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ENERGY EFFICIENT HOME APPLIANCES

Perspectives from Lebanese consumers

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ACRONYMS & ABBREVIATIONS

AC: air conditioning
APBE model: attitudes, perceptions, behavior and experience model
BTU: British Thermal Unit
CAPI: Computer Aided Personnel Interviews
CDR: Council for Development and Reconstruction
CEDRO: Community Energy Efficiency and Renewable Energy Demonstration Project for Lebanon
EDL: Electricite du Liban
EDZ: Electricite de Zahle
EE: Energy Efficiency
EU: European Union
Genset: generator set
GHG: greenhouse gas
GoL: Government of Lebanon
IEA: International Energy Agency
INDC: Intended Nationally Determined Contributions
K-CEP: Kigali Cooling Efficiency Program
Kgs: kilograms
LB: Light Bulb
LCEC: Lebanese Center for Energy Conservation
LED: Light Emitting Diode
LHR: Left Hand Rule
LHSP: Lebanon Host Community Support
MEPS: minimum energy performance standards
MEW: Ministry of Energy and Water
MSc: Masters of Science
PHD: Doctor of Philosophy
RG: Refrigerator
RHR: Right Hand Rule
SD: Standard Deviation
SDGs: Sustainable Development Goals
SE4ALL: Sustainable Energy for All
TV: television
T2B: Top Two Boxes scores within 5point scale questions
UK: United Kingdom
UN: United Nations
UNDP: United Nations Development Programme
UNFCCC: United Nations Framework Conventions on Climate Change
UPS: Uninterruptible Power Supply
USD: United States Dollar
WM: Washing Machine
WTP: willingness to pay

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1 INTRODUCTION AND BACKGROUND

In September 2015, countries around the world came together to agree on 17 Sustainable Development Goals (SDGs). One of those goals, SDG 7, calls for a secure access to affordable, reliable, sustainable and modern energy for all by 2030. The United Nations (UN) launched a Sustainable Energy for All (SE4ALL) initiative to achieve three primary objectives:

(1)	(2)	(3)
Ensure universal access to modern energy services	Double the global rate of improvement in energy efficiency	Double the share of renewable energy in the global mix

Energy efficiency has been defined as "the first fuel", as it is the one energy resource that all countries possess in abundance (IEA, 2016). Strong energy efficiency policies are therefore vital to achieving the key energy-policy goals of reducing energy bills, addressing climate change and air pollution, improving energy security, and increasing energy access (IEA, 2016).

Household appliances consume a significant amount of electricity, and therefore play a key role in promoting energy efficiency, particularly in the residential sector. In International Energy Agency (IEA) member countries[1], for example, where data is easily accessible, residential appliances constitute approximately an average of 19% of the total energy consumption (IEA, 2016).

Many important initiatives are taking place to push forward resource efficiency. One of these initiatives is the Kigali Cooling Efficiency Program (K-CEP). The K-CEP is a philanthropic program to support the Kigali Amendment of the Montreal Protocol. Under the amendment, 197 countries committed to cut the production and consumption of hydrofluorocarbons (HFCs) — potent greenhouse gases used in refrigeration and air conditioning — by more than 80 percent over the next 30 years. K-CEP focuses on the energy efficiency of cooling to increase and accelerate the climate and development benefits of the Kigali Amendment to phase down HFCs.

Accurate and updated data on the share of electricity demand pertaining to the Lebanese residential sector is lacking (MED-ENEC, 2013), let alone more disaggregated data on various Lebanese household energy consumption patterns and characteristics. An earlier study indicated that the residential sector in Lebanon consumes approximately 29 percent of the total energy demand, ahead of any other sector in Lebanon in terms of energy consumption (World Bank, 2009). On a more disaggregated level, only one study, based on data obtained in 1994, indicated that Lebanese household electricity-consuming appliances accounted for approximately 47% of the total energy used within the residential sector, while the remaining 53% are related to hot water and electric heaters (Chedid & Ghajar, 2004).

[1] *IEA Member Countries: https://www.iea.org/countries/membercountries/*

Lebanon has signed the Paris Agreement in 2016, committing itself through the Intended Nationally Determined Contributions (INDCs) framework to an unconditional 3 percent (or a conditional 10 percent) reduction in power demand through energy efficiency measures. This is in parallel to renewable energy targets. In total, Lebanon commits to an unconditional reduction of greenhouse gas (GHG) emissions of 15 percent (or 30 percent conditional) compared to the business-as-usual scenario by 2030 (UNFCCC, 2015).. Achieving these targets will assist Lebanon in reducing its reliance on expensive fuel oil and diesel, along with their associated financial burdens. Lebanon's Second National Energy Efficiency Action Plan (NEEAP) has addressed the need to transform the demand and supply of household appliances through various measures, discussed in this report, to enable a market for more energy efficient appliances.

This study aims to establish the baseline characteristics of Lebanese household appliances and the perception and willingness of Lebanese householders to shift towards more energy efficient choices. The study will focus on 5 appliances that constitute a major share of the electricity used within households. The selected appliances are:

(1) Washing machines
(2) Air conditioners
(3) Televisions
(4) Light-bulbs
(5) Refrigerators.

The above appliances were selected based on their relative importance in a typical Lebanese household and their overall usage pattern around the household, i.e., in relation to the duration and times of use.

The study will assess the respective current characteristics and use of these appliances, evaluate if Lebanese consumers are willing to opt for more energy efficient types in the near future, and what are the impediments or requirements to achieve this.

METHODOLOGY

2.1 APPROACH

In order to acquire a global understanding of the end user's behavior in terms of energy consuming equipment and their willingness to adopt and purchase (social acceptance and price sensitivity) more energy efficient counter parts, a survey was devised and carried out. Nielsen (http://www.nielsen.com/lb/en.html) was awarded the execution of this survey with funding received by the European Union and was conducted between the months of November 2016 to January 2017.

The survey took the form of quantitative interviews and was carried out among target respondents using a face-to-face Computer Aided Personnel Interviews (CAPI) technique. Representativeness of the sample was ensured throughout the sampling process. Random sampling was used to select the respondents to include in this study. The sample of 630 respondents was divided equally between Males and Females between the ages of 18 to 55+, covering the different socio-economic classes A, B, C1, C2, D and E in the five main regions: Beirut, Mount Lebanon, North, South and the Bekaa.

Social class follows the United Kingdom's National Readership Survey (NRS) and is subdivided into the following categories or grades:

- A: Upper middle class; respondents with higher managerial, administrative or professional occupation
- B: Middle class; respondents from the intermediate managerial, administrative or professional occupation
- C1: Lower middle class; respondent with supervisory or clerical junior managerial, administrative or professional occupation
- C2: Skilled working class; skilled manual workers
- D: Working class; semi-skilled and unskilled manual workers
- E: Non-working class; respondents with casual or lowest grade workers, pensioners and others who depend on the welfare state for their income

The objective of the survey is twofold:
1. It aimed to collect baseline information on household appliances being purchased, as well as current consumer perspectives, attitudes, knowledge, and socio-demographic variables that may influence these choices

2. It aimed at disclosing, through the marginal willingness to pay concept, how much Lebanese consumers are willing to sacrifice (in monetary term) to obtain a relatively more efficient appliance (all else being equal), and what are the variables that influence this marginal willingness to pay.

The survey itself was built from an extensive review of similar studies of consumers and willingness to pay (WTP) for more energy efficient household appliances undertaken in many countries (see for example, Barr et al. (2005), Diamantopoulos et al., (2003), Frederiks et al., (2015), Ma et al., (2013), Reynolds et al. (2012), Testa et al., (2016), and Ward et al., (2011)). This was done in order to design a survey that will take into account all the possible variables that may impact, to varying extents, consumers' attitudes towards energy efficient appliances.

2.2 SAMPLING TECHNIQUES

This study was conducted using a 2-stage sampling technique:
- First part: selection of starting points and households in urban areas and
- Second part: selection of starting points and households in rural areas.

One of the main reasons for the separation of urban and rural households is related to the potential difference in the purchase and/or use of certain appliances, namely air conditioning.

2.2.1 Part 1: Selection of Starting Points and Households in Urban Areas

The interviewees' selection was done by superposing the list of selected cities and the number of interviewees per areas – referred to from here onwards as sample points - which were randomly selected (a total of 6 interviewees per area – either male or female). Once the area list was developed, the starting point sampling point was selected in each area. Starting points were any famous landmark, market, plaza, or important place that could be considered the center of the area. Six interviews were conducted around each starting point by skipping two households after a successful interview. This provided a reasonable number of starting points in each city and an adequate geographical spread within the area. Alternate starting points (sampling points) were selected from the list for male and female interviewees beginning with randomly selected Census blocks within each of the six geographic sites and random starting points in each block. Moreover, building/ apartment selection was done based on the right and left hand side rule, and finally, in case more than one respondent was eligible for answering any part of the questionnaire, the Kish grid/random function concept[2] was applied to select who will continue answering the interview. For the selection of a household around a particular starting point, the Right Hand Rule (RHR) was used for female and Left Hand Rule (LHR) was used for male respondents. These methods enabled a systematic procedure while minimizing surveyor's bias.

2.2.2 Part 2: Selection of Starting Points and Households in Rural Areas

The selected rural areas are divided into four hypothetical quarters, with two starting points per area: one for male respondents and one for female respondents. Three interviews were conducted around each starting point. A skipping of five households in Stratum I villages and skipping of three households in Stratum II villages was made after one successful interview. Male and female surveyors were used for male and females respondents respectively. Again, the Right Hand Rule (RHR) was used for female and Left Hand Rule (LHR) was used for male respondents for the selection of a household around a particular starting point.

[2] *For more information on Kish Grid, kindly regard: http://www.statisticshowto.com/kish-grid/*

2.3 SAMPLE SIZE

For this study, a total of 630 surveys were conducted covering the 6 areas (Governorate of Beirut, Governorate of Mount Lebanon, Governorate of North, Governorate of South, Governorate of Nabatieh and Governorate of El Bekaa) with 70% of interviews conducted in urban areas and 30% in rural areas as shown in Table 1.

Table 1. Sample size by region

REGION	TARGET SAMPLE	ACHIEVED SAMPLE
Governorate of Beirut	62	70
Governorate of Mount Lebanon	240	251
Governorate of North	123	124
Governorate of South	64	72
Governorate of Nabatieh	35	35
Governorate of El Bekaa	75	78
TOTAL	600	630

2.4 SURVEY EXECUTION AND QUALITY CONTROL

The survey was pre-tested before conducting the pilot interviews and fieldwork for flow of questions, clarity and translation errors if any. The pre-testing was conducted in an area with similar demographic characteristics to the actual areas of the survey. All trained interviewers participated in the pilot. Quotas of interviews were tightly controlled to ensure consistency of data collection. Furthermore, on-site checks were performed by the field supervisors for their respected teams immediately after the completion of the interview. Approximately 30% of all interviewers were accompanied by the field supervisor of each team. Interviews and questionnaires not adhering to quality standards were immediately terminated and all interviews conducted by that interviewer were cancelled. Errors were printed as a 'dump' and manually verified with the source document. Before processing, 100% accuracy was ensured in the punched data. This is related to the logic tests, making sure all answers were logical. All data checks were conducted in house to maintain quality standards and ensure confidentiality.

With respect to data entry, CAPI technology was used for quality checks. Accordingly, the data entered to the system were cleaned automatically, as the entry program shows a warning message in case there is something wrong with the data entered or contradiction between any answers. After completing the data collection, an extra validation check was done through 'Error Check Report' to identify any further errors that might be missed during the punching stage.

3 SITUATIONAL ANALYSIS

3.1 ENERGY BACKGROUND

Lebanon's electricity sector is in a dire situation given the demand-supply deficit and the large technical and non-technical losses (approximately 35%) in the electricity network. These problems have led to daily blackouts averaging 6 hours for the entire country, which the Lebanese economy mostly countered through diesel back-up self-generation (MEW, 2010) and other means, outlined in this Chapter. The situation was exacerbated given the increase in the population of Lebanon by at least 1 million (i.e., a quarter of the current Lebanese population) due to the Syrian refugee crises.

Investments in both generation capacity and network infrastructure are the target of the Ministry of Energy and Water (MEW) since the MEW Policy Paper of 2010, in order to deliver 24 hour electricity.

3.1.1 Blackout hours

Blackout hours range between 3 hours in Central Beirut and can go up to 12 hours in rural areas. Of the 630 pool of respondents, approximately 98% experience blackouts in their residential areas while only 2% indicated that they do not (Figure 1).

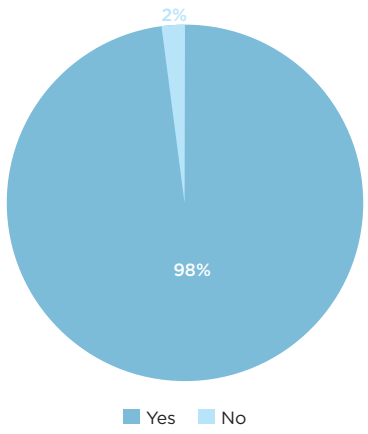


Figure 1. Respondents experiencing blackouts

Table 2 shows the shares of respondents experiencing blackouts split into economic classes. Due to the very small base sample gathered for social class E and Class A, these categories will be dropped for the remainder of the analysis.

Table 2. Blackout experience split by economic class

	Total	B	C1	C2	D	E
Total	630	71	196	219	138	5*
Yes	98	100	98	98	98	100
No	2	0	2	2	2	0

* Very small base for analysis

No noticeable difference between experiencing blackout hours and social class was observed. However this is not the case when the number of blackout hours experienced is taken into account.

Electricity rationing varies among the six administrative regions of Lebanon: Beirut, Mount Lebanon, North, South, Bekaa and Nabatieh. Respondents were asked whether they experience those blackouts; results are listed in Table 3.

Table 3. Blackout experience split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	630	70	251	124	72	78	35
Yes	98	99	100	98	93	100	97
No	2	1	0	2	7	0	3

Values collected from respondents showed a 100% exposure to blackouts in two areas: Mount Lebanon and the Bekaa. The lowest share of blackouts experienced is in the South (93%). This may reflect areas treated with relative preference due to their adjacent location to existing power plants, namely the Zahrani power plant.

As electricity rationing varied in terms of hours each day, the unit of measure for respondents was the quantifiable amount in terms of hours. Of the 630 respondents, the average (mean score) hours of blackout experienced is 7.7 hours per day, however this value is significantly higher in the North region with an average of 9.13 hours / day and in the Bekaa where the average was 10.1 hours / day. This is detailed in Figure 2, and further broken down per region in Table 4.

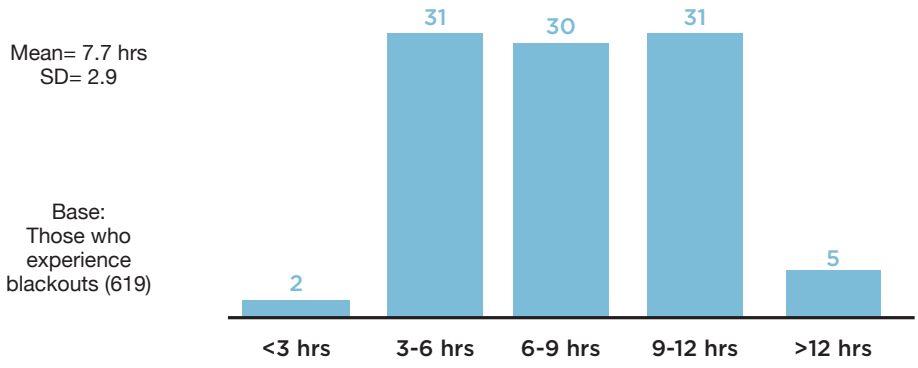


Figure 2. Hours of blackouts experienced per day (in %)

Table 4. Hours of blackouts experienced split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	619	69	250	121	67	78	34
<3 hrs	2	1	4	0	0	0	0
3-6 hrs	31	45	29	7	79	0	82
6-9 hrs	30	1	41	36	21	28	18
9-12 hrs	31	52	19	53	0	59	0
>12 hrs	5	0	7	4	0	13	0
Mean (in hrs)	7.7	7.64	7.43	9.13	5.13	10.1	5.03

Interventions that are currently ongoing with respect to power generation and delivery need to pay attention to the above values in order to achieve a more equitable rationing of power. In particular the North of Lebanon and the Bekaa require prioritization in terms of new power capacity.

3.1.2 Backup solutions

In order to mitigate blackouts, residents resort to backup solutions depending on the length of blackout hours, their need for it, the available options (see Figure 3) and their financial capabilities (options differ also in their respective costs and their capability to satisfy various power needs). In order to identify the available options utilized, the answers have been referenced per economic class and region.

The identified backup solutions used by the pool of respondents that experience blackout (base 619 respondents) are shown in Figure 3 hereafter.

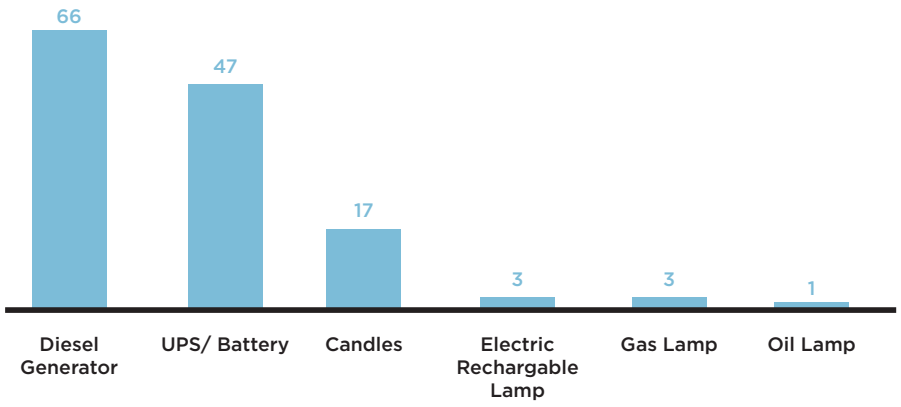


Figure 3. Backup solutions used during blackouts (in %)

The most common backup solution adopted by the respondents (66% of the 619 base) is diesel generators which can be in the form of renting from centralized neighborhood generators or personally owned generators. The second most common backup system utilized is UPS / Battery with 47%, followed by candles with 17% and various fuelled lamps. The values do not add to 100% because a considerable number of households use more than one type of backup solution during blackout hours.

Tables 5 and 6, hereafter, detail the choice split per social class and region, respectively.

Table 5. Backup solutions used during blackouts split by social class

	Total	B	C1	C2	D
Total	619	71	193	214	135
Candles	17	1	8	14	39
UPS/Battery	47	35	49	48	53
Oil lamp	1	0	0	1	4
Gas lamp	3	0	0	3	7
Diesel Generator	66	92	77	67	38
Electric-charging lamp	3	1	4	2	5

Table 5 clearly shows how diesel generators are used mostly by the relatively better off social classes, notably social class B, followed by social class C1 and C2. Respondents from social class E (not shown in Table 5), tend to use candles (100%) and gas lamps (60%). Although only 5 respondents were surveyed to be in this group, this finding requires further consideration and assessment in future studies.

With respect to the regions, Table 6 shows that Mount Lebanon uses almost exclusively diesel generators (90% of respondents of the region), while in Nabatieh UPS / Battery are in the lead with 76%. Respondents from Beirut tend to use candles most often as compared to other regions, an unexpected finding. One explanation could be that administrative Beirut experiences 3 hours of blackouts, and therefore candles can be regarded as a viable alternative to cover these relatively few daily hours of blackouts.

Table 6. Backup solutions used during blackouts split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	619	69	250	121	67	78	34
Candles	17	39	10	16	16	19	15
UPS/Battery	47	29	36	56	73	51	76
Oil lamp	1	4	2	0	0	1	0
Gas lamp	3	4	0	0	16	0	9
Diesel Generator	66	48	90	34	52	71	59
The lamp that can be charged on electricity	3	6	4	3	0	4	0

Of the respondents that indicated they use diesel generators (408 out of the 619 surveyed), approximately 10% own private generators and the remaining 90% rent local generator power (subscription from either municipality owned and operated centralized generation, or from neighborhood generators), as detailed in Figure 4 hereafter.

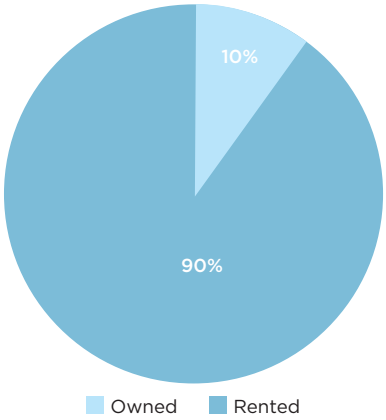


Figure 4. Ownership of diesel generator backup solution (in %)

Ownership of diesel operated generators as a backup solution has been further analyzed based on the parameters identified at the beginning of the section. Tables 7 and 8 show the ownership rate in percent (%) referenced to economic/social class and region.

Based on information indicated in Table 7, the majority of respondents that own generators are from social class B (28% = 18 respondents).

Table 7. Respondents who use (own or rent) diesel generator split by social class

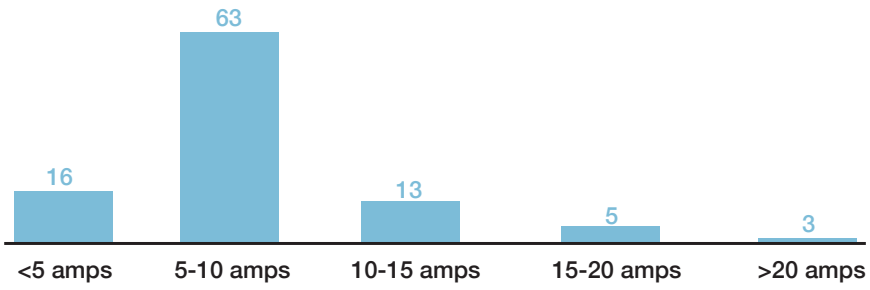
	Total	B	C1	C2	D
Total	408	65	148	143	51
Own	10	28	7	6	2
Rent	90	72	93	94	98

South-residing respondents represent the highest percentage share of respondents that own generators (31% of those with generators in South Lebanon). On the other hand, Mount Lebanon residing respondents are the highest percentage that use or rent out generator subscription and/or power (table 8).

Table 8. Respondents who use (own or rent) diesel generator split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	408	33	224	41	35	55	20
Own	10	9	5	7	31	16	15
Rent	90	91	95	93	69	84	85

The majority of end users that rely on diesel operated generators resort to renting out a limited electricity capacity from either the neighborhood or the municipality owned / operated generator. Of the majority of the 408 respondents that experience blackouts and resort to renting out a capacity share of the diesel generator, 63% opt for a 5-10 amperes power. The remaining are divided into two groups: approximately 13% opt for 10-15 amperes and 16% for less than 5 amperes, as detailed in Figure 5.



Base: Those who use Diesel generator during blackouts (408)

Figure 5. Diesel generator power rented capacity distribution (in %)

The power share split is further analyzed based on the parameters identified previously and detailed in Tables 9 and 10.

Table 9. Diesel Generator Power Split by social class

	Total	B	C1	C2	D
Total	408	65	148	143	51
< 5 amps	16	2	9	22	35
5-10 amps	63	37	69	71	61
10-15 amps	3	28	19	5	2
15-20 amps	5	20	3	1	0
>20 amps	3	14	1	1	2

Social class C1 and D rent out 'less than 5 Amps' and 'between 5 and 10 Amps' subscriptions, hence opting for partial powering of their residences during blackouts. Social class B registered the highest percentage share of '15 Amps and above' subscriptions.

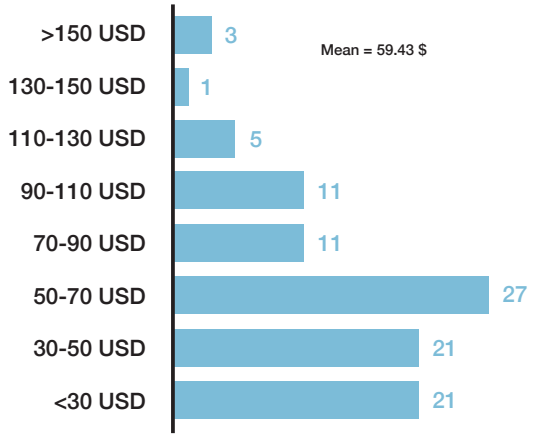
Table 10. Diesel Generator Power Split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	408	33	224	41	35	55	20
< 5 amps	16	9	10	7	3	60	5
5-10 amps	63	79	67	76	60	25	75
10-15 amps	13	9	16	17	17	0	15
15-20 amps	5	3	4	0	17	4	5
>20 amps	3	0	2	0	3	11	0

When evaluated over the various regions as per Table 10, the Bekaa registered the highest percentage share of respondents that rent out 'less than 5 Amps' and 'more than 20 Amps' subscriptions (60% and 11% respectively). The 5-10 Amps range had the highest percentage share over all regions except for the Bekaa. Diesel gensets remain a relatively costly alternative to Lebanese citizens, yet the only alternative so far that satisfies the minimum power needs of citizens during blackouts.

3.1.3 Cost of power

Interviewees experiencing blackouts that resort to diesel operated generators were asked about the monthly allocated budget for the backup solution. Results shown in Figure 6 hereafter show a monthly average (mean score) of approximately USD 59.



Base: Those who experience blackouts (619)

Figure 6. Average money spent on backup solutions per month (in %)

The analysis of the monthly cost has been further disaggregated with respect to economic class and region, as detailed in Tables 11 and 12.

Table 11. Money spent on backup solutions per month split by social class

	Total	B	C1	C2	D
Total	619	71	193	214	135
< 30 USD	21	0	13	20	41
30-50 USD	21	0	14	26	34
50-70 USD	27	13	29	36	20
70-90 USD	11	14	16	11	4
90-110 USD	11	34	17	4	0
110-130 USD	5	15	8	3	1
130-150 USD	1	3	2	0	0
> 150 USD	3	21	2	0	0
Mean (In $)	59.43	111.13	68.81	50.93	33.63

Table 11 shows the monthly averages divided per social class. Results show that social class B registers the highest average money spent on backup power, with USD 111.13 and its highest share of subscribers lie in both the USD 90 – 150 price range and over 'USD 150' range. Subscribers belonging to social class C1 pay the second highest monthly cost average, followed by the C2 social group.

Table 12. Money spent on backup solutions per month split per region

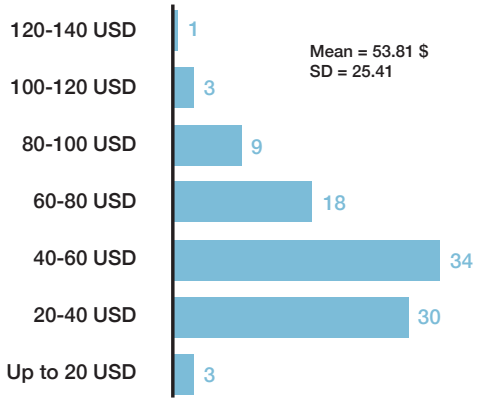
	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	619	69	250	121	67	78	34
< 30 USD	21	17	9	41	33	10	38
30-50 USD	21	16	27	14	16	13	38
50-70 USD	27	48	25	26	27	22	15
70-90 USD	11	7	10	11	16	18	6
90-110 USD	11	9	15	6	4	14	3
110-130 USD	5	3	9	1	1	10	0
130-150 USD	1	0	2	1	1	1	0
> 150 USD	3	0	4	0	0	12	0
Mean (In $)	59.43	54.78	68.68	42.15	47.46	81.41	35.59

Investigating blackouts per regions and monthly average cost (Table 12), the highest average monthly cost of subscribing to diesel operated generators was in the Bekaa with USD 81.41. The second highest region was in Mount Lebanon with USD 68.68. These observations are driven by different reasons, the Bekaa features a higher subscription than other regions, namely the South and North of Lebanon due to the compounded bill (EDL plus backup) that is paid by part of the residents of the Bekaa where EDZ operates[3]. However Mount Lebanon values reflect the higher interviewee base when compared to other regions.

National utility fees

The survey next focused on the national utility cost on the end user in order to complete the overview of electricity costs. Over the total respondents (base: 630), average monthly cost for the national utility company was 54 USD, as depicted in Figure 7. The cost analysis have been carried out with respect to social group and location as detailed in Tables 13 and 14.

[3] *EDZ (http://www.edz.com.lb/Home) is a local power generation and distribution company given a concession by the Lebanese Government to operate in the Zahle (Bekaa) region. It has managed to deliver 24 hour electricity to its residents, given its ability to generate power (as well as purchase power from the national utility EDL) and its overall relatively stronger management of the sector within its jurisdiction.*



Base: All Respondents (630)

Figure 7. Average money spent on EDL utility bill per month (in %)

Table 13. Average money spent on EDL utility bill per month split by social class

	Total	B	C1	C2	D
Total	630	71	196	219	138
Up to 20 USD	3	0	0	5	5
20-40 USD	30	6	22	31	52
40-60 USD	34	17	42	35	32
60-80 USD	18	31	19	21	7
80-100 USD	9	24	11	7	3
100-120 USD	3	10	4	2	1
120-140 USD	1	10	1	0	0
Mean (In $)	53.81	81.55	57.55	50	40.58

When the monthly costs for the primary energy source per social class are examined more closely, class B features the highest monthly average payment, which is also mirrored in subscription cost brackets 60 USD up to 140 USD, whereas in lower brackets (below 60 USD) other social classes have higher subscribers.

When evaluated over the regions (Table 14), the South, Beirut and Mount Lebanon have higher mean values then the total average, with the South of the country taking the lead.

Table 14. Average money spent on EDL utility bill per month split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	630	70	251	124	72	78	35
Up to 20 USD	3	0	2	11	0	0	34
20-40 USD	30	24	33	20	14	56	46
40-60 USD	34	37	32	30	44	29	17
60-80 USD	18	16	16	27	25	10	0
80-100 USD	9	17	9	10	13	4	3
100-120 USD	3	3	5	2	4	0	0
120-140 USD	1	1	3	0	0	0	0
Mean (In $)	53.81	59.43	55.74	52.1	59.72	42.31	48.29

The survey turned next to illicit the respondents' perception regarding the monthly cost of electricity. Results indicate that the majority (68%) considered it 'very costly' or 'relatively costly'. Only 10% of those surveyed indicated that the amount paid to electricity is 'rather' or 'very' reasonable (figure 8).

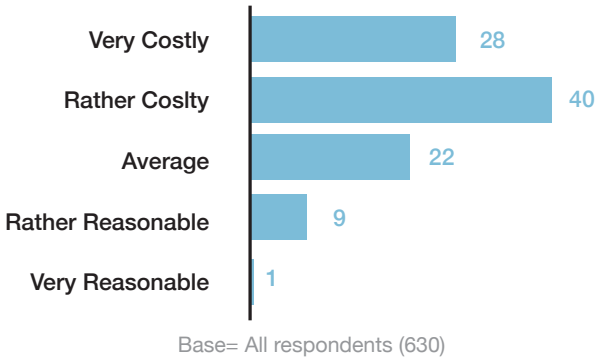


Figure 8. Perceptions of affordability of total electricity payments (in %)

To further investigate this situation, Figure 9 shows the percentage of income paid for electricity in total, i.e. both EDL and backup solution.

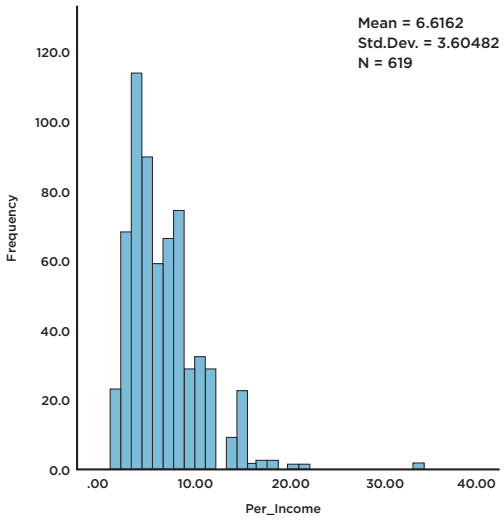


Figure 9. Percent of income paid for EDL and backup power

Approximately 6.6% of household income goes to paying for electricity. However what is relevant here is that approximately 16% of households pay more than 10% of their income on electricity provision in Lebanon. Moreover, the degree and/or extent of burden the power sector has on Lebanese households falls much more on the less privileged, as expressed below;

• Social Class B has a mean monthly income of $4,585, and pays 4.5% of this income on securing power from both the national utility and the back-up diesel generators.

• Social Class C1 has a mean monthly income of $3,056, and pays 4.8% of this income on securing power from both the national utility and the back-up diesel generators.

• Social Class C2 has a mean monthly income of $1,670, and pays 7.1% of this income on securing power from both the national utility and the back-up diesel generators.

• Social Class D has a mean monthly income of $945, and pays 8.7% of this income on securing power from both the national utility and the back-up diesel generators.

Furthermore, it is important to note that during the survey, crude oil prices ranged between $45 and $55 per barrel. Any change from this range will automatically change the income paid to secure power, as evident in an earlier study on willingness to pay for renewable energy were it was found that the average total payments for electricity was approximately 10.4% of household income (UNDP, 2015). Oil prices during this survey (that was undertaken in October 2013) were over $100 per barrel.

The investigation was carried out over the various parameters identified previously and detailed in Tables 15 and 16.

Table 15. Perception about the total amount of money paid for electricity split by social class

	Total	B	C1	C2	D
Total	630	71	196	219	138
Very reasonable	1	0	1	1	1
Rather reasonable	9	4	9	8	11
Average	22	28	19	21	24
Rather costly	40	28	43	44	36
Very costly	28	39	28	25	29

Examining the response of the interviewed pool of people in terms of social class, social class B perceives electricity costs to be very high; almost 94% of the respondents of the social class in question perceive that the cost is above what they consider as reasonable. Noting that social class B has the majority of respondents that rent out backup generation with capacities 15 Amps and above, therefore with corresponding highest costs paid to backup generation. The majority of respondents belonging to other social classes consider the electrical expenses as 'rather costly'.

Table 16. Perception about the total amount of money paid for electricity split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	630	70	251	124	72	78	35
Very reasonable	1	0	0	1	4	0	6
Rather reasonable	9	1	6	13	21	0	23
Average	22	14	17	27	49	0	54
Rather costly	40	56	45	38	24	40	17
Very costly	28	29	33	21	3	60	0

Results shown in Table 16 confirm that most respondents across Lebanon view their payments on power to be 'rather' or 'very' costly.

Finally respondents were asked about their perception of the current energy sector and the role of the Government of Lebanon. Figure 10 shows that the majority (58% = 365 respondents) consider the energy situation as 'very poor', 27% as 'poor', and only 3% (equivalent to 18 respondents) labeling it as 'good'.

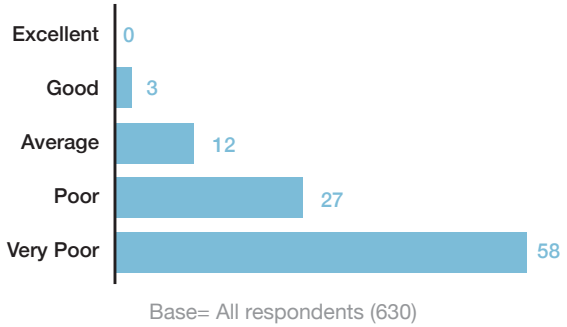


Figure 10. Judging the current energy situation in Lebanon (in %)

Examining the answers closer with respect to social class, Table 17 indicates that class D shows the highest percentage share (65% = 89 respondents) and social class C2 shows the highest number of interviewees (54% = 118 respondents) that believe the current situation is 'very poor'.

Table 17. Opinion on the current energy situation in Lebanon split by social class

	Total	B	C1	C2	D
Total	630	71	196	219	138
Very poor	58	59	57	54	65
Poor	27	28	30	30	19
Average	12	10	10	12	12
Good	3	1	3	4	4
Excellent	0	1	1	0	0

With regards to the public's opinion about the government's role in making electricity available within the next 5 years, 57% of the total respondents (equivalent to 359 individuals) think that this is unlikely to happen while only 19% (equivalent to 119 persons) have trust in the Lebanese Government's role regarding this issue, as shown in Figure 11.

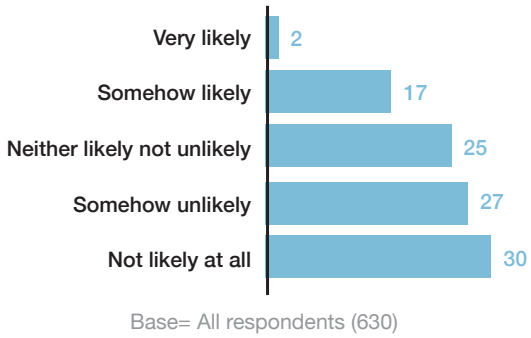


Figure 11. Perception of GoL'S ability to fix the power sector (in %)

When evaluated over the social classes, class D registers the highest percentage share of respondents that have no trust in the government (46% = 63 respondents), social class C2 registered the second highest percentage share of respondents, but the highest in number of respondents that have no trust that the Government can fix the electricity situation (31% = 67 respondents). Whereas respondents from social class B have more trust in the role of the Government (27% = 170 respondents) and feel that it is 'somehow likely' for the Government to make electricity available within the next 5 years. Table 18 hereafter details the answers.

Table 18. Government role in electricity problem in Lebanon split by social class

	Total	B	C1	C2	D
Total	630	71	196	219	138
Not likely at all	30	20	22	31	46
Somehow unlikely	27	15	28	30	25
Neither likely nor unlikely	25	37	27	22	20
Somehow likely	17	27	21	15	8
Very Likely	2	1	3	2	1

The results of Table 18 highlight the need for the Government of Lebanon to better cater for the essential needs (e.g. water and electricity) of relatively poorer households, given their poor faith in the Government. Another way to assess the situation of the relatively lower economic classes is to assess energy poverty. Energy poverty represents a situation where "households spend too high a proportion of their disposable income on expenditure for energy", the definition further highlights the hidden energy poverty concept which depicts a situation where "households have an abnormally low level of spending on energy services" in reference to the disposable income (KBF, 2015). Lebanon has been listed as having 99% electrification, however this percentage does not reflect access to electricity by source or modality. As shown in earlier sections of this chapter, two separate bills are paid to secure 100% electricity availability in all Lebanese cities. Looking closer at the pair of bills gives the energy poverty definition more relevance.

4 OVERVIEW OF HOUSEHOLDS' AND APPLIANCES

This chapter evaluates household awareness of environmental and energy matters, as well as energy efficient electrical home appliances. This background data is important, in general, for policy makers that aim to encourage more sustainable lifestyles, and important also for the regression analysis of Chapter 6, given the linkages between the appeal of more energy efficient appliances and attitudinal and knowledge attributes.

4.1 Appliances ownership and user-ship in Lebanon

A preliminary list of electric appliances has been drafted and approximately 630 respondents were asked about ownership, usage patterns, purchasing cost and replacement rate, details of which are listed in Table 19.

Table 19. Select household appliance characteristics

Appliance	% of respondents who own the appliance	Average number of items	Most Purchased Type	Average price at purchase	Average use	Average replacement rate
Refrigerator	100%	1	-	$1,202	-	Every 10 years
Light bulbs	100%	20	LED	$12	-	Every 8 months
Microwave	77%	1	-	$160	3 times/day	Every 5 years
Oven	100%	1	Gas	$555	3 times/day	Every 8 years
Clothes washing machine	100%	1	7-9 Kgs	$630	4 times/week	Every 7 years
Clothes dryer machine	22%	1	7-9 Kgs	$752	3 times/week	Every 7 years
Split AC Units	87%	3	12,000 BTU	$455	-	Every 7.5 years
Fan	84%	2	-	$51	5.5 hours/day	Every 3.5 years
Heating	92%	1	Electric heater 12,000 BTU	$295	5.5 hours/day	Every 6 years
Computer	77%	1	Laptop	$931	5 hours/day at home	Every 3.5 years
TV	100%	3	32'-40'	$868	5 hours/day	Every 4 years
Dish Washer	4%	1	-	$923	2 times/day	Every 6.5 years

Refrigerators, light bulbs, ovens, washing machines and televisions are the home appliances that are used unanimously by all respondents. The major equipment (such as refrigerators, washing machines, etc…) have a relatively long replacement rate.

4.1.1 AC/Heating usage in Lebanon

Air conditioners (ACs) and electric heaters potentially have the highest energy consumption rates among the different list of appliances used by people around the world (GEA, 2012). Furthermore, and based on results shown in Table 19, ACs and heaters are used by a relatively large percentage of respondents; 87% (equivalent to 545 respondents) and 92% (equivalent to 579 respondents), respectively. To this end, the usage habits of ACs and water heaters are further investigated hereafter.

Respondents who own AC split units or central ACs were asked about the average use of AC for cooling in both the summer period (running from June to September) and all the other periods combined.. As shown in Figure 12, ACs are used for space cooling during the summer period with an average of 7.7 hours per day while during the remaining months AC usage drops to an average of 3 hours per day.

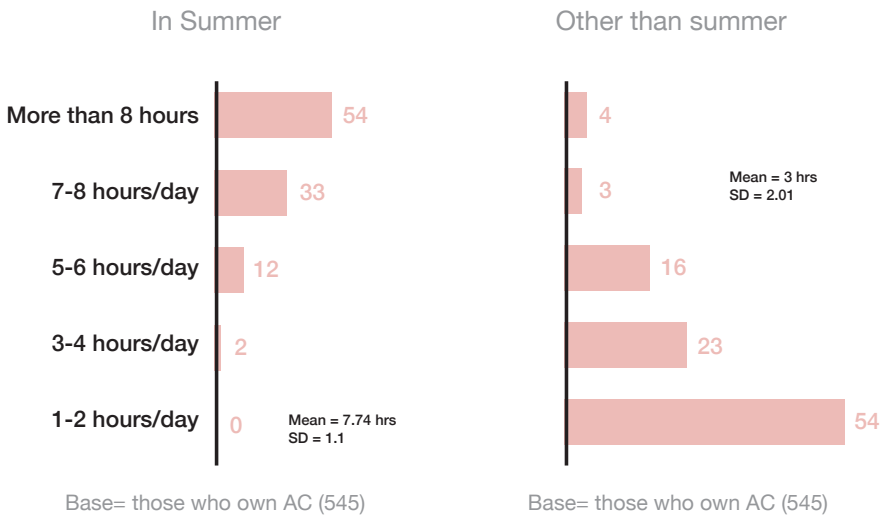
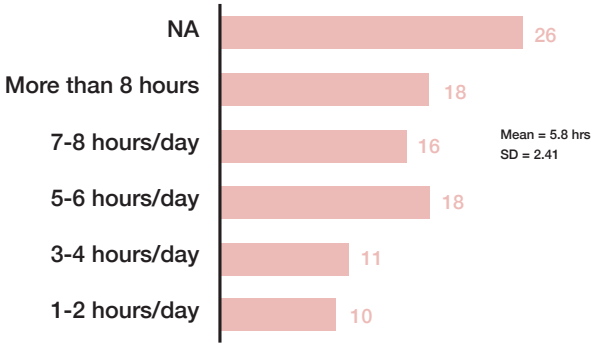


Figure 12. Use of AC for cooling in summer and other than summer (in %)

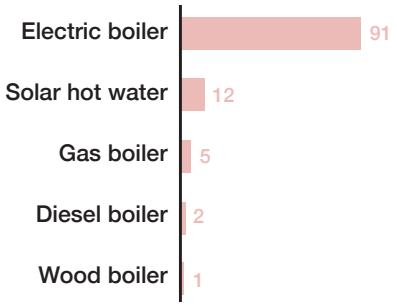
During winter months ACs are commonly used for space heating and respondents were asked about their usage patterns, namely the duration. Answers pertaining to AC usage pattern over the winter season for space heating are shown in Figure 13, indicating an average use of 6 hours per day.



Base= respondents who use ACs for heating (545)

Figure 13. Use of AC for heating in winter (in %)

In addition, respondents were asked about the methods used to heat water around the residence; 91% (equivalent to 573 respondents) use electric boilers, 12% (equivalent to 75 respondents) use solar hot water and only 5% (equivalent to 31 respondents) use gas boilers, as shown in Figure 14.



Base= All Respondents (630)

Figure 14. Means used to heat Water (in %)

4.1.2 Awareness of environmental issues, climate change and household appliances

The provision of electricity for the Lebanese economy has tremendous environmental implications, particularly given the widespread use of local diesel generators in every neighborhood to meet the demand for electricity (El-Fadel et al., 2010).

This section will present the environmental situation analysis for the surveyed respondents in order to identify their level of awareness in terms of current environmental issues. In specific, data will be gathered on how much do responds talk or read about 'environmental issues', 'climate change', and energy efficient appliances'.

Figure 15 shows the percentage of respondents who 'never', 'rarely', 'sometimes', 'often' and 'very often' discuss these three key issues; environment, climate change, energy efficiency in relation to household appliances.

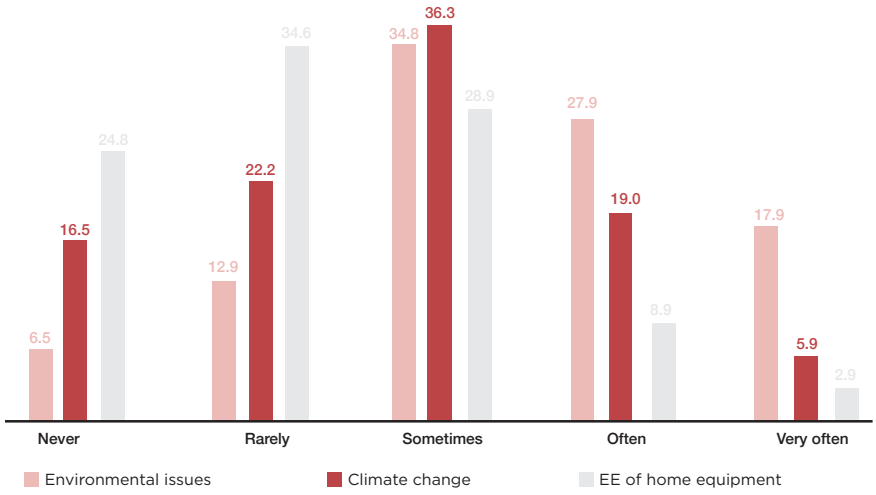
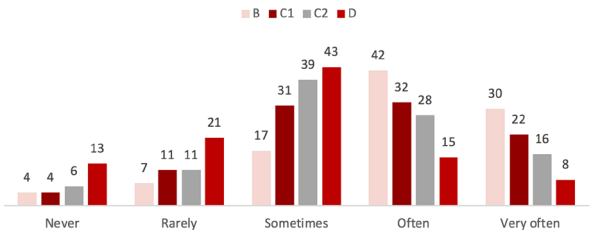


Figure 15. Awareness of 'environmental issues', 'climate change' and 'energy efficiency' in household appliances' (%)

As can be seen in Figure 15, the environment does take a lot of attention with approximately 81% of respondents indicating that they 'sometime', 'often' and 'very often' discuss and/or read environmental issues. One possible explanation for this is that, during the period of the survey, solid waste management in Lebanon captured the attention of the Lebanese media and people. When it comes to climate change and, more so, awareness of the specifics of energy efficient household appliances, the data shows that less people are aware of these two issues. Approximately 60% of respondents do not mention or read about energy efficiency in home appliances.

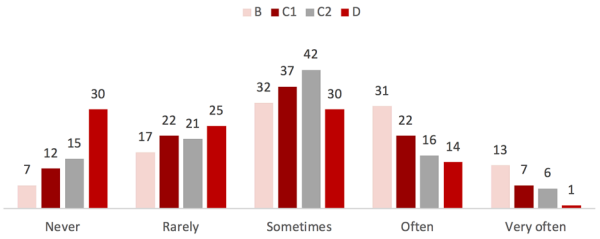
Results above have been further decomposed with respect to social class (Figure 16) and area of residence (Figure 17), shown in both table and graphic formats.

%	Environment			
	B	C1	C2	D
Never	4	4	6	13
Rarely	7	11	11	21
Sometimes	17	31	39	43
Often	42	32	28	15
Very often	30	22	16	8



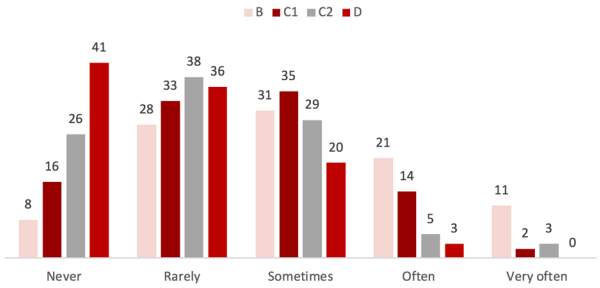
Environment awareness per social class (% of total)

%	Climate change			
	B	C1	C2	D
Never	7	12	15	30
Rarely	17	22	21	25
Sometimes	32	37	42	30
Often	31	22	16	14
Very often	13	7	6	1



Climate change per social class (% of total)

%	EE Appliances			
	B	C1	C2	D
Never	8	16	26	41
Rarely	28	33	38	36
Sometimes	31	35	29	20
Often	21	14	5	3
Very often	11	2	3	0



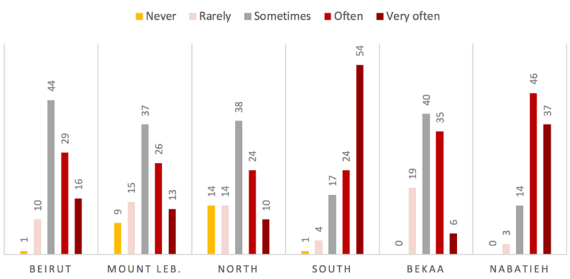
EE in household appliances per social class (% of total)

Figure 16. Social class and awareness of environment, climate change, and energy efficient appliances (values in %)

Figure 16 shows that over 70% of respondents from social class B do talk and read about environmental issues, whereas the majority of social class D do not. This discrepancy between social classes with respect to environmental awareness needs policy responses to identify the key reasons behind this statistic and the appropriate actions to increase awareness in all social classes. Similar to 'environmental issues', 'climate change awareness' is more present in social class B, yet in lower percentage shares. Class C2 has most percentage share of respondents that 'sometimes' read and talk about climate change (42% = 92 respondents), while class D has the most percentage share of respondents that 'never' read or talk about climate change issues.

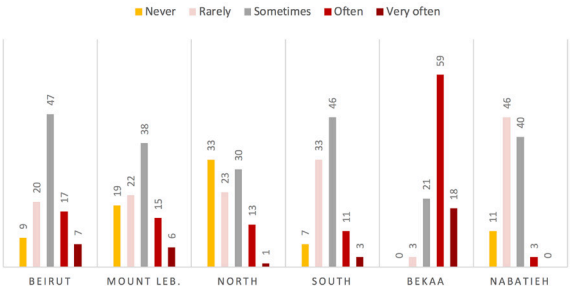
With respect to discussion or reading about energy efficiency in household appliances, social class B is more exposed to the concept of energy efficient appliances while social class D has the highest percentage share that are 'never' aware about the concept.

	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Never	1	9	14	1	0	0
Rarely	10	15	14	4	19	3
Sometimes	44	37	38	17	40	14
Often	29	26	24	24	35	46
Very often	16	13	10	54	6	37



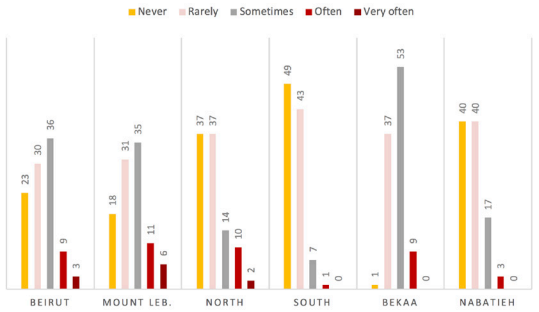
Environment awareness per area (% of total)

	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Never	9	19	33	7	0	11
Rarely	20	22	23	33	3	46
Sometimes	47	38	30	46	21	40
Often	17	15	13	11	59	3
Very often	7	6	1	3	18	0



Climate change awareness per area (% of total)

	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Never	23	18	37	49	1	40
Rarely	30	31	37	43	37	40
Sometimes	36	35	14	7	53	17
Often	9	11	10	1	9	3
Very often	3	6	2	0	0	0



EE in household appliances awareness per area (% of total)

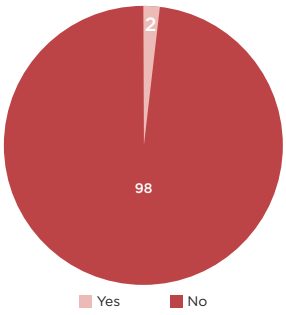
Figure 17. Area of residence and awareness of environment, climate change, and energy efficient appliances (values in %)

When examining the awareness split by region (figure 17), approximately 14% of the North respondents have never talked or read about environmental issues. The Nabatieh area leads the way with the highest share having 'often' and 'very often' talked and read about these issues, and the South represents the highest share that is 'very often' aware of such news. Both regions surpass Beirut and Mount Lebanon areas.

In order to identify the extent of awareness, respondents were asked about their knowledge pertaining to climate change and, unlike environmental issues, a higher share of people talk and read about climate change. The Bekaa has the highest relative percentage share of respondents that are exposed to climate change issues (77% = 60 respondents), while the highest share of respondents from Nabatieh are rarely exposed to such information (46%). The reason for the relative difference in the rankings between environmental awareness and climate change awareness in these two regions is that the Bekaa is more susceptible and/or discerning to water shortages given its relatively larger agricultural characteristic.

In topics related to energy efficient appliances, lower level of awareness is found amongst the respondents, with the majority having rarely or never been exposed to the topic at hand. Mount Lebanon represented the highest level of awareness with a mere 17% (equivalent to 42 people) having been exposed to the topic.

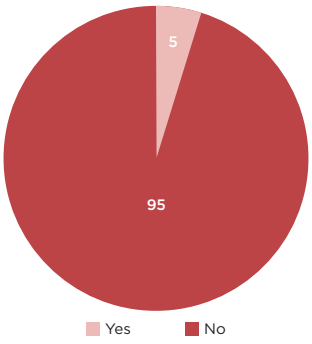
For a clearer understanding of the varied exposure of the interviewed batch, respondents were asked whether they are affiliated to any organization dealing with environmental or energy or climate issues; as detailed in Figure 18 hereafter, only 2% are involved in such organizations.



Base = All respondents (630)

Figure 18. Members of organizations dealing with environmental issues (in %)

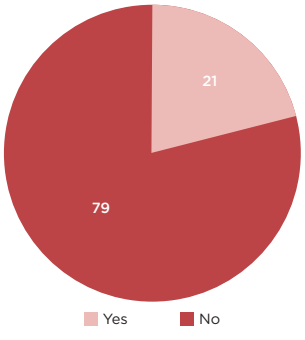
Furthermore, the majority (95%) of respondents do not have any connections (friends and/or family) in the market for home equipment retail business, as shown in Figure 19, therefore eliminating it as a "major" source of awareness or exposure of appliances and/or energy efficiency within appliances.



Base = All Respondents (630)

Figure 19. Connections in the market for home equipment (in %)

In light of the perception on electricity costs, exposure to rationing of electricity from the National Utility (EDL), and the need and options for backup generation, respondents were asked if they were ever exposed, in the past year, to any awareness campaigns about ways to reduce their energy consumption (figure 20).



Base = All Respondents (630)

Figure 20. Respondents exposed to awareness campaigns (in %)

Figure 20 shows that in 2016, 21% (132 respondent) of the total respondents have been exposed to awareness campaigns. The share of exposure to awareness campaigns is slightly higher for age brackets ranging from 18 to 30 years old. This can be attributed to social media and workplace exposure. When examining the variations amongst the different social classes (shown in Table 20 below), social class B presents the highest percentage overall.

Table 20. Exposure to awareness campaigns split by social class

	Total	B	C1	C2	D
Total	630	71	196	219	138
Exposed	21	35	20	19	17
Unexposed	79	65	80	81	83

Examining exposure over the identified regions, as shown in Table 21, both the South and the Bekaa have high shares of unexposed people (93% = 66 people and 96% = 74 people, respectively) to campaigns, particularly given the low number of respondents selected in the two regions. Mount Lebanon and the North, the regions with the highest share of respondents, showed comparable percentages (for both exposed and unexposed). Mount Lebanon represented the highest number of respondents exposed to awareness campaigns (equivalent to 75 person), although the share of respondents' awareness of environmental and climate change issues was not the highest. While the Bekaa had scored the highest percentage share of unexposed respondents to campaigns, it had the highest percentage share of respondents 'often' aware of climate change issues.

Table 21. Exposure to awareness campaigns split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	630	70	251	124	72	78	35
Exposed	21	14	30	25	7	4	14
Unexposed	79	86	70	75	93	96	86

Beyond the exposure to awareness campaigns, the survey inquired about the respondents' energy conservation behavior, namely:

(1) Turning off lights in unused spaces
(2) Unplugging devices instead of standby mode
(3) Whether they own any renewable energy source
(4) Recycling waste
(5) Conserving water
(6) Purchasing organic food
(7) Communication and cooperation with neighbors
(8) Participation in community activities.

These behavioral trends are shown in Figure 21.

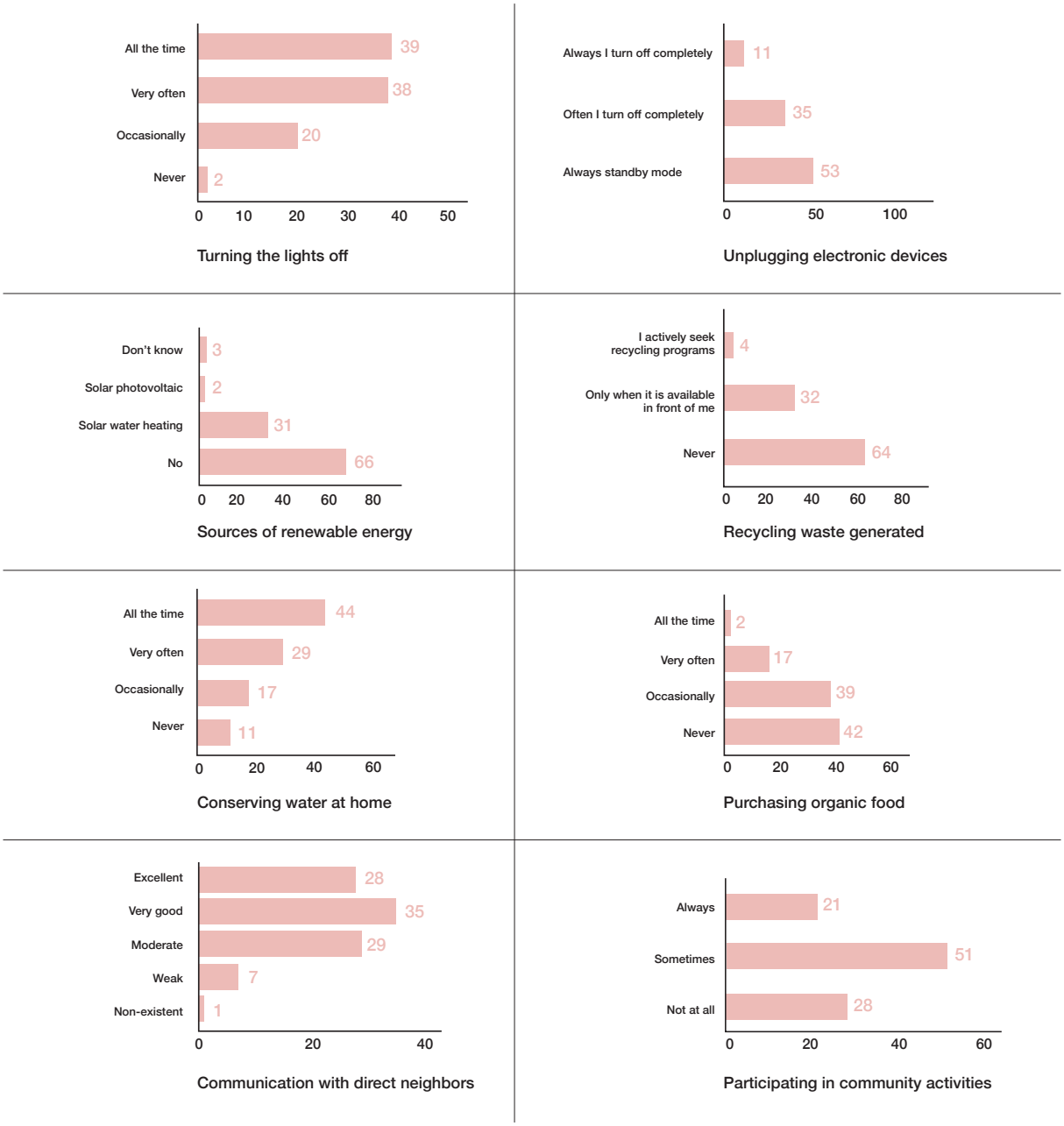
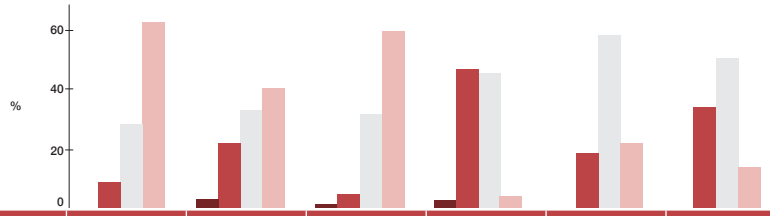


Figure 21. Select Environmental and Social Behavioural Characteristics (in %)

Respondents indicate that they 'turn off the lights' 'all the time' or 'very often' when they leave a room. This is a positive indication of energy awareness. Similarly, approximately 73% of respondents 'conserve water' 'all the time' or 'very often'. However for 'unplugging electronic devices', 'recycling waste generated', and 'purchasing organic food', the statistics are less favorable. In terms of community integration and involvement, results can be considered, at least on a national level, as positive, given that approximately 63% indicate an 'excellent' or 'very good' communication with neighbors and 72% 'always' or 'sometimes' get involved in community activities. With respect to 'sources of renewable energy', 2% of respondents indicated that they have a solar photovoltaic system, whereas 31% indicated that they have a solar hot water system. Solar hot water systems have advanced considerably with time in Lebanon. During a study on the solar hot water market in Lebanon, based on surveys in 2010, only 13% of respondents to the then survey indicated that they have solar hot water systems (MEW, UNDP, 2014).

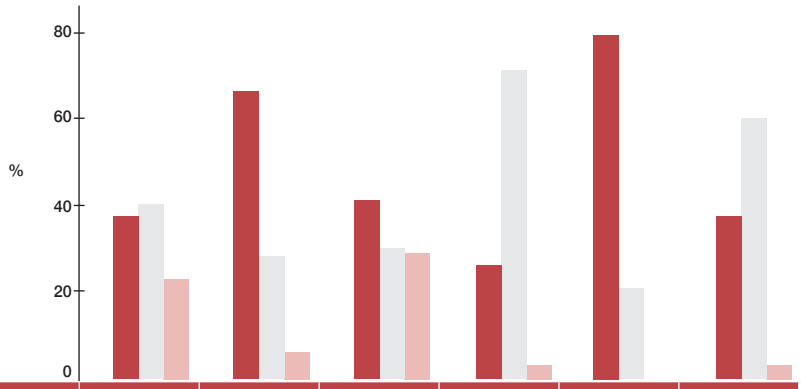
Disaggregating the data further on several of the above behavioral indicators, the following section outlines only the findings that have relatively substantial differences between regions and social class.



	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Never	0	3	2	3	0	0
Occasionally	9	22	5	47	19	34
Very Often	29	33	32	46	59	51
All the time	63	41	60	4	22	14

Figure 22. Turning the lights off by region (in %)

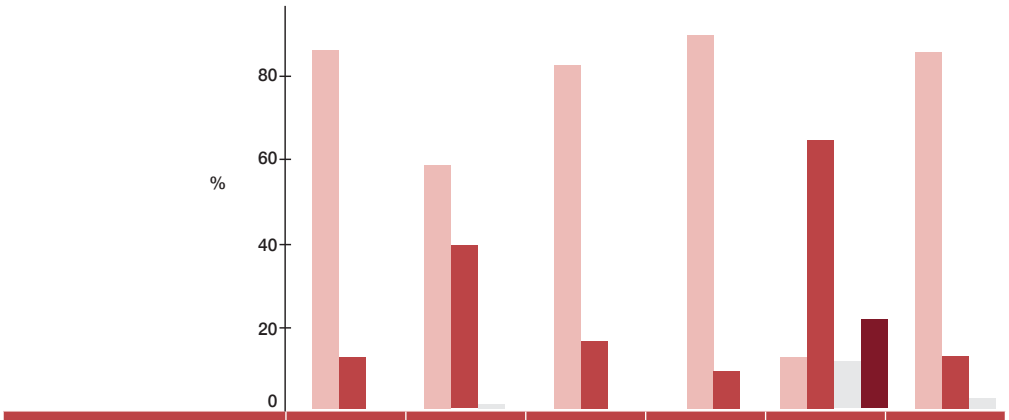
Figure 22 clearly shows that the regions of Beirut and the North of Lebanon have relatively better performance in terms of 'turning the lights off' when not in use, followed by Mount Lebanon.



	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Always standby mode	37	66	41	26	79	37
Often I turn off completely	40	28	30	71	21	60
Always I turn off completely	23	6	29	3	0	3

Figure 23. Unplugging electronic devices by region (in %)

In terms of unplugging electronic devices (Figure 23), again the North of Lebanon and Beirut fare better than other regions in Lebanon.

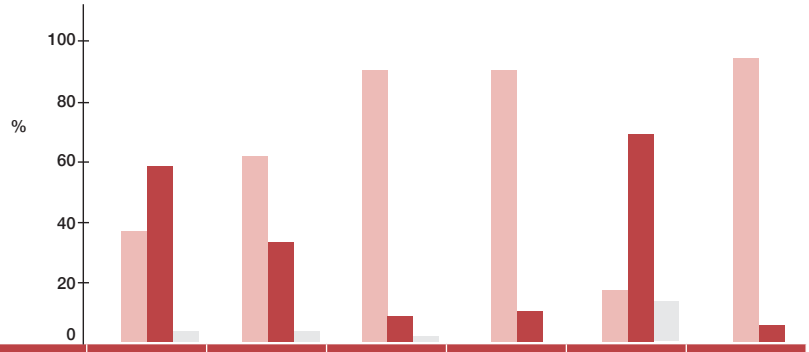


	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
No	87	59	83	90	13	86
Solar water heating	13	40	17	10	65	14
Solar photovoltaic	0	1	0	0	12	3
Don't know	0	0	0	0	22	0

Figure 24. Sources of RE available by region (In %)

Figure 24 shows that the Bekaa and Mount Lebanon are leading the way in terms of the use of solar hot water systems. The Bekaa is also the leader in terms of residential solar photovoltaic systems, perhaps due to its relatively better solar irradiance and availability of the required (non-shaded) roof space.

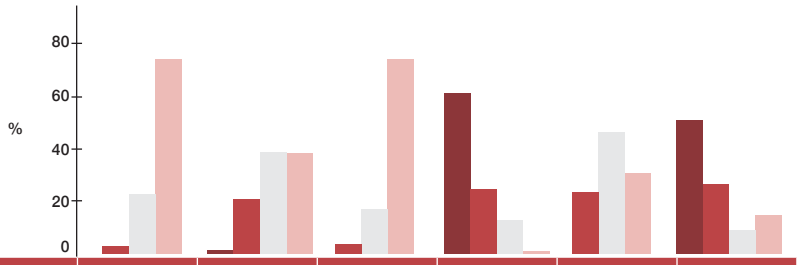
Figure 25 shows the recycling rates of various regions. Recycling habits, similar to water conservation, have been included in several studies linking the uptake of more energy efficient appliances and attitudes and behavior towards the environment (e.g. Gaspar & Antunes, 2011; Hartmann & Apaolaza-Ibáñez, 2012). A very small percentage of respondents indicated that they actually recycle in each of the indicated regions of Lebanon. Most other responses indicate a willingness to do so only if the proper and easily accessible infrastructure is present.



	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Never	37	62	90	90	17	94
Only when it is available in front of me	59	33	9	10	69	6
I actively seek recycling programs	4	4	2	0	14	0

Figure 25. Recycling waste by region (in %)

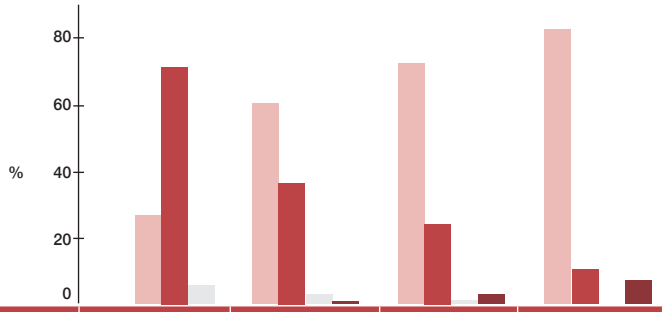
Figure 26 shows that the areas of the North of Lebanon and Beirut are the ones that conserve water the most, in accordance with their respective responses. The South and Nabatieh have relatively weaker water conservation habits.



	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Never	0	2	0	61	0	51
Occasionally	3	21	4	25	23	26
Very Often	23	39	17	13	46	9
All the time	74	38	79	1	31	14

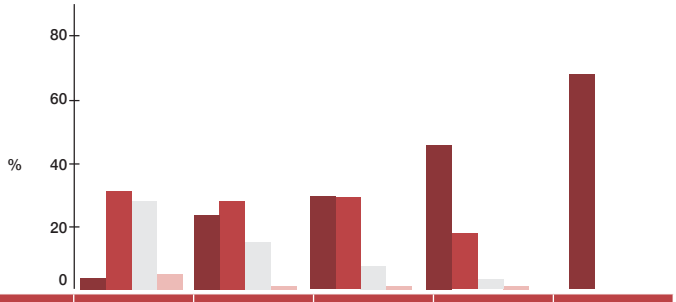
Figure 26. Conserving water at home by region (in %)

With respect to social class, Figures 27 and 28 show, comparatively, which social group utilizes renewable energy and which group consumes more organic food. Social groups B and C1 are more involved in both these categories, indicating that the required upfront costs for these technologies are more readily available for these relatively higher social class groups.



	B	C1	C2	D
No	27	61	73	83
Solar water heating	72	37	25	11
Solar photovoltaic	6	3	1	0
Don't know	0	1	3	7

Figure 27. Sources of renewable energy available split by social class (in %)



	B	C1	C2	D	E
Never	6	35	44	67	100
Occasionally	46	41	43	26	0
Very Often	41	22	11	5	0
All the time	7	2	1	1	0

Figure 28. Purchasing organic food split by social class (in %)

4.1.3 Energy labels awareness

Respondents were asked about their awareness of 'energy labeling' on home appliances, which was referred to as 'spontaneous awareness'. Spontaneous awareness tries to capture whether or not the respondent has been exposed to any awareness of energy labeling for household appliances prior to the current survey. Approximately 16% (equivalent to 100 respondents) had 'spontaneous awareness' of 'energy labels' on home appliances.

Subsequently, the rest of respondents, approximately 84%, who were not 'spontaneously aware' of energy labeling, were provided with cards that contained the energy labels available on home appliances to identify their level of exposure to available labels. This is referred to as 'aided awareness'. Only 9% of respondents (equivalent to 47 respondents) were aware of energy labels when 'aided'

The total awareness of energy labeling on home appliances, as shown below in Figure 29, represents both 'spontaneous awareness' and 'aided awareness', totalling up to 24% of total respondents. This is an indication that more work needs to be done to inform consumers on the availability and the implications of energy labeling for household appliances.

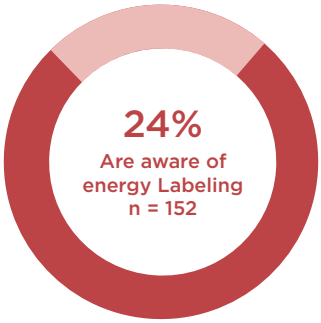


Figure 29. Total awareness about energy labels on home appliances

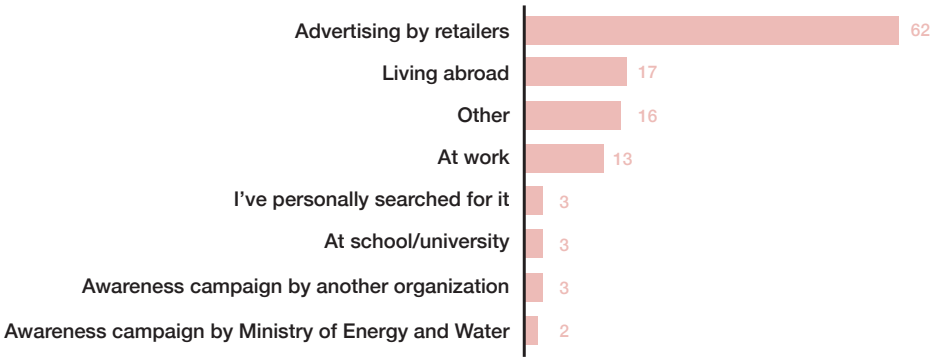
When evaluated over the social classes, energy labeling awareness is significantly higher for both classes B and C1 when compared to the total (Table 22). This trend was also found with exposure to 'climate change' and 'environmental awareness' as well as 'family member or friend connection' to the electric appliances market. This result indicates that more efforts should be put in reaching out on these environmental matters to all citizens.

Table 22. Energy labelling total awareness split by social class (in %)

	Total	B	C1	C2	D
Aware	24	63	32	16	6
Unaware	76	37	68	84	94

Subsequently, the 478 respondents who were not aware of 'energy labels' were asked whether some of their appliances have an energy rating. These surveyed respondents were either 'not aware' if there are any energy labels available on their appliances or they indicated that they have not seen any labels at all.

The 152 respondents who indicated awareness of energy labels were, in turn, asked about their source of awareness. As shown in Figure 30, advertising by retailers was the main source of information (app. 62% of respondents responded in this category).



Base = respondents aware of energy labels (152)

Figure 30. Sources of awareness about energy labels (in %)

When 'awareness' is evaluated over the various social classes, percentage shares are rather homogeneous over the various sources and social classes. However social class B registers a high percentage (33% equivalent to 14 respondents out of 45 for social class B), and indicated that their source of 'awareness' was 'living abroad', as shown in Table 23.

Table 23. Sources of awareness about energy labels split by social class

	Total	B	C1	C2	D
Total	152	45	63	35	8
Advertising by retailers	62	60	59	71	50
Awareness campaign by MEW	2	0	2	3	13
Awareness campaign by another organization	3	2	3	3	0
Living abroad	17	33	14	6	0
At school/ university	3	0	5	3	13
At work	13	11	11	17	13
I've personally searched for it	3	2	3	0	13
Other	16	13	16	17	25

When evaluated over the existing regions (Table 24), Beirut based respondents noted 'work' to be the second most common source of awareness (44% = 7 out of 18 respondents). Mount Lebanon, the South and Nabatieh indicate that their awareness comes from 'retailers and from 'other' sources. In the Bekaa, 47% of respondents list the source of awareness as either 'living abroad' or 'other'. Finally, the North has a relatively higher share of respondents listing 'retailers' as the source of awareness (81% = 25 out of 31 respondents), and they also register the highest percentage for interviewees that have 'personally searched for' the information (10% = 3 out of 31 respondents).

Table 24. Sources of awareness about energy labels split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	152	18	59	31	18	17	9
Advertising by retailers	62	67	64	81	67	6	78
Awareness campaign by MEW	2	6	0	3	4	0	0
Awareness campaign by another organization	3	6	3	0	4	0	0
Living abroad	17	11	14	10	19	47	22
At school/ university	3	0	7	0	0	6	0
At work	13	44	19	0	0	0	0
I've personally searched for it	3	0	2	10	0	0	0
Other	16	6	10	6	26	47	22

4.1.4 Importance of energy labeling in purchase decisions

In order to identify the elements considered when purchasing new electrical appliances, respondents were asked to rank the most important criteria considered when purchasing home appliances. Figure 31 details the answers registered.

'Brand popularity' is listed as the most important criteria by 30% of respondents (equivalent to 189) and 'convenient prices' was indicated as the 2nd most important criteria 17% of respondents (equivalent to 107). Energy rating was considered the least important relative criteria.

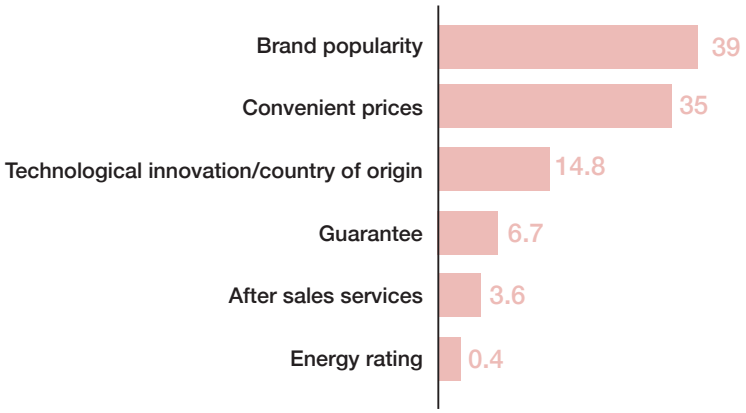


Figure 31. Important criteria considered when selecting appliances to purchase (in %)

Based on the answers, respondents were then asked whether 'energy labels' play an important role in the decision making process. Answers were recorded on a scale from 1 to 5, where 1 is 'not important at all' and 5 is 'very important'. As shown in Figure 32, 54% of respondents agreed that energy labels are considered 'important' and 'very important' in their purchasing decisions, 29% were neutral about 'energy labels', and the other 17% indicated that energy labels are of no importance in their purchase decisions.

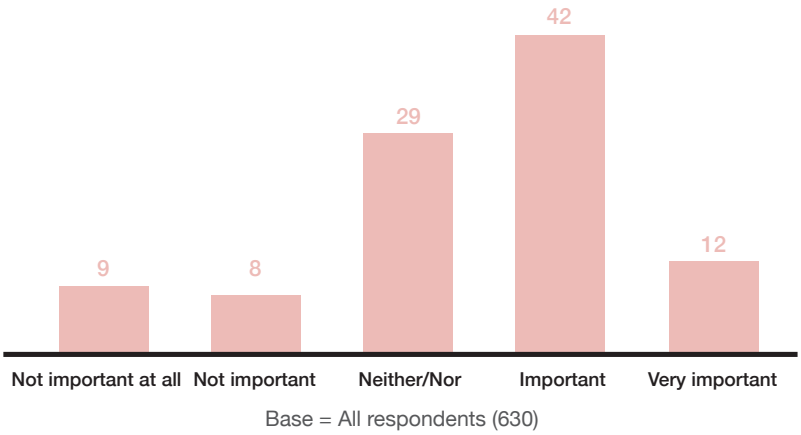


Figure 32. Energy labeling importance in purchase decision (in %)

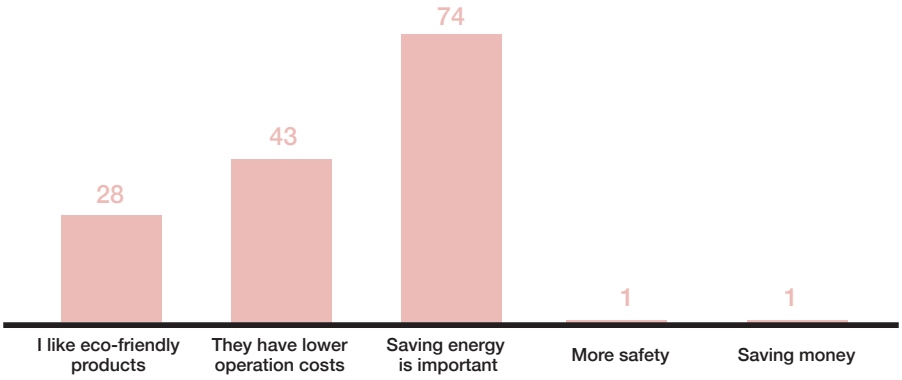
When evaluated over the various social classes, social class B and C1 (75% = 53 and 63% = 123 respondents, respectively) had the highest shares of percentages that have answers in the top two brackets of Table 25 (indicating the importance of labels in the decision making process). Social class C2 had the third highest number of respondents putting a high importance on energy labels (53% = 116 respondents).

Table 25. Importance of energy labels split by social class

	Total	B	C1	C2	D
Total	630	71	196	219	138
T2B[4]	54%	75%	63%	53%	33%

Respondents who considered energy labels important in their purchasing decisions (base: 338 respondents) were asked about the reasons behind this importance. As shown in Figure 33, approximately 28% (equivalent to 94 respondents) were driven by their preference of eco- friendly products, 43% (equivalent to 145 respondents) agreed that energy labels have lower operations costs and 74% (equivalent to 250 respondents) agreed that saving energy is of critical importance.

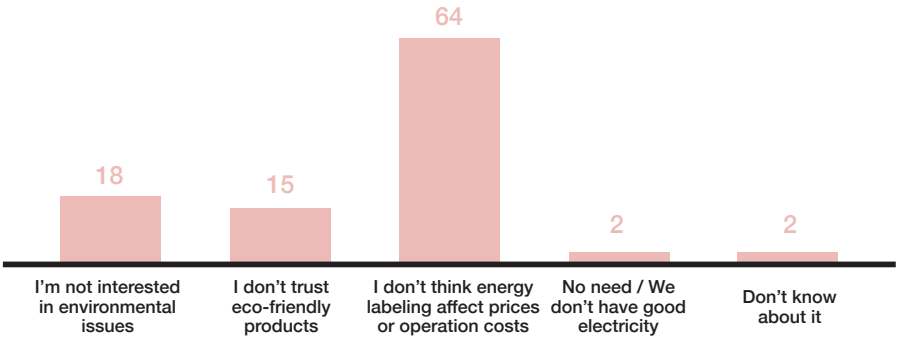
[4] *T2B: Top Two Boxes scores within 5 point scale questions (in this case 'important' and 'very important').*



Base = respondents who think energy labels are important (338)

Figure 33. Reasons for the importance of energy labels in purchasing decisions (in %)

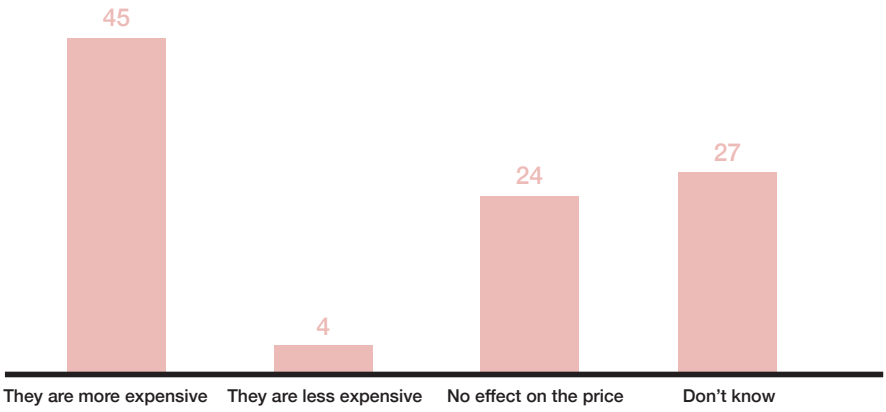
On the other hand, respondents (base: 107 respondents) that did not consider energy labels as an important factor in their purchasing decisions were asked about the reason for this dismissal. As shown below in Figure 34, approximately 18% of respondents (equivalent to 19 respondents) are not interested in environmental issues, 15% (equivalent to 16 respondents) do not trust eco-friendly products while 64% (equivalent to 68 respondents) thought energy labels do not affect prices or operations costs.



Base = Those who think energy labels are NOT important (107)

Figure 34. Reasons for considering energy labels NOT important (in %)

Finally respondents (base: 630 interviewees) were asked whether they believed energy labels affect the prices of the appliances. Approximately 45% (equivalent to 283 respondents) assert that products with energy labels are more costly, 24% (equivalent to 151 respondents) thought energy labels had no effect on the products' prices and only 4% (equivalent to 25 respondents) thought that labels lower prices, as shown in Figure 35. Although this assertion may hold for many appliances, it will surely not be the case when the lifecycle costs of appliances are taken into account. It is the latter costs that should be well communicated.



Base = All respondents (630)

Figure 35. Perception of effect of energy labels on products' prices (in %)

When evaluating the answers over the 'area' and 'social class' criteria, approximately 60% of respondents (equivalent to 46 out of 78 respondents) from the Bekaa believe that labels increase the cost of the appliances. Mount Lebanon and the North had the highest number of respondents that believe labels increase the product's cost. Details are listed in Table 26.

Table 26. Effect of energy labels on prices split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	630	70	251	124	72	78	35
They are more expensive (%)	45	34	38	52	51	60	49
They are less expensive (%)	4	0	5	5	7	0	6
No effect on the price (%)	24	20	31	19	32	0	37
Don't Know (%)	27	46	25	24	10	40	9

5 WILLINGNESS TO PAY FOR ENERGY EFFICIENT HOME APPLIANCES

This chapter analyses the willingness to pay (WTP) of consumers for more energy efficient home appliances. Approximately 28% of respondents (equivalent to 176 respondents) are not willing to pay any additional upfront cost for energy efficient appliances compared to 33% (equivalent to 207 respondents) that are willing to pay additional upfront costs for EE home appliances. A third segment, 39% of the total respondents, agreed that willingness to pay depends on the appliance needed to purchase. Details are provided in Figure 36 hereafter.

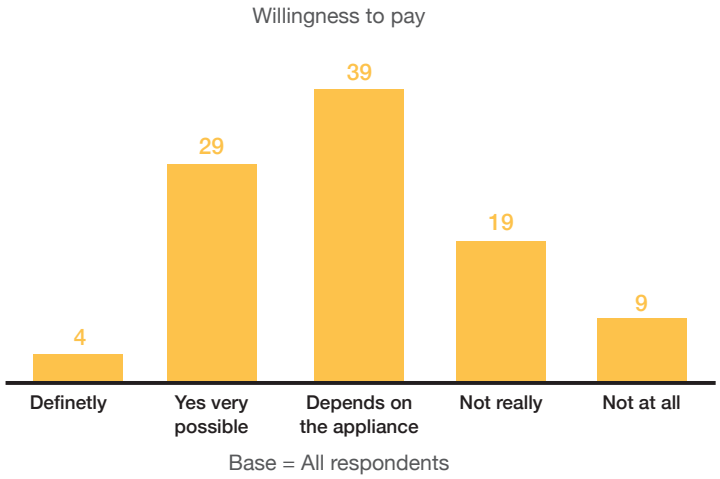


Figure 36. WTP additional upfront cost for EE home appliances (in %)

When evaluated over the different social classes, social class D had the highest share of percentage of respondents not willing to pay any additional upfront cost for EE appliances. Social classes C1 and C2 had the highest percentage of respondents that thought the upfront cost depended on the appliance while social class B had the highest percentage of respondents that are most willing to pay more for EE home appliances. Details are provided in Table 27. Social class B had the highest share of respondents that consider energy labels are important when purchasing electrical equipment.

Table 27. WTP additional upfront cost for EE home appliances split by social class

	Total	B	C1	C2	D
Total	630	71	196	219	138
Not at all	9	1	3	53%	33%
Not really	19	1	12	17	37
Depends on the appliance	39	24	47	46	25
Yes very possible	29	54	35	28	12
Definitely	4	20	3	2	1

Over the regions, respondents from the North were the least willing to pay any additional cost; this result is in line with the registered responses thinking that labels increase cost of the equipment. Mount Lebanon had the highest share of respondents most willing to pay additional amounts for EE appliances. Details are provided in Table 28.

Table 28. WTP additional upfront cost for EE home appliances split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
Total	630	70	251	124	72	78	35
Not at all	9	6	7	21	3	6	0
Not really	19	19	18	9	25	26	26
Depends on the appliance	39	43	35	40	40	46	43
Yes very possible	29	29	35	23	32	22	26
Definitely	4	4	5	7	0	0	6

The respondents who were not willing to pay upfront cost for EE home appliances (approximately 27% of those surveyed) were asked about the reasons behind their lack of willingness. As seen in Figure 37, approximately 34% of 172 respondents cannot afford to pay for EE home appliances, 44% thought EE home appliances are not really effective in reducing electricity bills, 13% do not really care about having more EE equipment and finally 9% think that the government should first interfere and set minimum energy performance standards (MEPS) and labeling program before they consider paying more for EE home appliances.

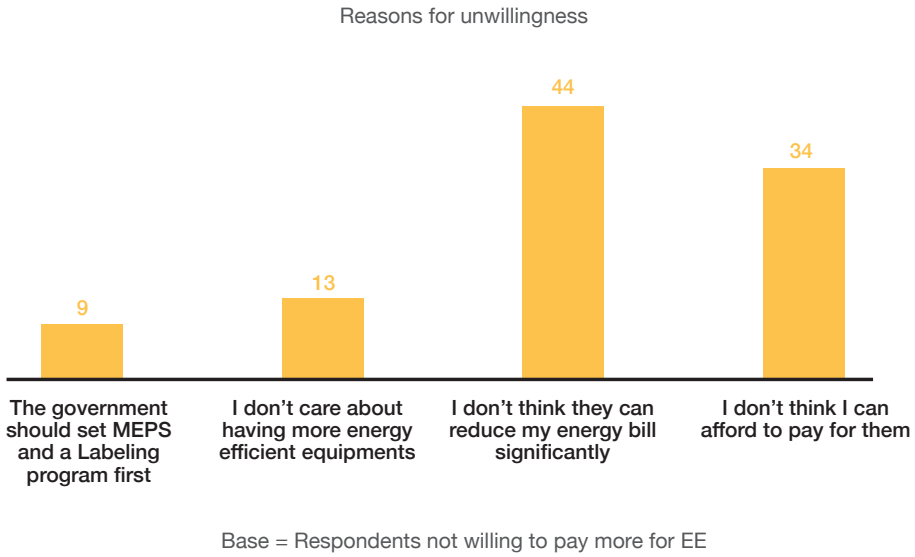


Figure 37. Reasons for not willing to pay upfront cost for EE Home appliances (in %)

When evaluated over the criteria used throughout the study, social classes D and E had the highest share in percentage that deemed buying EE home appliance as too expensive for them. Most respondents from social classes C1 and C2 thought that such appliances would not reduce their bills significantly. Social class B respondents were equally split between not caring about having EE home appliance and thinking the government should set a minimum standard before they actually purchase anything. Details are shown in Table 29.

Table 29. Reasons for not WTP additional upfront cost for EE Home appliances split by social class

	Total	B	C1	C2	D	E
Total	172	2	29	52	86	3
I don't think I can afford to pay for them	34	0	7	13	53	100
I don›t think they can reduce my energy bill significantly	44	0	59	63	30	0
I don›t care about having more energy efficient equipment	13	50	17	13	12	0
The government should set Minimum Energy Performance Standards and a labelling program first	9	50	17	10	5	0

Respondents from the North region had the highest percentage share of respondents that did not care about having energy efficient appliances, as shown in Table 30. Mount Lebanon registered the highest percentage share and number of respondents (55% = 35 respondents) that believe that such appliances have little impact on their energy bills.

Table 30. Reasons for lack of additional WTP upfront cost for EE Home appliances split by region

	Total	Beirut	Mount Lebanon	North	South	Bekaa	Nabatieh
TOTAL	172	17	64	37	20	25	9
I don't think I can afford to pay for them	34	41	17	43	20	72	22
I don't think they can reduce my energy bill significantly	44	53	55	24	65	16	67
I don't care about having more energy efficient equipment	13	0	14	30	10	4	0
The government should set MEPS and a labelling program first	9	6	14	3	5	8	11

All respondents were then asked about the willingness to purchase certain appliances in the future, namely: (1) washing machine (WM), (2) air conditioner (AC), (3) television (TV), (4) light bulbs (LB) and (5) refrigerator (RG).

Figures 38 and 39 provide respondents' willingness to purchase the here-listed equipment (along with mean and standard deviation values). On average (Figure 39), respondents are willing to upgrade their washing machine in 4-year intervals; air conditioners in 3.5 year intervals, televisions in 3 year intervals and lights bulbs in 6 months intervals as they are the most frequently used appliances and the less durable ones. Finally, respondents are willing to purchase a refrigerator, on average, over 5 years intervals.

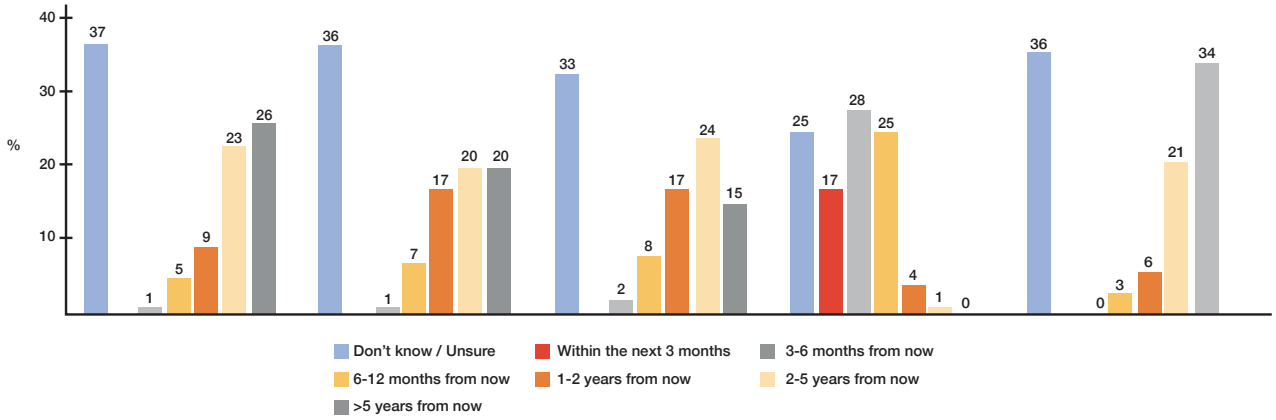


Figure 38. Rollover period for various surveyed appliances (in years)

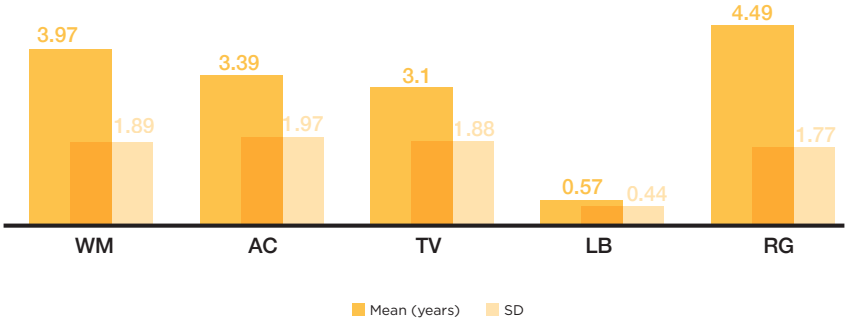


Figure 39. Mean and standard deviation of rollover (in years)

When evaluating respondents' WTP additional money to buy EE home appliances two approaches were used:

• 304 respondents were asked about their willingness to pay using questions that only provide information related to energy savings in percentages and none to monetary ones.

• 326 respondents were asked about their willingness to pay using questions that only provide information related to the dollar amount savings and none to energy percentage ones.

Figure 40 shows the mean additional willingness to pay and the standard deviation responses for each of the above two categories for each type of appliance.

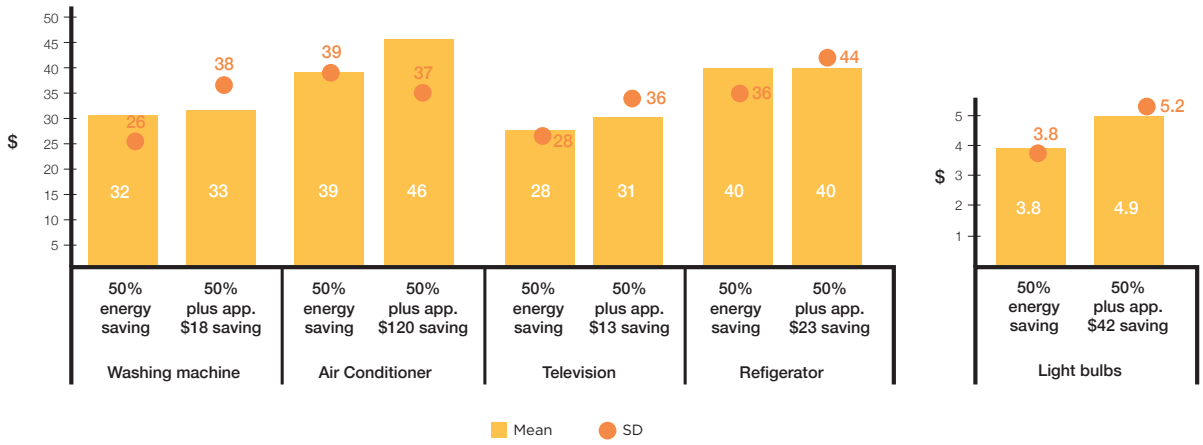


Figure 40. Mean WTP for each assessed appliance subject to information disclosure

Although the mean WTP is slightly more for almost every appliance when actual value of monetary saving is disclosed, we will see that this difference is modest at best. This indicates that using percentage savings on energy label or the equivalent actual money savings will not make much of a difference. This will be revisited in Chapter 6.

Results show that citizens are willing to pay, on average, an additional:

• $32 for highly efficient washing machines
• $39 for air conditioners
• $28 for televisions
• $40 for refrigerators
• $3.8 for a light bulb.

6 REGRESSION ANALYSIS, POLICY RECOMMENDATIONS AND CONCLUSION

6.1 Regression Analysis

6.1.1 Regression Analysis Specification

Willingness to pay (WTP) elicited estimates for the five appliances analyzed in this report are driven by underlying drivers to varying extents. It is critical that policy makers understand these drivers so that they apply more suitable policies to drive more energy efficient choices by consumers considering the purchase of household appliances.

It could be expected that the people who were found to have prior knowledge of energy labeling and who can be considered enthusiasts for energy-efficient appliances may express generally higher WTP estimates across all types of appliances while others, indifferent to them, may express generally lower WTP estimates. However there are other vital attributes that may lead to varying WTP elicitations. These can be either demographic covariates or attitudinal, perceptional, behavioral, and experience-related covariates. Table 31 lists the included covariates in the regression analysis.

Table 31. Socio-demographic and attitudinal/experience covariates used in the model

	COVARIATES
1	**Socio-demographics**
	Monthly personal income category
	Socio-economic grade
	Surface area of residence
	Age group
	Gender
	Level of education
	Geographical area of residence
2	**Attitudes, perceptions, behaviors and experience-related**
	Importance of EE label to purchasing decision
	Exposure to awareness campaigns to reduce energy consumption
	Opinion about current energy situation in Lebanon
	Belief that government will make electricity available 7/24
	Perception of total amount paid for electricity
	WTP more for EE appliances
	Reading or talking about the environment
	Turning off lights when leaving rooms
	Recycling practices
	Water conservation practices
	Hours of blackout per day
	Average monthly expenditure on backup solution
	Average monthly electricity bill
	Presence of renewable energy source at the place of living

Given the large number of covariates, two separate models were estimated: (1) a model which accounts for socio-demographic covariates (SD model) and (2) a model which accounts for the attitudes, perceptions, behavior and experience (APBE model) covariates. In addition, a covariate to account for the effect of the information disclosure treatments is included in the APBE model, given its perceptional nature.

6.1.2 Regression Analysis Results

Table 32 lists the results for the socio-demographic (SD) model, for each of the 5 analyzed household appliances.

Table 32. SD model estimates

Covariate	Washing machine	Air conditioner	TV	Light bulb	Refrigerator
Constant	-17.021**	10.985	-21.891***	-3.933***	-24.307***
Monthly personal income category					
<$1,500/month (base level)	0.000	0.000	0.000	0.000	0.000
$1,500-$3,000/month	6.811*	10.500**	12.722***	1.103	9.427*
>$3,000/month	4.046	10.077*	16.015***	1.237	5.628
Socio-economic grade					
D or E (base level)	0.000	0.000	0.000	0.000	0.000
C1 or C2	13.636***	13.303**	12.957***	1.399*	16.567***
A or B	27.116***	25.568***	22.461***	1.945*	27.948***
Surface area of residence					
40-100 m^2 (base level)	0.000	0.000	0.000	0.000	0.000
100-160 m^2	16.311**	9.751	23.171***	5.124***	27.102***
160 m^2 or more	29.453***	22.761***	28.830***	6.928***	44.790***
Age group					
18-30 (base level)	0.000	0.000	0.000	0.000	0.000
31-45	-0.587	-7.407*	-3.291	-1.084**	-0.593
>45	0.512	-8.078*	-5.922	-1.567***	0.878
Gender					
Male (base level)	0.000	0.000	0.000	0.000	0.000
Female	2.475	-1.574	-0.333	0.493	2.261
Level of education					
High school or less/Technical school (base level)	0.000	0.000	0.000	0.000	0.000
University/College 1st degree level	4.645	4.771	-1.614	-0.655	1.129
University higher degree (MSc/PhD)	16.338***	27.897***	9.980	-0.618	24.463***
Area of residence					
Beirut & Mount-Lebanon (base level)	0.000	0.000	0.000	0.000	0.000
North, South & Beqaa	5.325*	-7.884**	9.325***	2.036***	4.634

Legend: * P<0.10 | ** P<0.05 | *** P<0.01

Table 32 discloses the following observations with respect to the SD covariates:

• Income covariate: The SD model estimates suggest that WTP indeed increases with income as expected across all appliances with the exception of light-bulbs, with stronger associations and p-values generally found for the '$1,500-$3,000/month' income category compared to the higher '>$3,000/month'. With respect to light bulbs, coefficients were insignificant for all of the income groups, most probably due to the low unit price of this appliance and hence the limited impact on income from paying a premium for it.

• Socioeconomic grade covariate: It can be observed that WTP significantly increases from D/E group to the C1/C2 groups, and likewise from this latter to the highest A/B group across all appliances (with the exception of light bulbs where this increase was significant only at the 10 percent significance level).

• Surface area of residence covariate: the 'surface area' covariate has the highest association with WTP, with WTP highly significantly and substantially increasing across all appliances.

• Age covariate: As older aged groups are observed, they seem to have a highly significant effect in reducing WTP for air conditioners and light bulbs, the two appliances where yearly savings to energy efficiency were highest. The reason for this can be a combination or one of two possibilities; (1) young households may prefer up-to-date technology and/or (2) the younger generation may be more sensitive to environmental issues. The data surveyed indicates that approximately 40% of those surveyed over 51 years of age 'discuss and read about environmental issues', whereas 45% - 54% of those aged between 18 and 50 years 'discuss and read about environmental issues'.

• Gender covariate: Gender seems to play no part in WTP differences for energy efficient appliances

• Education covariate: Education has a significant impact confined to the highest level, namely university higher degree (MSc and PhD) for which coefficients were highly significantly positive for all appliances except TVs and light bulbs.

• Area of residence covariate:
- The coefficient for air conditioners for the 'North, South and Beqaa' is highly significantly negative, indicating a lower WTP for energy-efficient appliances among residents of these regions compared to Beirut and Mount-Lebanon. This is possibly a reflection of the fact that the former regions are more rural in character, and hence relatively less interested in air conditioning, and by implication energy-efficient air conditioning. This can be attested to given that in Beirut and Mount-Lebanon respondents in the sample reported the presence of an average of 3.2 split AC units in their residence, while North, South and Beqaa residents reported only 2.8.

- For TVs, light bulbs and washing machines, the coefficients were significantly positive (yet only at the 10 percent level for the latter), indicating that North, South and Beqaa residents have higher WTP for these appliances compared to their Beirut and Mount-Lebanon counterparts.

Table 33 lists the results for the attitudes, perceptions, behavior and experience (APBE) model, similarly for each of the 5 analyzed household appliance.

Table 33. APBE model estimates

Covariate	Washing machine	Air conditioner	TV	Light bulb	Refrigerator
Constant	-9.686*	13.707**	1.505	1.272	-2.038
Information treatment					
With cost savings information (base level)	0.000	0.000	0.000	0.000	0.000
Without cost savings information	0.664	-6.960**	-1.591	-1.585***	1.700
Importance of EE label to purchasing decision					
Not important/Neither (base level)	0.000	0.000	0.000	0.000	0.000
Important	10.670***	11.253***	10.742***	1.691***	13.001***
Exposure to awareness campaigns to reduce energy consumption					
No (base level)	0.000	0.000	0.000	0.000	0.000
Yes	-3.902	-0.556	-0.609	-1.310**	-6.798
Opinion about current energy situation in Lebanon					
Poor (base level)	0.000	0.000	0.000	0.000	0.000
Average/Good/Excellent	-1.322	-4.162	2.435	2.969***	-0.025
Belief that government will make electricity available 24/7					
Unlikely/Neither likely nor unlikely (base level)	0.000	0.000	0.000	0.000	0.000
Likely	1.797	7.452**	1.160	0.607	2.899
Perception of total amount paid for electricity					
Reasonable (base level)	0.000	0.000	0.000	0.000	0.000
Average/Costly	-9.362***	-5.890	-8.816**	-0.875*	-5.911
WTP more for EE appliances					
Not at all/Not really (base level)	0.000	0.000	0.000	0.000	0.000
Depends on appliance	28.213***	28.109***	23.086***	2.850***	27.189***
Yes very possible/Definitely	36.439***	37.298***	32.014***	2.843***	38.319***
Reading or talking about the environment					
Never/Occasionally (base level)	0.000	0.000	0.000	0.000	0.000
Sometimes	-1.339	-3.266	2.457	1.213**	-5.245
Often/V. often	-0.963	-4.698	0.567	1.513**	1.036

Covariate	Washing machine	Air conditioner	TV	Light bulb	Refrigerator
Turning off lights when leaving room					
Never/Occasionally (base level)	0.000	0.000	0.000	0.000	0.000
Very often	2.611	-3.908	-1.843	0.278	-1.490
All the time	-3.406	-9.362**	-6.335	-0.889	-12.899**
Recycling practices					
Never (base level)	0.000	0.000	0.000	0.000	0.000
Only when available/Active	-8.292***	-2.486	-3.729	0.818*	-4.024
Water conservation practices					
Never/Occasionally (base level)	0.000	0.000	0.000	0.000	0.000
Very often	1.026	2.053	-6.269	-1.494**	1.200
All the time	0.559	-5.947	-6.661	-1.711***	-1.933
Hours of blackout per day					
<6 hrs (base level)	0.000	0.000	0.000	0.000	0.000
6-9 hrs	5.315	3.800	2.816	-1.793***	3.827
>9 hrs	1.916	-4.152	-6.322	0.322	-2.772
Average monthly payment on backup solution					
<$50/month (base level)	0.000	0.000	0.000	0.000	0.000
$50-$90/month	3.513	3.295	5.551	0.488	6.635*
>$90/month	10.351**	13.821***	5.812	1.162*	11.728**
Average monthly electricity bill					
<$40/month (base level)	0.000	0.000	0.000	0.000	0.000
$40-$80/month	14.445***	10.488***	13.469***	0.384	18.685***
>80$/month	32.131***	36.567***	30.671***	2.120***	33.060***
Presence of renewable energy source at place of living					
No (base level)	0.000	0.000	0.000	0.000	0.000
Yes	-2.160	-4.044	-6.941*	-0.381	-3.106

Legend: * P<0.10 | ** P<0.05 | *** P<0.01

Table 33 discloses the following observations with respect to the APBE covariates:

• Disclosure of actual cost savings information covariate: Disclosure of actual approximate cost savings of purchasing more energy efficient appliances are significant only for air conditioners and light bulbs, with negative signs in both cases. Interestingly, savings were highest per year for these two types of appliances, suggesting that respondents were reacting rationally to the disclosure of actual monetary saving information by registering a significant WTP increase when informed about the extent of energy efficiency. Therefore when actual money saved is relatively considerable, using this value instead of percentage saving could have added value.

• Importance of EE labels covariate: Respondents who indicated that EE labeling is important registered highly significant WTP increases across all appliances, indicating that WTP for EE appliances is largely driven by a desire to reduce energy usage. Therefore raising awareness of energy use and labeling for household appliances is essential.

• Perception of current electricity situation covariate:
- Respondents who believed that the current energy situation in Lebanon was 'average', 'good' or 'excellent' (15 percent of the sample) stated a highly significantly larger WTP for energy efficient light bulbs than the groups who thought the situation was poor.

• Belief in GoL ability to provide 24 hour electricity covariate: the respondents that believe the GoL is likely to make electricity available 24/7 (app.19% of the sample) indicate a WTP for more energy efficient air conditioners that is significantly higher (at the 10% level) than for the pessimistic or agnostic majority.

• Perception of amount of money paid on electricity covariate: Respondents who think of the amount paid for electricity as 'average' or 'costly' are WTP significantly less for all appliances except for refrigerators and air conditioners than respondents who think this amount is reasonable. They are likely to be discounting what they perceive as an additional electricity-related financial burden.

• Belief in WTP for EE appliances covariate: We observe, as expected, a highly significant increase in WTP for all EE appliances the stronger the respondents' stated belief that they will pay more for such appliances.

• Reading/talking about the environment covariate: When people 'sometimes', 'often' or 'very often' read and talk about the environment, it can be observed that it significantly increases their respective WTP for EE light bulbs only. Therefore and in general, a moderate concern towards the environment, expressed in reading and talking about the environment, does not lead, in itself, to any major changes in choices of more EE appliances.

• Turning off lights when leaving the room covariate: Findings here are significant only for air conditioners and refrigerators, where there is a relative decrease in WTP as more often people turn off their light when leaving a room.

• Recycling and water practices covariate: Recycling and water conservation practices seem to decrease WTP for washing machines in the case of the former and for light bulbs in the case of the latter. These finding highlight again the important difference between energy 'curtailment' behavior (i.e. habitual behavior) and occasional purchasing decisions, where the latter seems to be less influenced by attitudes concerning the environment.

• Hours of blackout experienced per day covariates: This attribute does not seem to have much influence over the magnitude of WTP for EE appliances except with respect to respondents who face 6-9 hours of blackouts per day who have a relatively lower WTP than those who experience both lower and higher durations of blackout per day.

• Average monthly expenditure on backup solutions covariate: WTP for all EE appliances significantly increases with average monthly expenditure on backup solutions, especially when this amount exceeds $90 per month. Moreover, the strongest positive correlation with WTP can be observed with the average monthly national electricity bill. This can be explained by the fact that backup generators are in large part paid for in the form of a fixed periodical sum, and hence offer less of an incentive for households to buy EE appliances when compared to those whose metered consumption of national grid electricity provides them with the bulk of their energy need.

• Presence of renewable energy at place of living covariate: The presence of a renewable energy source at the place of living has no sizable impact on WTP for EE appliances.

6.2 CONCLUSION AND POLICY RECOMMENDATIONS

In an effort to collect data geographically representative of the Lebanese population, a survey has been conducted with 630 respondents from all five regions on five types of energy-efficient home appliances. Information pertaining the respondents' socio – demographic status, their attitudes, perception, behavior and experience have been assembled and analyzed to identify the variables that influenced WTP for energy efficient equipment, and to identify approximate WTP values for each of the five selected appliances. It is hoped that this study has provided more data on current trends in the appliance market and on Lebanese consumer choices and behavior with respect to the analyzed five appliances. It is by no means comprehensive or valid through time, and thus more assessments are required on a systematic basis to better inform policy makers' choices and responses.

The main results show a mean additional willingness to pay ranging from 3.2% to 34.5% on the respective product costs, as indicated below:

(1) Approximately $30 for a washing machine (equivalent to app. 4.8% of the average indicated product cost)
(2) Approximately $41 for an air conditioner (equivalent to app. 9.1% of the average indicated product cost)
(3) Approximately $29 for a television (equivalent to app. 3.3% of the average indicated product cost)
(4) Approximately $4 for a light bulb (equivalent to app. 34.5% of the average indicated product cost)
(5) Approximately $39 for a refrigerator (equivalent to app. 3.2% of the average indicated product cost)

Approximately 60% of the Lebanese respondents to the survey indicated that they 'never' or 'rarely' discuss energy efficiency in appliances, and only approximately 12% indicate that they do. Therefore, this study confirms the need to introduce awareness of energy labeling schemes and introduce energy labeling on all household appliances. This is particularly the case as respondents who indicated that EE labeling is important registered highly significant WTP increases across all appliances, indicating that WTP for energy efficiency is largely driven by a desire to reduce energy usage. It also confirmed the need to enforce diesel genset operators to charge customers on their power consumption as opposed to their power capacity. This will incentivize more energy efficient purchasing decisions. Furthermore, the outcome of the study calls for a more targeted awareness campaign on energy efficient appliances. Awareness campaigns can focus on air conditioners for Beirut and Mount Lebanon, and on TVs, light bulbs and washing machines for the North, South and the Bekaa regions in line with the knowledge gaps statistically observed in this study.

The outcome of the study also shows that the younger generation are more pertinent to undertake the necessary changes required.

Last, income was a defining covariate in the analysis. Targeting higher income groups first may pave the way to begin the change required in purchasing decisions towards more energy efficient appliances.

A recent study by the LCEC (2018), indicated that approximately 36% of total electricity consumption is attributed to the Lebanese residential sector. Therefore, the potential to reduce energy use in the residential sector is of utmost importance. Policies and commitments that push in the direction of more energy efficient choices can be seen at all levels. Internationally, Lebanon has signed the Paris Agreement in 2016, committing itself through the Intended Nationally Determined Contributions (INDCs) framework to an unconditional 3 percent (or conditional 10 percent) reduction in power demand through energy efficiency measures, to achieve, together with similar renewable energy commitments, an unconditional reduction of greenhouse gas (GHG) emission of 15 percent (or 30 percent conditional) compared to the business-as-usual scenario by 2030 (UNFCCC, 2015).

Specific initiatives for specific appliances are also being rolled out. One of these is the Kigali Cooling Efficiency Program (K-CEP) that will focus on the energy efficiency of cooling to increase and accelerate the climate and development benefits of the Kigali Amendment to phase down HFCs.

In Lebanon, the need to transform our choices has been outlined in the first and second National Energy Efficiency Action Plans of the Ministry of Energy and Water and the Lebanese Center for Energy Conservation.

Understanding and targeting the behavior of citizens in terms of private household energy consumption and conservation is essential in achieving energy efficiency targets.

Several policy recommendations emerge from this study's finding;

(1) The continued situation of structured blackouts in Lebanon and the subsidized tariffs that Lebanese householders pay for electricity from the national utility create a barrier for a more effective adoption of more energy efficient appliances. The more households pay for national utility electricity, the more they are WTP for most of the assessed energy efficient appliances, as was found in the data collected and analyzed for this study. Therefore subsidized tariff rates dampen down the potential of this important driver.

(2) Legally enforcing the backup generator sector to charge consumers for the power they actually consume as opposed to the capacity they rent out can be a short-to-medium term solution for incentivizing household purchasing decisions with respect to appliances, until the Government of Lebanon secures a reliable national 24-hour electricity.

(3) The introduction of energy performance labeling for home appliances is essential to kick-start the pathway toward a more energy efficient appliance stock. Lebanon is still a long way off from raising awareness about the presence and purpose of energy labeling in appliances. In fact approximately 79 percent of the surveyed respondents indicated that they have not come across energy efficiency labeling awareness campaigns. However, the survey results indicate that respondents would be WTP more for the surveyed appliances should they actually have energy performance labels. The relative premiums for energy efficient appliances range from over 3 percent for televisions and refrigerators, over 9 percent for air conditioners, over 34 percent for light bulbs, and just under 5% for washing machines.

(4) It is recommended to set up a local labeling certificate for those appliances that are manufactured in Lebanon (e.g. fridges), and to assist these manufacturers in increasing the energy performance of their respective appliances.

(5) Pending further assessments required and the introduction of mandatory energy performance labeling, it would be advisable to eventually ban appliances that do not have and/or do not communicate their energy performance via acknowledged energy labeling schemes, and to eventually begin to ban the sale of relatively very poor energy performing appliances. In other words, a minimum energy performance standard is advisable for each appliance type as a pre-requisite for sale in the country. The social implications of this need to be well analyzed, in specific the implications on relatively less well-off households and their ability to afford, upfront, better energy performing appliances, assuming that they tend to be sold at a relatively higher price, ceteris paribus. The data discussed in this report have shown that socio-economic groups C2 and D require special attention in terms of awareness of the financial benefits of selecting better 'energy performing' household appliances.

(6) Given the above premium, it is recommended to use fiscal measures (e.g. tax-credits or subsidies) to increase the relative cost-effectiveness of efficient appliances in relation to their respective common types. A detailed study on this would be required.

(7) Awareness campaigns should run in parallel with the introduction of energy performance labeling on appliances and they would be more effective if differentiated by appliance type and region, and tailored to different socio-economic and age groups. Households in urban areas (specifically in Beirut and Mount-Lebanon) seem more inclined to pay for more energy efficient air conditioners than rural areas, whereas in the latter they are more concerned with the energy performance of washing machines, televisions and light-bulbs.

All things being equal, it can be expected that the cost of relatively more energy efficient appliances are higher than their average types. The WTP estimates given by the surveyed respondents can be compared to this price difference, per appliance type, to decide the level of the required tax credit, subsidy or alternative support mechanism that policy makers should enact. This tax credit and/or subsidy is required as consumers have indicated that convenient prices (upfront purchase price) is the second most important criteria considered when purchasing an appliance. Following the introduction of mandatory energy labeling schemes, the introduction of minimum energy performance standards should be considered, after a thorough due diligence on their economic and social implications.

Many of the above recommendations can be considered as anchored or tested policies and programs used to overhaul slowly the household appliance sector (see, for example, Kelly, 2012). In Lebanon, the National Energy Efficiency Action Plan (NEEAP) indicates that the Government of Lebanon, through the MEW and LCEC, are working to administer energy labeling for household appliances for Lebanon, and to introduce minimum energy performance standards.

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