | |
|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates |
| Household Size | -0.145 | 0.215 | -0.263 | 0.143 |
| | -0.51 | -0.43 | -0.541 | -0.353 |
| Proportion of Family Members < 12 | -0.128 | 0.169 | 1.254 | -0.328 |
| | -0.867 | -0.737 | -0.933 | -0.556 |
| Awareness of Conservation Campaign | 0.963*** | 1.182*** | 0.909** | 0.454** |
| | -0.368 | -0.281 | -0.434 | -0.221 |
| Discuss Conservation: Family | 0.164 | -0.920** | 1.089 | -0.599** |
| | -0.602 | -0.392 | -0.694 | -0.28 |
| Discuss Conservation: Non-Family | -0.0818 | -0.243 | -1.311* | -1.629** |
| | (0.484) | (0.304) | (0.765) | (0.737) |
| Intercept | -0.19 | -2.933 | 3.263 | 1.764 |
| Observations | 236 | 525 | 205 | 521 |
| Prob >Chi^2 | 0.001 | 0.001 | 0.001 | 0.004 |
| R-squared/Pseudo-R-squared | 0.241 | 0.1987 | 0.1998 | 0.0514 |
| AIC | 252.877 | 511.849 | 261.818 | 708.592 |
| BIC | 318.446 | 592.672 | 324.676 | 785.057 |

*Note*. Figures within the parenthesis are z-values based on heteroskedasticity adjusted robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

## Table 2

*EM Models*

| Explanatory Variables | EM1 | | EM2 | | EM3 | | EM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Governorate (Ahmedi) | -2.723*** | -0.528 | -0.922 | 0.124 | 1.236 | | 5.094*** | 2.479** |
| | (0.833) | (0.668) | (0.765) | (0.953) | (0.916) | | (1.725) | (0.988) |
| Governorate (Farwaniya) | 0.152 | 0.419 | -0.741 | -1.529*** | 1.159 | -3.040 | -2.741*** | -2.796*** |
| | (0.502) | (0.462) | (0.457) | (0.556) | (0.919) | (2.280) | (0.865) | (0.784) |
| Governorate (Hawally) | -0.345 | 0.108 | 0.739* | -0.203 | 0.0960 | -3.521 | 1.346** | -0.985 |
| | (0.522) | (0.444) | (0.446) | (0.539) | (0.801) | (2.157) | (0.568) | (0.713) |
| Governorate (Jahra) | -2.018*** | -0.708 | -0.452 | 0.735 | 0.297 | -2.923 | -2.620*** | -1.494 |
| | (0.686) | (0.540) | (0.576) | (0.691) | (0.667) | (1.830) | (0.984) | (1.072) |
| Governorate (Mubark Al-Kabir) | -4.032*** | -1.108 | 0.212 | -1.436** | -2.983*** | -6.680** | 2.612*** | 1.689 |
| | (0.905) | (0.839) | (0.627) | (0.600) | (0.911) | (2.701) | (0.834) | (1.066) |
| Dwelling Type | 0.304 | -0.166 | 0.158 | 0.910*** | 0.304 | -0.513 | 0.0528 | -0.268 |
| | (0.214) | (0.198) | (0.174) | (0.250) | (0.292) | (0.428) | (0.199) | (0.380) |
| Occupancy Status | -0.0313 | -1.754*** | 0.387 | 0.418 | -0.515 | -0.154 | 0.403 | 0.773* |
| | (0.328) | (0.540) | (0.285) | (0.284) | (0.433) | (0.345) | (0.349) | (0.461) |
| Average Monthly Electricity Bill | 0.929 | 0.627*** | 1.294* | -0.0441 | | 2.586 | -0.00512 | 0.429 |
| | (0.658) | (0.192) | (0.666) | (0.187) | | (1.655) | (0.833) | (0.370) |
| Number of ACs in House | 0.00438 | -0.0339 | -0.516*** | -1.317*** | -0.208*** | -0.491** | -0.0576 | -0.327* |

## Cont. Table 2

*EM Models*

| Explanatory Variables | EM1 | | EM2 | | EM3 | | EM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| | (0.0594) | (0.0901) | (0.0665) | (0.159) | (0.0743) | (0.242) | (0.0698) | (0.189) |
| Number of Appliances | -1.012* | -1.089*** | 0.204 | 1.476*** | -1.109 | -3.049** | 0.112 | 1.468** |
| | (0.601) | (0.339) | (0.529) | (0.347) | (0.708) | (1.494) | (0.740) | (0.627) |
| Age: Household Head | 0.213 | 0.551 | -0.551 | -0.616 | 2.734** | 0.114 | -0.848 | 3.261*** |
| | (0.839) | (0.500) | (0.764) | (0.505) | (1.091) | (1.539) | (1.151) | (1.006) |
| Education: Household Head | -0.710* | -0.0549 | 0.458 | 0.602*** | 1.430*** | 1.688*** | -0.0978 | 1.042*** |
| | -0.405 | -0.213 | -0.348 | -0.207 | -0.455 | -0.559 | -0.455 | -0.396 |
| Education: Household Head | -0.710* | -0.0549 | 0.458 | 0.602*** | 1.430*** | 1.688*** | -0.0978 | 1.042*** |
| | -0.405 | -0.213 | -0.348 | -0.207 | -0.455 | -0.559 | -0.455 | -0.396 |
| Monthly Salary: Household Head | 0.890* | 0.194 | 0.738* | 0.893*** | 0.65 | -1.255* | 0.479 | -0.343 |
| | -0.502 | -0.208 | -0.398 | -0.214 | -0.574 | -0.725 | -0.628 | -0.42 |
| Household Size | -1.068* | -0.169 | 1.004** | 0.515* | 0.58 | 1.816** | 1.598** | -0.533 |
| | -0.579 | -0.321 | -0.426 | -0.303 | -0.665 | -0.84 | -0.626 | -0.56 |
| Proportion of Family Members < 12 | 0.977 | 0.737 | -1.704** | -0.791 | 3.126** | 3.126 | -1.712 | 1.702 |
| | -0.945 | -0.528 | -0.851 | -0.533 | -1.475 | -2.766 | -1.339 | -1.039 |

## Cont. Table 2

*EM Models*

| Explanatory Variables | EM1 | | EM2 | | EM3 | | EM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Awareness of Conservation Campaign | 0.640* | 0.647*** | -0.31 | 0.405* | -0.22 | -1.311 | 0.542 | 0.785** |
| | -0.366 | -0.208 | -0.369 | -0.227 | -0.456 | -1.084 | -0.406 | -0.379 |
| Discuss Conservation: Family | -0.114 | -1.299*** | -0.224 | -0.113 | -1.202 | -0.143 | 0.00482 | 0.045 |
| | -0.47 | -0.289 | -0.485 | -0.236 | -0.862 | -1.254 | -0.871 | -0.547 |
| Discuss Conservation: Non-Family | 0.0637 | 0.304 | -0.097 | 0.500** | 0.477 | -0.341 | -0.711 | -0.319 |
| | -0.36 | -0.218 | -0.317 | -0.225 | -0.402 | -0.925 | -0.442 | -0.415 |
| Cut-1 | | | -2.274 | -2.274 | | | | |
| Cut-2 | | | 5.101** | 5.101** | | | | |
| Cut-3 | | | 1.357 | 1.357 | | | | |
| Cut-4 | | | 6.125** | 6.125** | | | | |
| Cut-5 | | | 1.543 | 1.543 | | | | |
| Cut-6 | | | 6.136** | 6.136** | | | | |
| Intercept | -3.916 | 5.033* | | | -8.702 | 20.28*** | -6.962 | -16.93*** |
| Observations | 286 | 638 | 286 | 638 | 250 | 618 | 281 | 630 |
| Prob >Chi^2 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

## Cont. Table 2

*EM Models*

| Explanatory Variables | EM1 | | EM2 | | EM3 | | EM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Pseudo-R-squared/R-squared | 0.1815 | 0.1394 | 0.1406 | 0.2389 | 0.1358 | 0.4881 | 0.2166 | 0.2838 |
| AIC | 245.289 | 889.4 | 269.967 | 1294.046 | 205.628 | 108.462 | 217.489 | 319.307 |
| BIC | 315.0683 | 795.775 | 339.992 | 1409.963 | 262.799 | 196.991 | 273.827 | 412.667 |
| Governorate (Ahmedi) | -0.818 | -1.477 | -1.909* | -2.025 | 0.897 | 2.396* | | |
| | (0.653) | (0.917) | (1.075) | (1.439) | (0.825) | (1.247) | | |
| Governorate (Farwaniya) | -0.581 | -1.908*** | -1.691 | -3.334** | -1.038* | -4.901*** | | |
| | (0.559) | (0.602) | (1.239) | (1.412) | (0.592) | (1.502) | | |
| Governorate (Hawally) | 0.359 | 0.0721 | 1.243 | -1.977* | 1.409** | -1.127 | | |
| | (0.564) | (0.581) | (1.288) | (1.197) | (0.596) | (0.813) | | |
| Governorate (Jahra) | -1.532*** | -1.898*** | -5.015*** | -7.247*** | -0.0561 | -2.020 | | |
| | (0.569) | (0.695) | (1.079) | (1.602) | (0.630) | (1.491) | | |
| Governorate (Mubark Al-Kabir) | 1.688* | 2.167* | 2.326 | | -0.232 | 0.580 | | |
| | (0.899) | (1.290) | (1.490) | | (0.661) | (1.557) | | |
| Dwelling Type | 0.455** | 0.481** | 0.498 | -2.276** | 0.307 | 0.238 | | |
| | (0.184) | (0.230) | (0.480) | (0.928) | (0.251) | (0.668) | | |
| Occupancy Status | 0.0403 | 1.079*** | 0.165 | -6.277* | 0.650 | -1.332* | | |
| | (0.296) | (0.395) | (0.758) | (3.631) | (0.402) | (0.802) | | |

## Cont. Table 2

*EM Models*

| Explanatory Variables | EM1 | | EM2 | | EM3 | | EM4 | |
|---|---|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Average Monthly Electricity Bill | -0.200 | 0.852*** | 1.372 | 0.922** | 0.973 | 0.458 | | |
| | (0.627) | (0.211) | (1.142) | (0.417) | (0.789) | (0.455) | | |
| Number of ACs in House | -0.0925 | -0.238** | 0.125 | 1.973** | 0.162** | 0.611** | | |
| | (0.0585) | (0.0949) | (0.147) | (1.000) | (0.0761) | (0.270) | | |
| Number of Appliances | -0.331 | -1.482*** | 1.316 | -3.150*** | 0.447 | 0.169 | | |
| | (0.520) | (0.369) | (1.115) | (0.717) | (0.500) | (0.746) | | |
| Age: Household Head | -0.694 | 0.0944 | -1.491 | 0.948 | -0.890 | 3.620*** | | |
| | (0.789) | (0.521) | (1.547) | (1.148) | (0.820) | (1.319) | | |
| Education: Household Head | 0.758* | 0.651*** | -1.266* | 0.951** | 0.103 | 0.316 | | |
| | (0.407) | (0.229) | (0.727) | (0.421) | (0.315) | (0.431) | | |

## Cont. Table 2

*EM Models*

| Explanatory Variables | EM5 | | EM6 | | EM7 | |
|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Monthly Salary: Household Head | -0.327 | 0.108 | 0.0166 | 0.207 | 0.163 | 0.650* |
| | (0.432) | (0.232) | (0.776) | (0.430) | (0.427) | (0.349) |
| Household Size | 0.285 | 0.164 | -0.440 | 1.706*** | 0.449 | -0.991 |
| | (0.518) | (0.342) | (1.067) | (0.620) | (0.506) | (0.708) |
| Proportion of Family Members < 12 | 0.184 | -0.670 | -0.131 | -1.598 | -1.222 | 3.867*** |
| | (0.834) | (0.576) | (1.822) | (1.286) | (1.021) | (1.468) |
| Awareness of Conservation Campaign | 0.177 | 1.404*** | 1.212* | 3.631*** | 0.176 | 1.792*** |
| | (0.354) | (0.248) | (0.694) | (0.629) | (0.375) | (0.448) |
| Discuss Conservation: Family | 0.592 | -0.530** | -1.597* | -3.246*** | 0.663 | 1.789** |
| | (0.453) | (0.262) | (0.880) | (0.755) | (0.521) | (0.797) |
| Discuss Conservation: Non-Family | 0.0392 | 0.201 | 0.148 | 0.971** | 0.0392 | -1.449*** |
| | (0.366) | (0.254) | (0.582) | (0.415) | (0.331) | (0.535) |
| Cut-1 | | | | | 4.743 | 18.42*** |
| Cut-2 | | | | | 6.608* | 18.46*** |
| Cut-3 | | | | | 8.790** | 19.78*** |
| Cut-4 | | | | | 8.965** | 22.91*** |

## Cont. Table 2

*EM Models*

| Explanatory Variables | EM5 | | EM6 | | EM7 | |
|---|---|---|---|---|---|---|
| | Nationals | Expatriates | Nationals | Expatriates | Nationals | Expatriates |
| Cut-5 | | | | | 9.777** | |
| Intercept | 4.152 | -2.559 | 3.477 | 24.54* | | |
| Observations | 281 | 629 | 204 | 318 | 210 | 335 |
| Prob F Statistic | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Pseudo-R-squared/R-squared | 0.1998 | 0.2191 | 0.1363 | 0.4359 | 0.048 | 0.3523 |
| AIC | 261.818 | 703.994 | 584.832 | 250.524 | 736.164 | 305.881 |
| BIC | 324.675 | 797.321 | 658.100 | 325.765 | 802.454 | 397.421 |

*Note*. Figures within the parenthesis are z-values based on heteroskedasticity adjusted robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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