MINISTERO DELL'AMBIENTE

LEBANESE REPUBLIC
MINISTRY OF ENERGY AND WATER

LCEC
LEBANESE CENTER FOR ENERGY CONSERVATION

Availability, Efficiency & Use of Home Appliances in Lebanon

Results of Survey of Home Appliances within Retailers and Households

December 2020

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The Lebanese Center for Energy Conservation (LCEC) is the national energy agency for Lebanon. LCEC is an association at the Lebanese Ministry of Energy and Water (MEW) with a financially and administratively independent statute. LCEC acts as the technical arm of the Lebanese Government, specifically the Ministry of Energy and Water in all issues related to energy efficiency, renewable energy, and green buildings.

For more information:
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Note: The information contained in this document has been developed within a specific scope, and might be updated in the future.

Foreword

This report describes the state of the local market of home appliances in Lebanon based on several retailer and consumer surveys that have been conducted in 2018 and 2019, respectively.

It highlights the importance of continuously replacing the country's current stock of home appliances with more energy-efficient ones, ultimately leading to tremendous energy saving at both the individual and national levels. Such large-scale national initiatives would be aligned with Lebanon's objectives to reduce its energy demand, as well as national commitments to support a deep de-carbonization of the building sector fully in line with the objectives of the Paris Agreement.

The report is part of the Italian Energy-Efficient Home Appliances Program approved in August 2018 as part of a technical cooperation agreement on sustainable development between the Italian Ministry for the Environment Land and Sea and the Lebanese Center for Energy Conservation. The program aims to promote energy-efficient home appliances among Lebanese consumers. It highlights the importance of the European energy labelling scheme. It also introduces Lebanese consumers to the concept of lifecycle cost of their home appliances.

We hope that this report would raise awareness amongst Lebanese stakeholders to understand the benefits of energy saving in home appliances and its impact on the environment, to grasp the importance of changing consumer behavior, and to work towards a better and greener future.

The LCEC will build on the results of this report in the preparation of new national programs and initiatives, especially within the National Energy Efficiency Action Plan for Lebanon 2021-2025 which is currently under development. The LCEC is expected to launch a national implementation program of energy efficient home appliances soon.

1. Introduction and background

1.1. Country context

For the past ten years, Lebanon has been committed to achieve specific targets to increase its energy efficiency at both the supply and demand sides, as well as within the infrastructure of its national electricity network. In 2010, the Council of Ministers approved a national policy paper[1] introducing the first national strategy for the electricity sector in Lebanon and setting the country on a track to reach a target to decrease energy demand by 5% by 2020.
Based on this policy paper, the Lebanese Center for Energy Conservation (LCEC) developed the first National Energy Efficiency Action Plan (NEEAP) for Lebanon for 2011-2015, including fourteen initiatives to increase energy efficiency, among which is Initiative 14 calling for the promotion of energy efficient equipment.
The second NEEAP for Lebanon for 2016-2020 introduced other key measures to tackle energy efficiency in the end-use sector such as H 01 on Minimum Energy Performance Standards, B 04 on the Use of efficient equipment in buildings, and PU 02 on Green procurement for public buildings.[2]
Following the Paris Agreement that was reached in 2015, Lebanon also committed itself to an unconditional 3%, and a conditional 10%, reduction in energy demand by 2030, as part of its Intended Nationally Determined Contribution.[3]
The Italian Energy-Efficient Home Appliances (IEEHA) Program detailed below is part of several national incentives that will help achieve the above-mentioned energy-efficiency targets.

1.2. Italian Lebanese cooperation

Cooperation between the Italian Ministry of Environment Land and Sea (IMELS) and the LCEC dates back to 2013 when the MEDiterranean DEvelopment of Support schemes for solar Initiatives and Renewable Energies (MED-DESIRE Project) was launched. MED DESIRE was co-funded by the European Union (EU) through the ENPI CBC MED Programme 2007-2013. As a result of this cooperation and based on a local solar ordinance that was prepared in 2015, LCEC finalized in 2019 a national solar ordinance which was approved by the Higher Council for Urban Planning and drafted in a decree that is being reviewed by different ministries and stakeholders. Also, the Central Bank of Lebanon issued the Intermediate Circular No 399, allowing “villages and rural areas” to access the existing subsidized financing mechanism for energy efficiency, renewable energy, and environmental measures.

[1] Policy Paper for the Electricity Sector, June 2010
[2] “The Second National Energy Efficiency Action Plan for The Republic of Lebanon,” LCEC, 2016
[3] “Lebanon’s Intended Nationally Determined Contribution,” 2015

Based on the successful cooperation between IMELS and LCEC, a technical cooperation agreement on sustainable development was signed on 7 July 2016 in Rome. The objective of the agreement is to strengthen bilateral relations between Italy and Lebanon in the field of sustainable development and the battle against climate change. Several initiatives were launched as part of the agreement:

- In December 2016, the Heat-Pump Project was approved aiming to promote heat-pumps for space heating and cooling and for hot water production in the domestic and tertiary sectors.
- Also in December 2016, IMELS signed an agreement with the Central Bank of Lebanon including a €5 Million grant aiming to promote a subsidized financing line for projects in the field of energy efficiency and renewable energy in Lebanon through the National Energy Efficiency and Renewable Energy Action (NEEREA) financing mechanism.
- In August 2018, the IEEHA Program was approved for the promotion of high efficiency Italian home appliances according to the European labelling scheme by providing financial support to end-users. The IEEHA program tackles the use of energy-efficient equipment in the end-use sector in Lebanon.

1.3. Italian Energy Efficient Home Appliances program

The IEEHA Program aims to reduce the energy demand of Lebanese households by incentivizing the market to shift towards more energy-efficient technologies, of Italian brands and/or manufactured in Italy. It also aims to build local capacity in energy-efficient technologies.

Within this program, consumers will benefit from a financial rebate when purchasing an eligible product from one of the retailers partnering with the program. So far, four main retailers have joined: Abed Tahan, Agha Sarkissian, Beytech, and Khoury Home. A marketing and communication campaign will help reach a broad range of Lebanese consumers, online and at the stores, and raise awareness on energy-efficient equipment and on the savings in terms of energy and money that this equipment could achieve.

Towards this goal, both retailer and consumer surveys were conducted between August 2018 and February 2019 to identify the Lebanese market and set the program framework. This report presents the results of the above-mentioned surveys, as well as the potential for energy savings that can be reached at a national level.

2. Country characteristics

The following chapter introduces the main characteristics that have been taken into consideration while conducting the surveys and for the extrapolation of the results at a national level.

2.1. Lebanon's climate characteristics

Lebanon can be divided into four climate zones,[4] as shown in Figure 1. The general characteristic of each climate zone is summarized in Table 1.

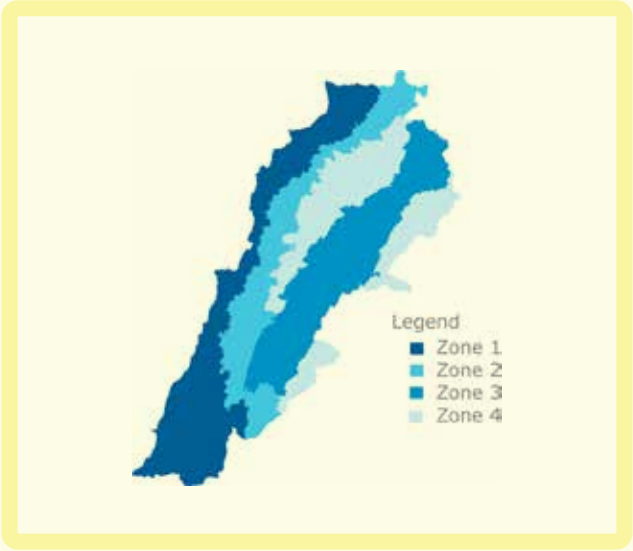

Figure 1 Climate zones in Lebanon (Source: Climate Zoning for Buildings in Lebanon, 2005)

Table 1 General characteristics of climate zones

Climate Zone	Approximate Altitude range
Coastal (Zone 1)	1A (altitude < 200 m)
	1B (altitude > 200 m and up to 700 m)
Western mid-mountain (Zone 2)	700 - 1,400 m
Inland Plateau (Zone 3)	700 - 1,150 m
High Mountain (Zone 4)	Littoral side: > 1,400 m Inland side: > 1,150 m

2.2. Lebanon's electricity demand

In Lebanon, the demand for electricity is greater than the supply capacity, leading to a deficit in electricity supply. In 2017, demand on electrical energy reached 22,812 GWh, while only 14,113 GWh[5] of electrical energy was produced. In addition to supply shortage, the electricity sector faces several other challenges such as load shedding, technical losses, and aging power plants. These result in technical and financial impacts on customers, the government, and the economy.[6] Many end-users are forced to rely on private diesel generators to overcome electricity shortages.

[4] Thermal Standards for Buildings, Republic of Lebanon, Ministry of Public Works and Transport, General Directorate of Urban Planning
[5] Council for Development and Reconstruction, Overview of CDR Activities in 2017
[6] The Second National Energy Efficiency Action Plan for The Republic of Lebanon, LCEC, 2016

2.3. Lebanon's energy efficiency targets for the residential sector

Lebanon's building sector is the greatest consumer of electricity with a total consumption of around 78% of the overall electricity generated in the country. Within this sector, residential buildings have been the largest consumers of electricity during recent years, accounting for 37% of the overall electrical and thermal energy demand in 2015.[7]

In its NEEAP 2016-2020, the LCEC set a target of 1.5 TWh of savings to be achieved by 2020. These include 149 GWh of savings in buildings, of which 55.6 GWh from energy efficient equipment. To achieve these savings, LCEC has defined various energy efficiency initiatives to be implemented for the period 2016-2020, one of which is the use of more energy efficient equipment. This is all further emphasized as the International Energy Agency (IEA) estimates that major energy savings can be achieved thanks to more energy-efficient household appliances. Already 16% to 26% of savings have been reached worldwide in the past 10 years and an additional 10% to 20% could be reached in the coming years.[8]

Moreover, Lebanon has partaken in a long-term low-emission and climate-resilient strategy in September 2015, at the Paris 21st Conference of Parties (CoP), reducing its CO_2 emissions, thus limiting global warming and promoting climate actions. This engagement translated into the following unconditional target within the "Intended Nationally Determined Contributions" (INDCs) to be achieved by 2030: Energy efficiency improvements leading to a 3% reduction in power demand compared to the demand under a business-as-usual scenario. The INDCs included the possibility to increase this reduction to 10% if additional international support is provided.

The program launched by IMELS and LCEC emerged in response to these objectives and as a trigger to unleash the potential of energy savings in the residential sector.

3. Retailers survey

A market study has been conducted during the months of August and September 2018 among eight major Lebanese retailers of home appliances, with branches covering the whole country (Table 2):

[7] The First Energy Indicators Report of the Republic of Lebanon, LCEC, 2018
[8] Energy Efficiency report, IEA, 2017

Table 2 Surveyed retailers

Name of retailer	Main branch visited	Total number of stores in Lebanon (at the time of the survey)
Khoury Home	Dora	12
Abed Tahan	Mazraa	9
Agha Sarkissian	Dora	1
Beytech	Mirna Chalouhi	1
Lteif	Jbeil	1
Rasheed Electric	Mirna Chalouhi	1
Hajj Electronics	Sin el Fil	1
Mikdashi Electric	Sin el Fil	1

Main retail branches are located in the area of Greater Beirut, except for one which is in the city of Jbeil-Byblos (Figure 2).

Figure 2 Map of main branches of surveyed retailers

The purpose of the retailer surveys is to assess the equipment available on the market, the representation of the EU energy label, as well as the average annual energy consumption of each type of equipment with the EU energy label. A total of 1,486 appliances were checked as detailed in Table 3.

Table 3 Total number of appliances checked during the market study

Type of equipment	Total number of appliances checked
Washers and Driers	436
Refrigerators and Freezers	357
Ovens	194
Split Air Conditioners (ACs)	185
Cookers	117
Televisions (TVs)	102
Dishwashers	95
Total	1,486

For 73% of the appliances, the country of origin could be found as presented in Figure 3, among which 25% come from China, 18% from Italy, 13% from Korea, 13% from Turkey and 10% from Thailand.

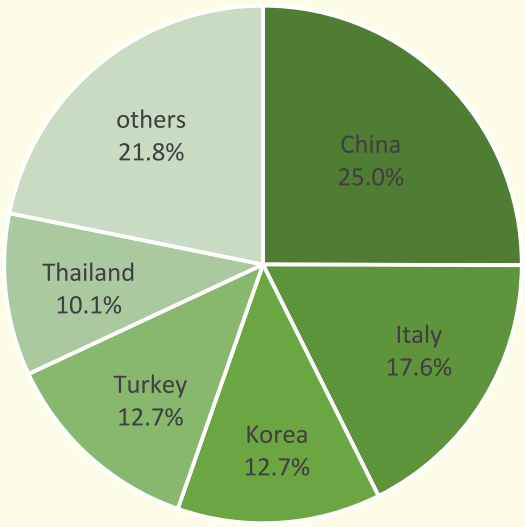

Figure 3 Appliances' most common countries of origin

Also, 47% of the appliances had an EU energy label, with high energy ratings having a good share (Figure 4).

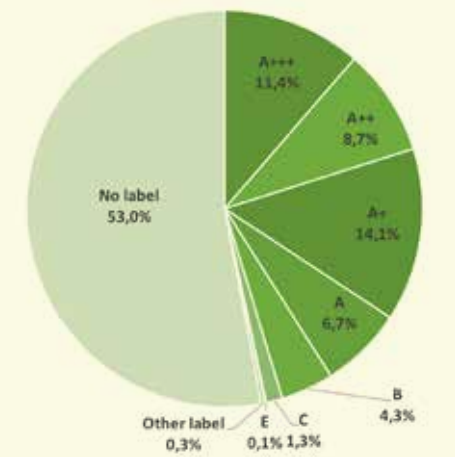

Figure 4 Availability of higher EU energy ratings on equipment at retail stores

4. Consumer survey

4.1. Methodology

A survey was conducted among three hundred Lebanese households from December 2018 until February 2019. To account for the potential differences in appliance usage and overall energy consumption, the different climate zones have been considered. On average, sixty households were visited per zone, from forty-four in coastal 1B and up to seventy-five households in coastal 1A. The distribution of the surveyed households per climate zone is represented in Table 4:

Table 4 Distribution of surveyed households per climate zone

Climate Zone	National distribution of households[9]	Distribution of surveyed households
Coastal 1A (Zone 1)	47%	25%
Coastal 1B (Zone 1)	24%	14.7%
Western Mid-Mountain (Zone 2)	17%	20.7%
Inland (Zone 3)	9%	22.7%
High Mountain (Zone 4)	2%	17%
Total	100%	100%

Within each climate zone, priority was given to municipalities with a high population. Table 5 presents the total number of surveyed households per municipality and per climate zone.

[9] The distribution of Lebanese households per climate zone has been calculated based on the distribution of EDL subscribers.

Table 5 Total number of surveyed households per municipality and climate zone

Climate Zones	Municipalities	Number of surveyed households
Coastal 1A (Zone 1)	Amchit	10
	Batroun	12
	Sour	12
	Jiyyeh	10
	Saida	10
	Jadra	10
	Jbeil	13
Coastal 1B (Zone 1)	Ghazir	10
	Maghduche	10
	Kahhaleh	10
	Qornet Chehwan	10
	Ballouneh	4
Western Mid-Mountain (Zone 2)	Jezzine	12
	Aabadiyyeh	10
	Saoufar	10
	Baabdat	10
	Ajaltoun	10
	Bteghrine	10
Inland (Zone 3)	Zahleh	10
	Kamed Al Lawz	10
	Saghbine	12
	Riyaq	13
	Al Marj	13
	Baalbek	10
High Mountain (Zone 4)	Hammana	11
	Baskinta	10
	Ain Dara	10
	Hrajel	10
	Mtain	10

Figure 5 Mohamad Thabet- then-LCEC Site Engineer, at two of the selected municipalities

Households were selected with the help and collaboration of corresponding municipality representatives to make sure they come from diverse socioeconomic backgrounds. The surveys were conducted by an LCEC representative, as well as a representative of the corresponding municipality. The methodology adopted to perform the surveys is summarized in Figure 6.

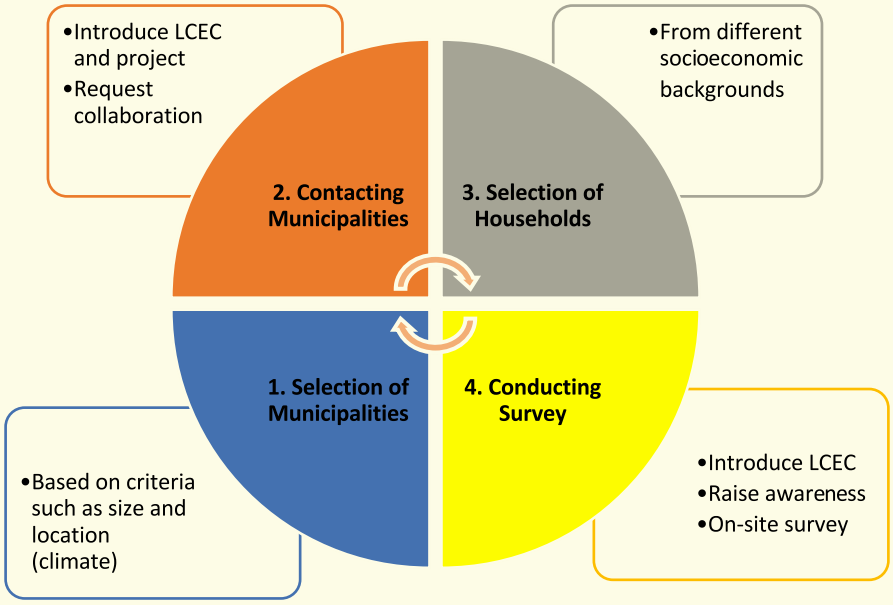

Figure 6 Methodology of consumer surveys

Figure 7 The on-site survey included a visual check of the appliances and their power rating as well as measurement of their actual consumption

4.2. Awareness raising

Awareness raising on the benefits of renewable energy and energy efficiency was introduced through the distribution of the brochure in Figure 8. The brochure, developed within the MED-DESIRE project co-funded by the EU through the ENPI CBC MED Programme 2007-2013, includes an introduction to climate change and tips on saving energy.

Figure 8 Awareness raising brochure

During the survey, households were directly supported to become more energy-efficient and to start saving on their energy bill, as each of them received two Light Emitting Diode (LED) lamps as a gift to thank them for their participation and in replacement of existing non-efficient lamps. A total of five hundred and seventy-seven LED lamps were distributed, resulting in total estimated energy savings of 51.6 MWh per year.[10]

4.3. Results and main findings

4.3.1. Household socioeconomic background

Almost all respondents among the surveyed households own their home (92%) living in an average 172 square meters (sqm) area. In most cases, respondents live in an apartment (58%) with an average surface area of 158 sqm, while others live in individual houses (36%) with an average surface area of 185 sqm. Only a small share of respondents lives in other types of dwellings (6%), mostly luxurious houses, with an average surface area of 254 sqm (Figure 9 and Figure 10).

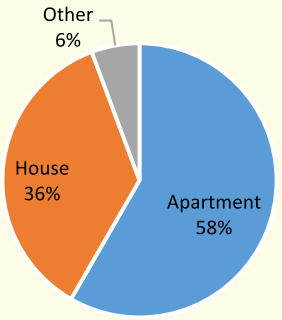

Figure 9 Types of housing for surveyed households

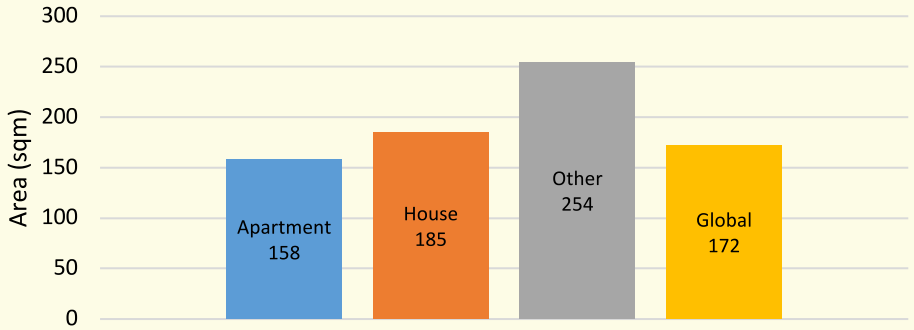

Figure 10 Average surface area of units in surveyed households in sqm

The average monthly income of the surveyed households is USD 1,908.[11] This value represents the average combined income of all members of the same household, and not only the income of the respondent.

[10] Assuming 3.5 hours of daily operation as per United Nations Framework Convention on Climate Change, "Small-scale Methodology: Demand-side Activities for Efficient Lighting Technologies."

[11] All numbers in United States Dollars (USD) in this report are based on the exchange rate of 1,500 LBP/USD.

Figure 11 shows the distribution of income: 37% have a gross monthly income in the range of USD 1,000 to 1,999. It should be noted that around 23% of the respondents preferred not to answer the question related to their monthly income.

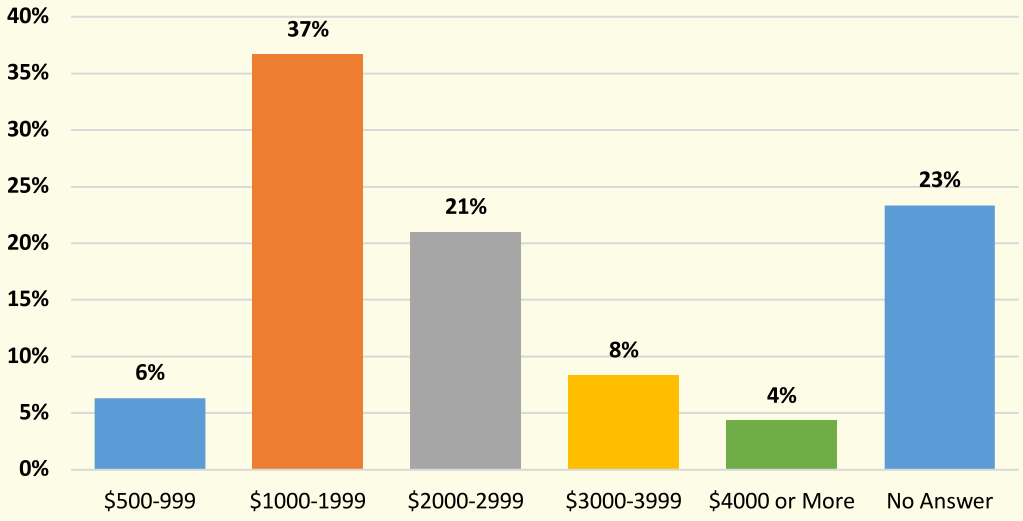

Figure 11 Distribution of average monthly income in surveyed households, in USD

4.3.2. Household electricity blackout experience

Almost all households (88%) connected to the national electricity utility Electricité du Liban (EDL) have said to experience daily electricity shortage, with an average blackout of 8.9 hours per day (Figure 12). By contrast, households located in regions where electricity is supplied by Electricité de Zahlé (EDZ)[12] did not experience regular power blackouts (12%).

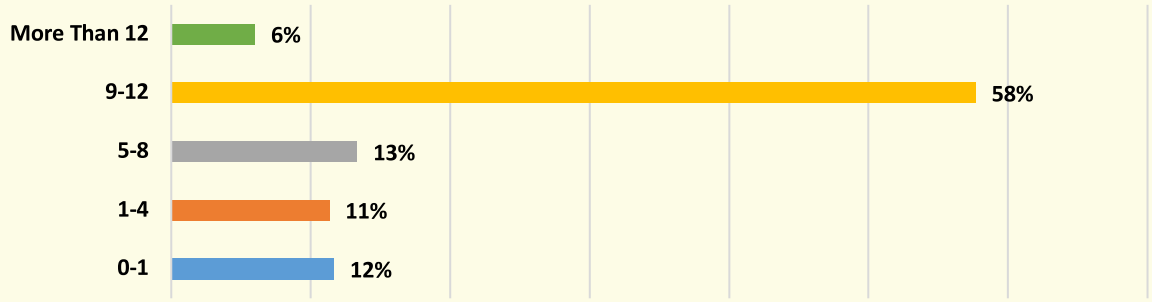

Figure 12 Daily number of blackout hours experienced by surveyed households

To cover their electricity needs during blackouts, most households rely solely on diesel generators (79%). In addition to diesel generators, according to Figure 13, some households also installed Uninterruptible Power Supply (UPS) systems and batteries to cover the blackouts (19%). Few households rely solely on UPS systems and batteries (2%).

[12] EDZ is a private electric utility that operates under a concession agreement with the Lebanese government.

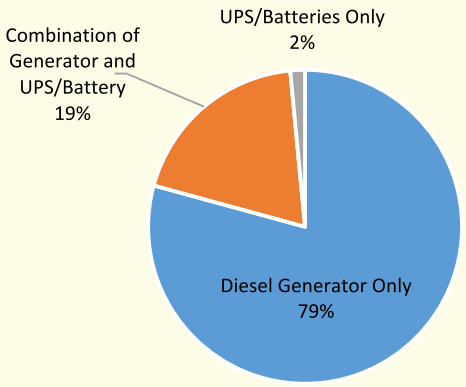

Figure 13 Alternative power supply during blackouts

Most of the households experiencing blackouts and using diesel generators are subscribed to local privately-owned generators (93%), while only a few households own their individual generators (7%) (Figure 14).

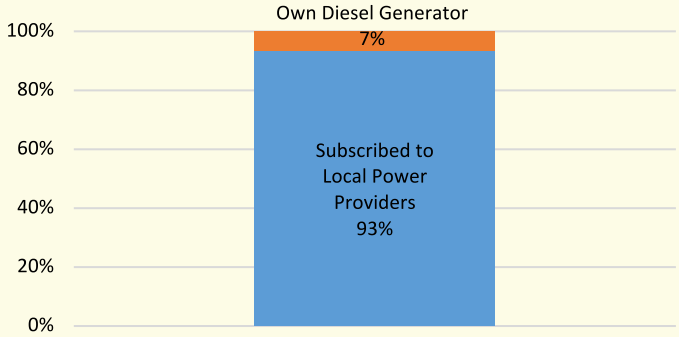

Figure 14 Share of households that owned or were subscribed to diesel generators

Most households are subscribed to diesel generators with a cap on current consumption of 5 or 10 amperes (A) (a combined 78%) (Figure 15).

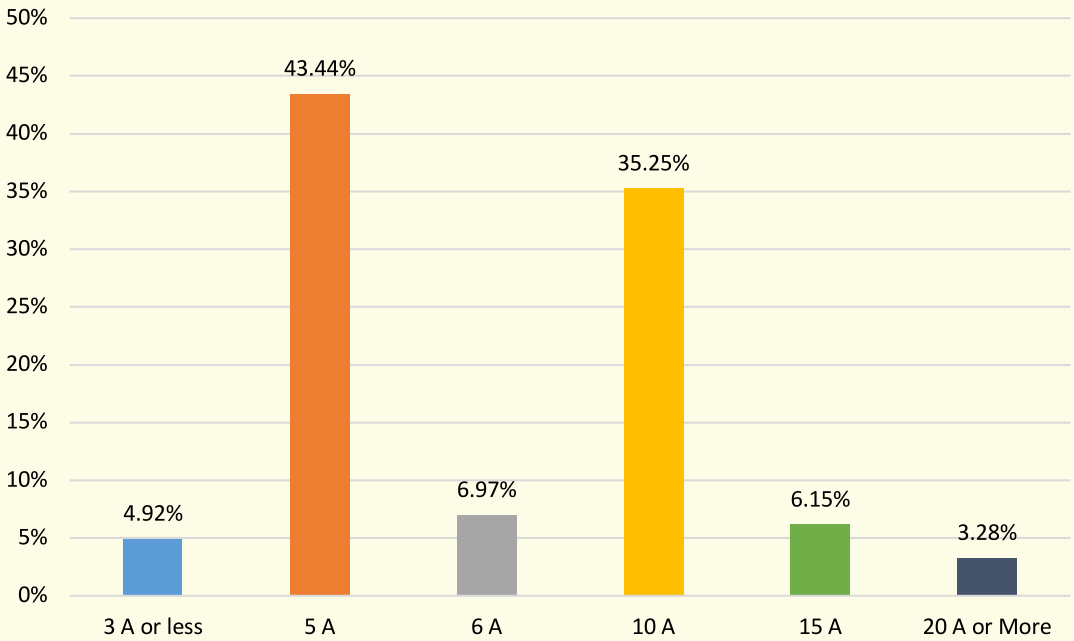

Figure 15 Average rented back-up power for households in Amperes

The size of subscription to backup generators is correlated to the household's average income. The average income of households with higher generator subscription is higher than that of households with smaller generator subscription (Figure 16).

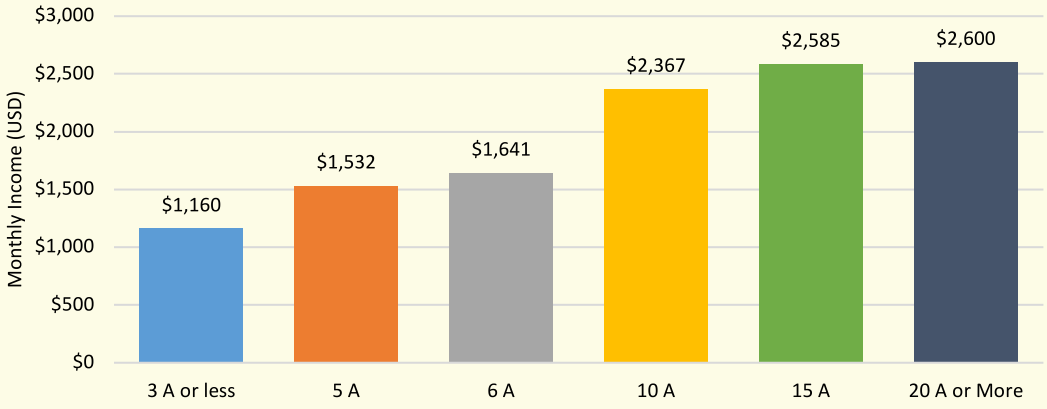

Figure 16 Household average income per generators subscription size

4.3.3. Household electrical energy bills

As shown in Figure 17, households which do not use a generator pay a monthly electrical energy bill of USD 74 on average, while households which use a generator, pay on average USD 38 for their utility bill[13] and USD 67 for their generator, resulting in an average total bill of USD 105. It is to be noted that households that own diesel generators also need to pay for the fuel, whose cost has not been included in the survey.

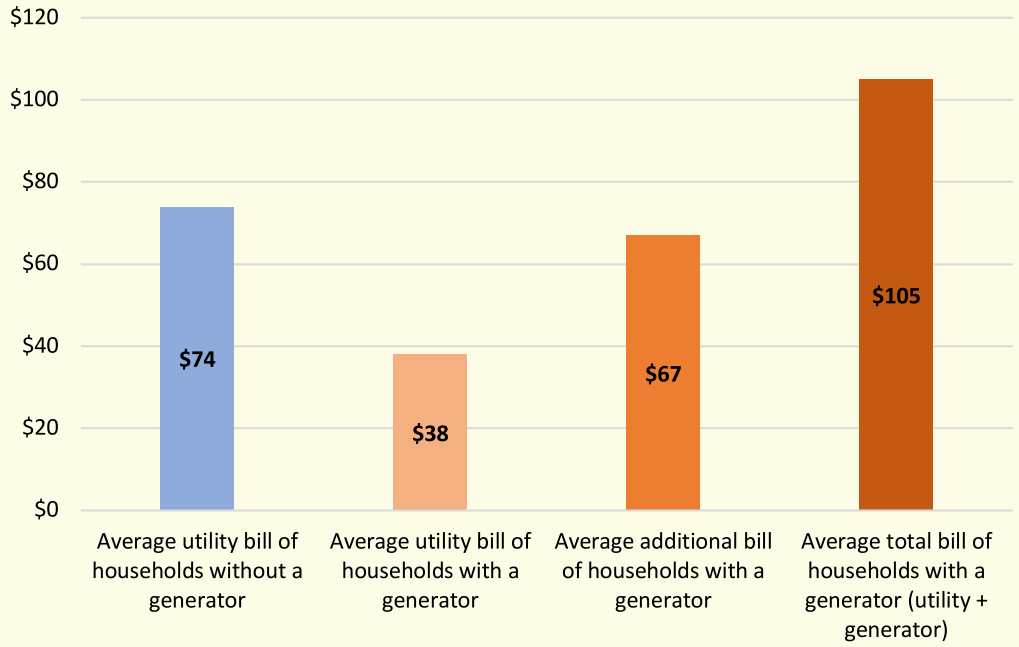

Figure 17 Monthly electrical energy bill in surveyed households (in USD)

[13] The utility bill is either from EDL, EDZ or any other concession.

When comparing the electricity bill with the average income, we find that according to Figure 18, on average, households spend 6% of their monthly gross income on their electricity bill. For 15% of households, the electricity bill accounts for more than 10% of their monthly income which, if combined with other indicators, could threaten these households to fall under a situation of energy poverty, with potential collateral socioeconomic damages including poverty, exclusion, and limited access to education, among others.

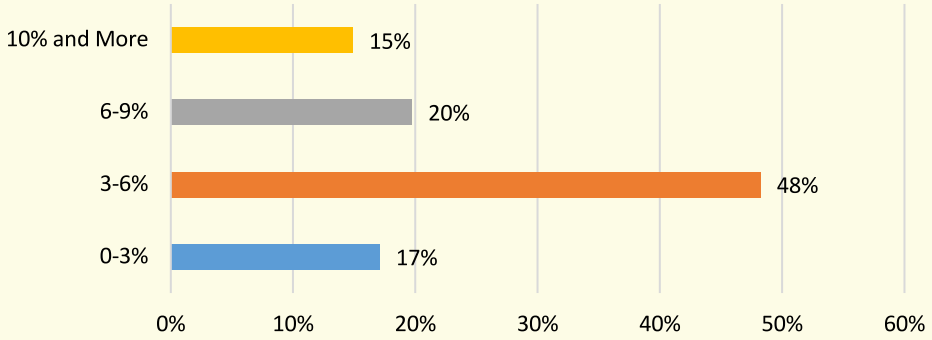

Figure 18 Share of household electricity bill of total monthly income

The cost of electricity is uneven from one municipality to another. When considering the average generator size and the average electricity bill of households gathered per municipality, we find that the value of a 1 Ampere generator subscription can be up to six times more expensive depending on the municipality in which the household is located, with an average price of USD 3 up to 18 per month. This disparity makes it more attractive to live in those municipalities where the price of electricity is less expensive.

4.3.4. Household renewable energy sources

As presented in Figure 19, most surveyed households (63%) did not install any source of renewable energy. Among the remaining 37% of households engaged in renewable energy, 63% use solar water heaters, 29% use wood pellets for heating and 8% use both sources. None of the surveyed households installed solar photovoltaic panels.

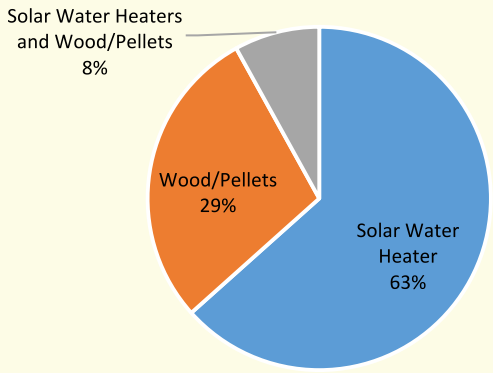

Figure 19 Renewable energy sources installed in households

4.3.5. Technologies used for heating

Among the surveyed households, 5% are not equipped with any heating equipment. For the remaining 95%, the main heating technologies are diesel heaters (32%), radiators with diesel boilers (15%) and electric resistance heaters (10%). Some households rely on gas heaters (6%) or wood and pellets (4%). Split air conditioners (ACs) are very poorly used for heating (2% of households only). A third of households rely on a combination of different heating solutions as per Figure 20.

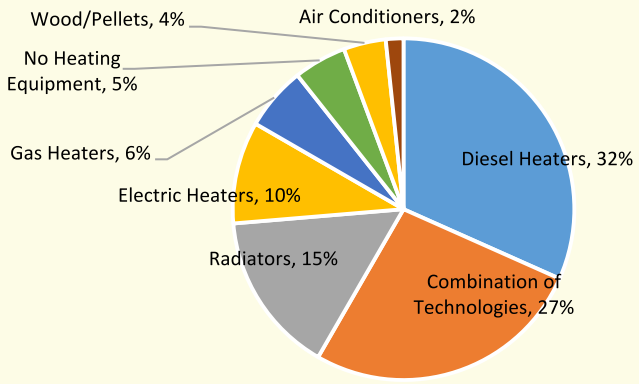

Figure 20 Heating technologies used in households

Figures 21, 22, 23, 24, and 25 present the repartition of technologies used for heating per climatic zone.

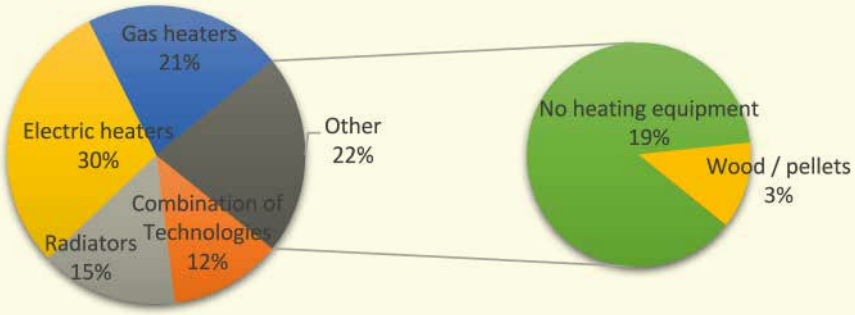

Figure 21 Heating technologies used in households in Coastal 1A

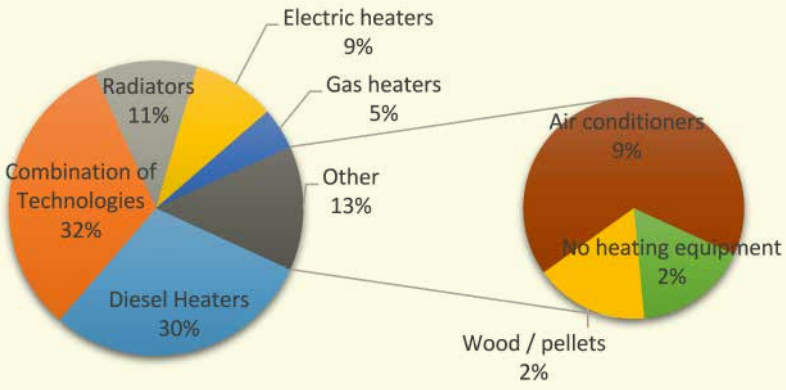

Figure 22 Heating technologies used in households in Coastal 1B

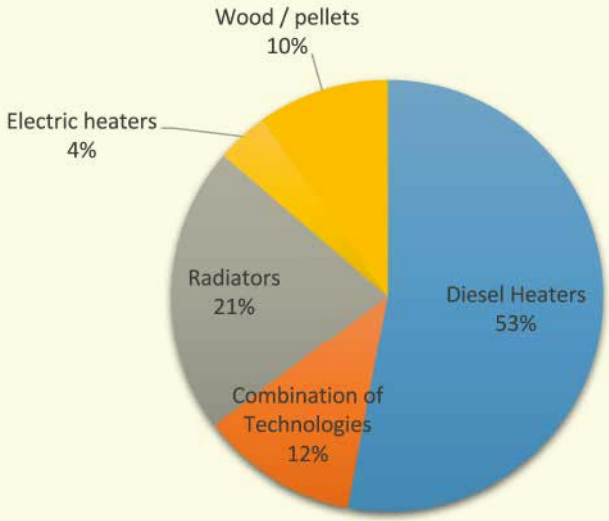

Figure 23 Heating technologies used in households in High Mountain

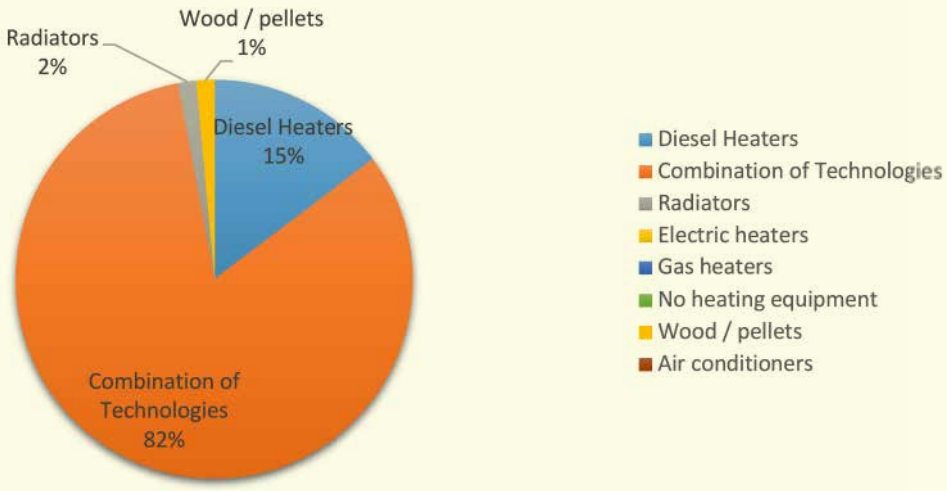

Figure 24 Heating technologies used in households in Inland

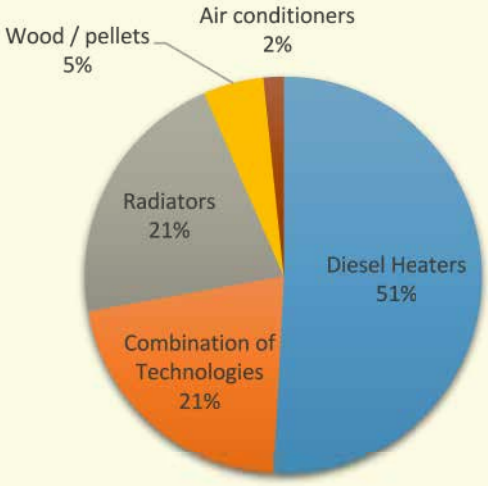

Figure 25 Heating technologies used in households in Western Mid Mountain

4.3.6. Household electrical appliances

The main electrical home appliances have been identified in the surveyed households, to check their type, model, brand, energy rating, as well as to calculate their average annual energy consumption. Results show that the rate of ownership is mostly similar for basic appliances such as refrigerators and washing machines while it can vary a lot for comfort appliances such as televisions (TVs) and split ACs. These mainly depend on the household's average income with higher income households having a greater ownership rate for these appliances (see Table 6 and Table 7 below). Another factor accounting for the total number of split ACs per household is the climate zone. Households in High Mountain and Western Mid-Mountain have a lower rate of ownership of ACs for cooling (on average 0.45) than households living in Coastal zones A and B (on average 2.3) as shown in Table 8. Some appliances have a low average ownership rate (below 1) such as driers, microwaves, electric ovens, freezers, washers-driers and dishwashers as households turn to other alternatives.

Table 6 Average number of appliances per household

Types of appliances	Ownership rate per household	Range of number of appliances	Description of the most representative panel	Replacement rate in years (depending on their lifetime)[14]
Television	2.2	From 0 to 6	68% have 1 to 2 TVs	4
Air Conditioner	1.3	From 0 to 7	42% have 1 to 2 ACs	7.5
Combination of Refrigerator-freezer	1.1	From 0 to 3	88% have 1 refrigerator-freezer	10
Washing machine	1.0	From 0 to 2	97% have 1 washer	7
Microwave	0.8	From 0 to 2	76% have 1 microwave	5
Drier	0.4	From 0 to 1	63% don't have a drier	7
Electric oven	0.3	From 0 to 2	74% don't have an electric oven	8
Freezer only	0.2	From 0 to 2	77% don't have a freezer only	10
Dishwasher	0.1	From 0 to 1	91% don't have a dishwasher	6.5
Refrigerator only	0.1	From 0 to 2	95% don't have a refrigerator only	10
Combination of washer-drier	0.03	From 0 to 1	97% don't have a washer-drier	7

Table 7 Average number of appliances per household, per group of income

Types of appliances	Ownership rate per household								
	Overall average	Average per group of income (in USD)							
		500 to 1,000	1,000 to 1,500	1,500 to 2,000	2,000 to 2,500	2,500 to 3,000	3,000 to 3,500	> 3,500	N/A[15]
Television	2.2	1.4	1.7	2.1	2.4	2.7	2.8	3.5	2.5
Air Conditioner for cooling	1.3	0.7	0.8	1.3	1.3	2.0	1.6	2.2	1.6
Air Conditioner for heating	0.3	0	0.1	0.5	0.4	0.3	1.4	0.8	0.3
Combination of Refrigerator-freezer	1.1	1.0	1.0	1.1	1.0	1.2	1.1	1.2	1.1
Refrigerator only	0.1	0	0.1	0	0	0.1	0.1	0.2	0.1
Freezer only	0.2	0	0.1	0.2	0.5	0.3	0.3	0.1	0.4
Washing machine	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Combination of washer-drier	0.03	0	0.02	0.03	0.05	0.04	0.1	0.08	0.01

[14] Energy Efficient Home Appliances, Perspective from Lebanese Consumers, CEDRO, 2018
[15] This column indicates values for households who preferred not to answer questions about their income.

Drier	0.4	0.1	0.2	0.4	0.6	0.5	0.7	0.5	0.4
Microwave	0.8	0.5	0.6	0.9	1.0	0.8	0.9	1.0	0.8
Electric oven	0.3	0.2	0.2	0.3	0.3	0.2	0.3	0.4	0.4
Dishwasher	0.1	0	0	0	0.2	0.2	0.5	0.2	0.1

Table 8 Average number of appliances per household, per climate zone

Types of appliances	**Ownership rate per household**					
	Overall average	**Average per Climate zone**				
		Coastal 1A	**Coastal 1B**	**High Mountain**	**Inland**	**Western Mid-Mountain**
Television	2.2	2	2.9	2	2.1	2.1
Air Conditioner for cooling	1.3	2.1	2.5	0.2	1	0.7
Air Conditioner for heating	0.3	0.2	1.1	0.1	0.1	0.4
Combination of Refrigerator-freezer	1.1	1.1	1.1	1	1.1	1.1
Refrigerator only	0.1	0	0.1	0.1	0	0.1
Freezer only	0.2	0.2	0.4	0.2	0.2	0.2
Washing machine	1.0	1	0.9	1	1	1
Combination of washer-drier	0.03	0.01	0.07	0.02	0	0.05
Drier	0.4	0.2	0.5	0.4	0.3	0.5
Microwave	0.8	0.8	1	0.8	0.7	0.7
Electric oven	0.3	0.2	0.3	0.3	0.3	0.3
Dishwasher	0.1	0.1	0.3	0.1	0	0.1

Analysis of the average daily use of each appliance shows that washers and driers are used daily, with an average of 1 cycle per day. The figure is higher than the average that is being assumed in the EU labeling scheme which is approximately equivalent to 4.2 cycles per week (220 cycles per year).[16] The same applies for TVs which are used on average 6.5 hours per day in surveyed households, while the average in the EU labeling scheme is of 4 hours per day.[17] In contrast, electric ovens and microwaves are not as frequently used by Lebanese households because they prefer other alternatives for cooking such as gas ovens and cooktops. Dishwashers are still not very common in Lebanese households. Their indicated usage is not representative (Table 9).

[16] Compliant with the current Regulation Commission Delegated Regulation (EU) No 1061/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regards to energy labelling of household washing machines Text with EEA relevance.
[17] Compliant with the current Commission Delegated Regulation (EU) No 1062/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regards to energy labelling of televisions Text with EEA relevance.

Table 9 Average daily use of each appliance type – except ACs

Types of appliances	Average daily usage
Refrigerator/Freezer	24 hours
Television	6.5 hours
Washing machine	1.3 hours
Drier	1 hour
Dishwasher	37 minutes
Electric Oven	23 minutes
Microwave	9 minutes

Results are not significantly different among different climate zones (Table 10).

Table 10 Average daily use of each appliance type, per climate zone – except ACs

Types of appliances	Average daily usage per household					
	Overall average	Average per Climate zone				
		Coastal 1A	Coastal 1B	High Mountain	Inland	Western Mid-Mountain
Refrigerator/ Freezer	24 hours					
Television	6.5 hours	6.4 hours	5.4 hours	6.9 hours	7.3 hours	6.2 hours
Washing machine	1.3 hours	1.3 hour	1.5 hour	1.1 hour	1.3 hour	1.1 hour
Drier	1 hour	1.6 hour	1.2 hour	54 minutes	1.1 hour	42 minutes
Dishwasher	37 minutes	1 hour	30 minutes	36 minutes	6 minutes	54 minutes
Electric Oven	23 minutes	19 minutes	22 minutes	25 minutes	26 minutes	21 minutes
Microwave	9 minutes	10 minutes	9 minutes	9 minutes	8 minutes	8 minutes

While households are relatively well-equipped with up-to-date appliances, the replacement rate for refrigerators-freezers seems to be lower. Appliances were purchased on average in 2011-2012. The only exception are refrigerators-freezers that were purchased on average in 2003. Therefore, it can be assumed that a high potential of energy savings could be reached with the replacement of refrigerators-freezers through the purchase of recent energy-efficient appliances.

4.3.7. Zoom on Air Conditioners

As per Figure 26, a total of 60% of households own at least one split AC for cooling and heating purposes. The majority owning at least one split AC use it for cooling only (81%) while others use it for both cooling and heating (19%). None of them use it only for heating.

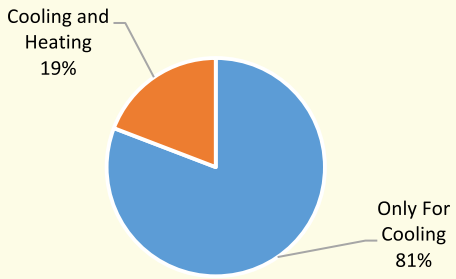

Figure 26 Household use of split AC

It was assumed while conducting the survey that the year is divided into two main seasons to inquire on the average use of split ACs in households: A cooling season of four months from May until August, and a heating season of three months from December until February. Results show that households use their split AC during the cooling season for an average of five hours per day, and for four and a half hours per day during the heating season. However, these figures vary depending on the climate zone. During the cooling season, split ACs are mostly used in the coastal zone 1A for 6.9 hours per day on average while during the heating season, split ACs are mostly used in the western mid-mountain zone for 6.5 hours per day on average (Figure 27).

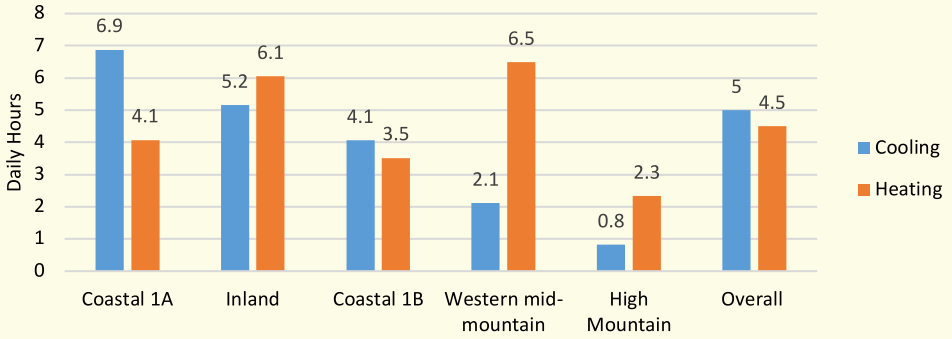

Figure 27 Average daily AC use during the heating and cooling seasons per climate zone

The ownership rate of split ACs also varies according to household income, with a higher rate of ownership when income is higher (Table 11).

Table 11 Average number of ACs for cooling, per household, per climate zone, per group of income

Climate zones	Ownership rate per household of ACs for cooling								
	Overall average	Average per group of income (in USD)							
		500 to 1,000	1,000 to 1,500	1,500 to 2,000	2,000 to 2,500	2,500 to 3,000	3,000 to 3,500	> 3,500	N/A[18]
Coastal 1A	2.1	1.3	1.6	2.7	1.0	3.5	N/A[19]	6.5	2.2
Coastal 1B	2.5	1.0	1.0	1.1	2.8	2.9	2.4	2.0	3.4
High Mountain	0.2	0	0	0.1	0	1.0	0	0	0.5
Inland	1	0.5	0.5	1.4	0.8	1.2	1.0	1.0	1.2
Western Mid-Mountain	0.7	0	0.4	1.0	1.2	0.8	1.0	1.3	0.6

As only a limited number of split air conditioners are used for heating, data is less consistent than for split air conditioners used for cooling. Moreover, given the low ownership rate of split air conditioners used for heating only, their number does not vary according to household income but rather according to climate zone (Table 8 and Table 12).

[18] This column indicates values for households who preferred not to answer questions about their income.
[19] The figure is not available for this group of income in coastal 1A.

Table 12 Average number of ACs for heating, per household, per climate zone, per group of income

Climate zones	Ownership rate per household of ACs for heating								
	Overall average	Average per group of income (in USD)							
		500 to 1,000	1,000 to 1,500	1,500 to 2,000	2,000 to 2,500	2,500 to 3,000	3,000 to 3,500	> 3,500	N/A
Coastal 1A	0.2	0	0	0.9	0	0	x	0	0.2
Coastal 1B	1.1	0	3.0	0.7	0.6	0.8	2.4	1.6	1.0
High Mountain	0.1	0	0	0	0	1.0	0	0	0.1
Inland	0.1	0	0	0.3	0	0	0.5	0	0.1
Western Mid-Mountain	0.4	0	0.2	0.6	0.8	0	0.5	1.0	0.3

4.3.8. Appliance energy labels and ratings

Appliances neither have an energy label nor a rating in most surveyed households (96%). For the remaining 4%, the energy label corresponds to the European Energy Labeling Scheme and were mostly found on washing machines (43%), refrigerators (21%), and driers (12%) – as shown in Figure 28.

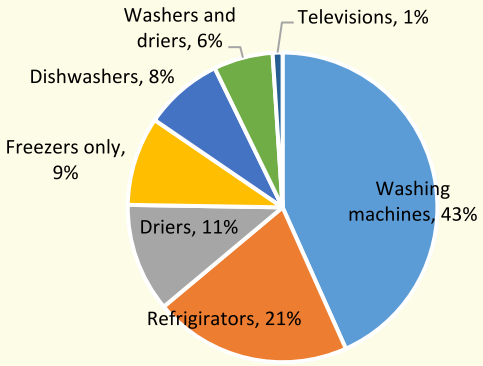

Figure 28 Energy ratings available per type of appliance

The most common energy rating found on appliances is the EU energy rating (A+), which is available on washing machines, refrigerators, freezers, dishwashers and washers-driers. The best available EU energy rating (A+++) was only found on washing machines. Driers presented only low EU energy ratings (B and C) as shown in Figure 29.

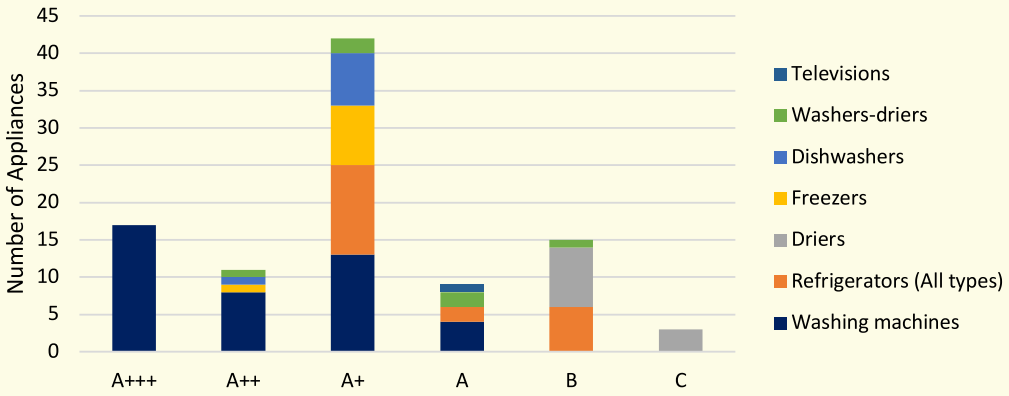

Figure 29 Number of appliances per energy rating

5. Annual electricity consumption per household

5.1. Country averages per household

Given the ownership rates, the average use of appliances and data collected on appliance tags, calculations have been made to set the average annual energy consumption, per appliance, per household (Figure 30 and Figure 31).[20] Results show that main consumption comes from split ACs used for cooling (29%) followed by refrigerators-freezers (20%), TVs (16%), washing machines (11%) and driers (10%) as per Figure 31.

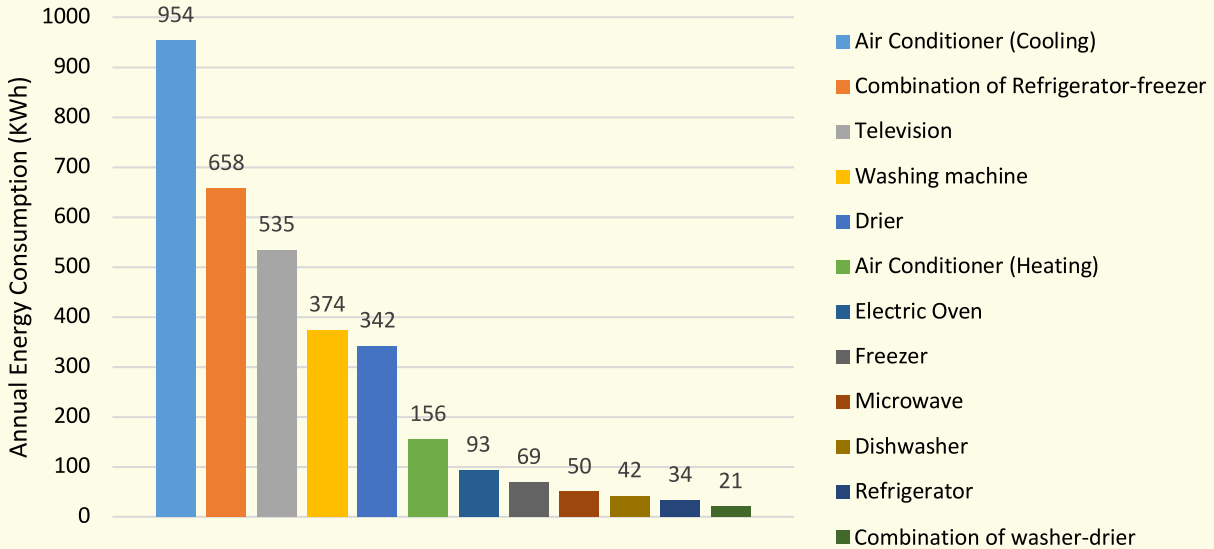

Figure 30 Annual energy consumption of selected appliances per household, in kWh/yr

[20] The annual energy consumption of appliances was calculated based on the power rating and the average number of hours of use, per household, per climate zone. For refrigerators, the assumption taken is that the compressor works a third of the time. For air conditioners, calculations have been made for both the cooling and the heating seasons. For washers-driers, some additional factors couldn't be taken into consideration such as the type of wash and the temperature per cycle. For all appliances, the annual energy consumption also considers ownership rates, per appliance, per household, per climate zone.

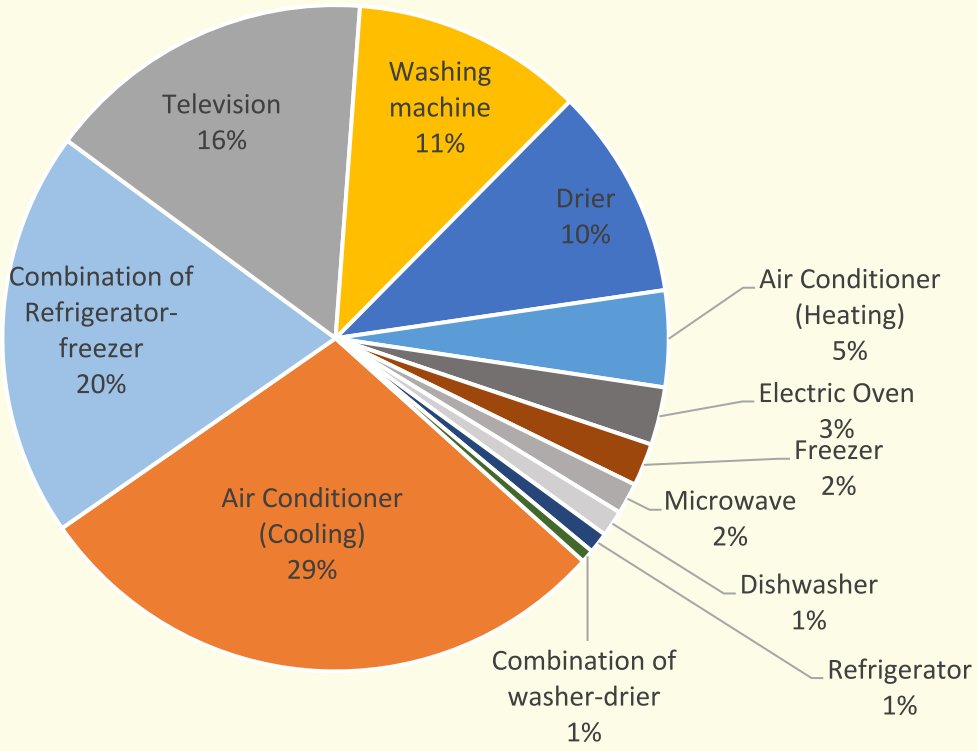

Figure 31 Share of energy consumption per appliance in households

Annual electricity consumption in households is calculated based on the average monthly cost of electricity from the grid and from the generator, if any.
Results of these calculations show that households consume on average 5,409 kWh of electricity per year. Selected appliances from the survey account for a total of 3,328 kWh per year, resulting in approximately 62% of electricity consumption in households. The remaining 38% of electricity consumption in households is assumed to be consumed through water heating, space heating (excluding split ACs for heating), lighting, and smaller electrical appliances.

5.2. Zoom per climate zone

Overall electricity consumption per household is uneven among different climate zones, with a higher average annual consumption in areas with greater use of air conditioning for cooling as in Coastal 1A and 1B (Figure 32 and Figure 33).

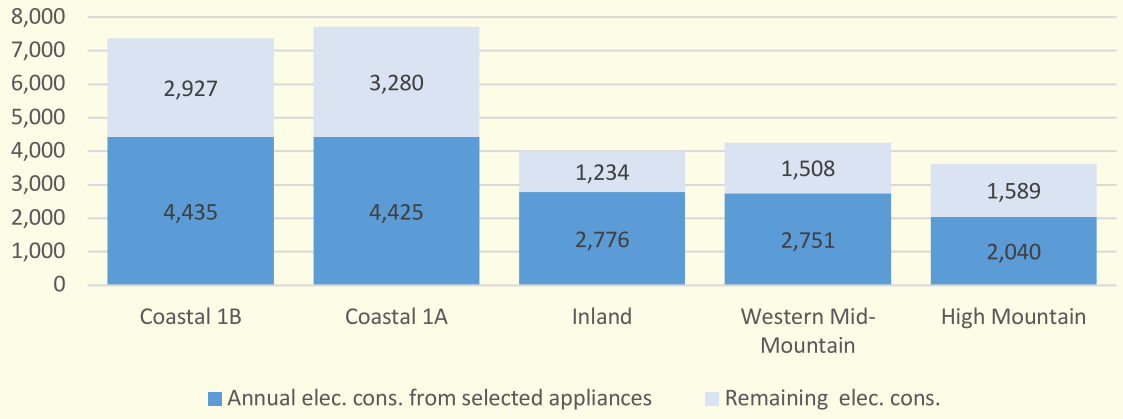

Figure 32 Average annual electricity consumption, per household, per climate zone, total and from selected appliances, in kWh/yr

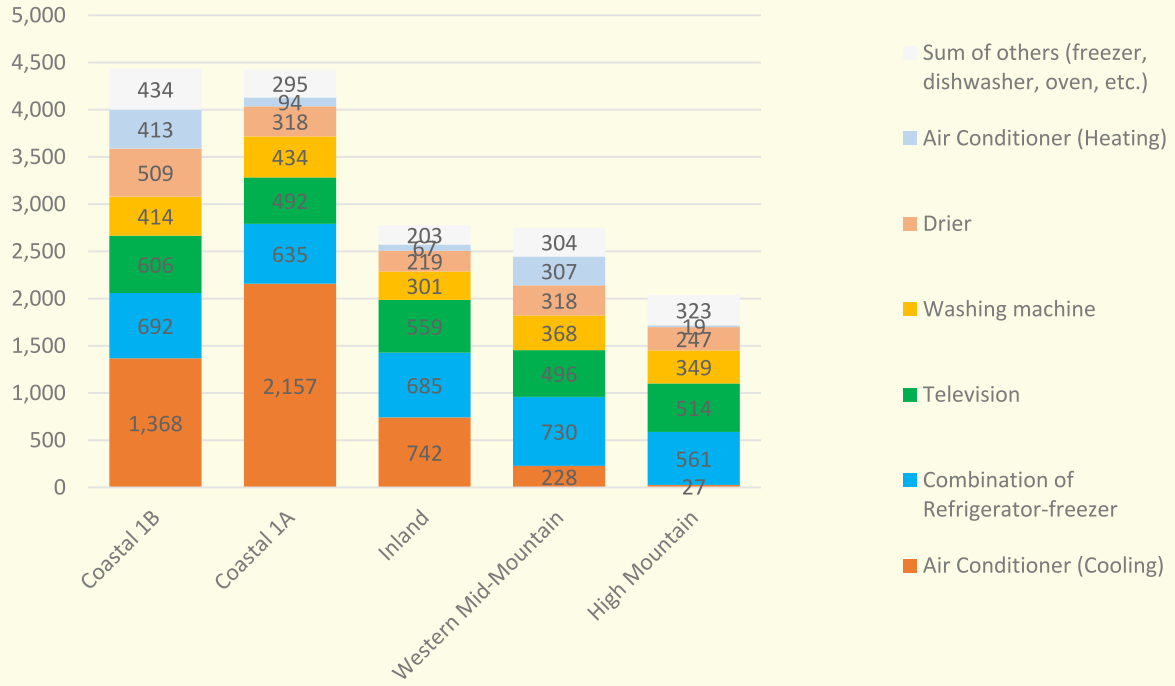

Figure 33 Average annual electricity consumption, per appliance, per household, per climate zone (in kWh/yr)

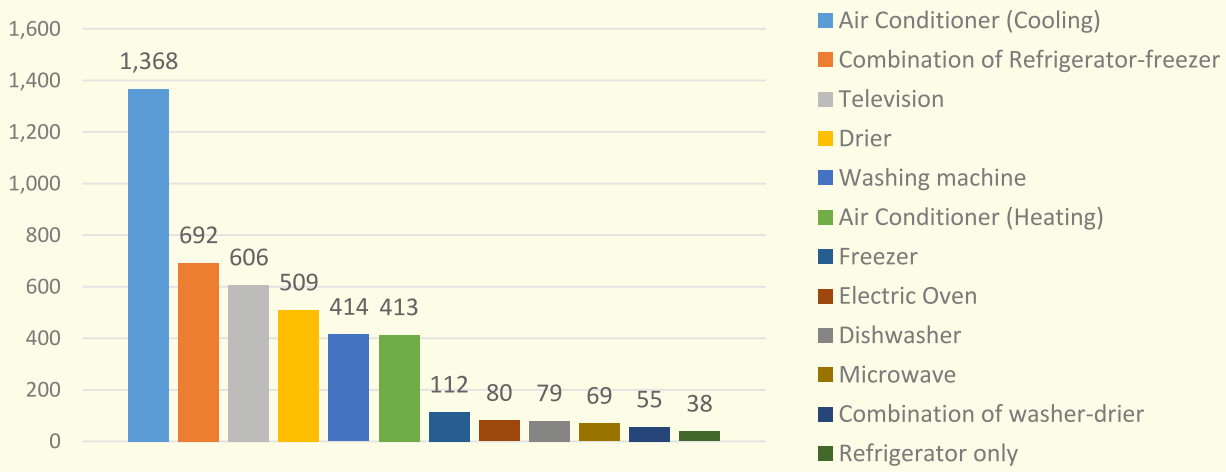

Figure 34 Average annual electricity consumption from selected appliances, per type of appliance, per household, in Coastal 1B (in kWh/yr)

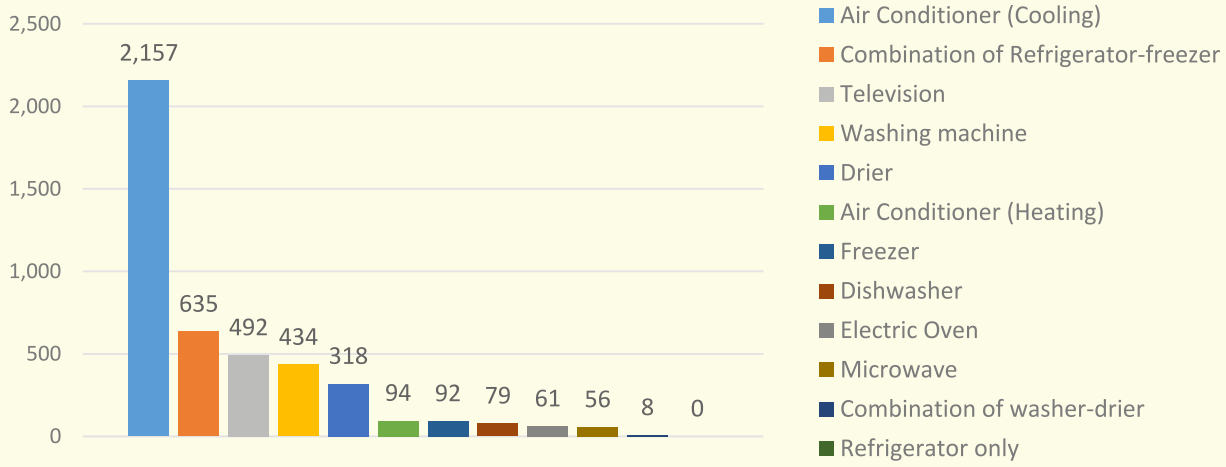

Figure 35 Average annual electricity consumption from selected appliances, per type of appliance, per household, in Coastal 1A (in kWh/yr)

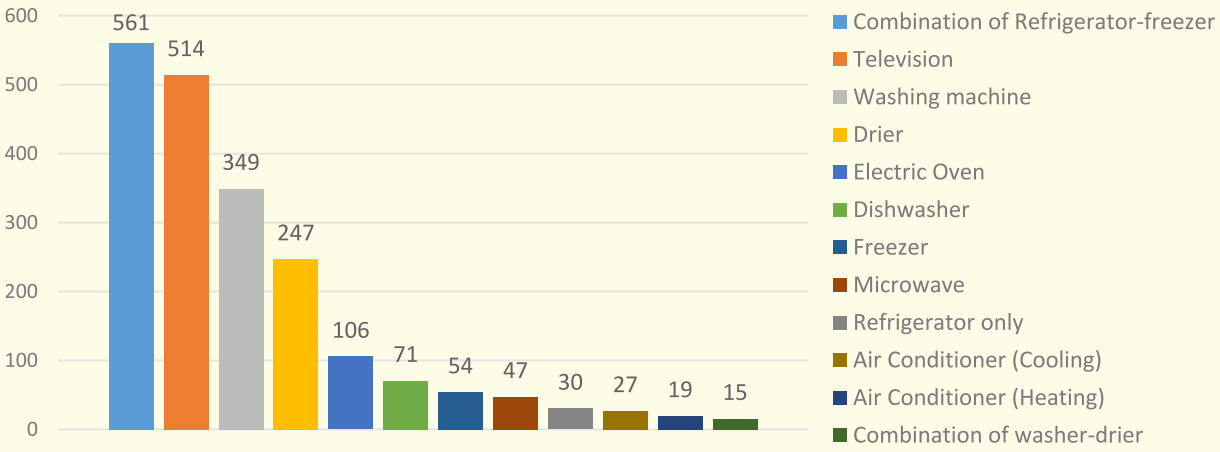

Figure 36 Average annual electricity consumption from selected appliances, per type of appliance, per household, in High Mountain (in kWh/yr)

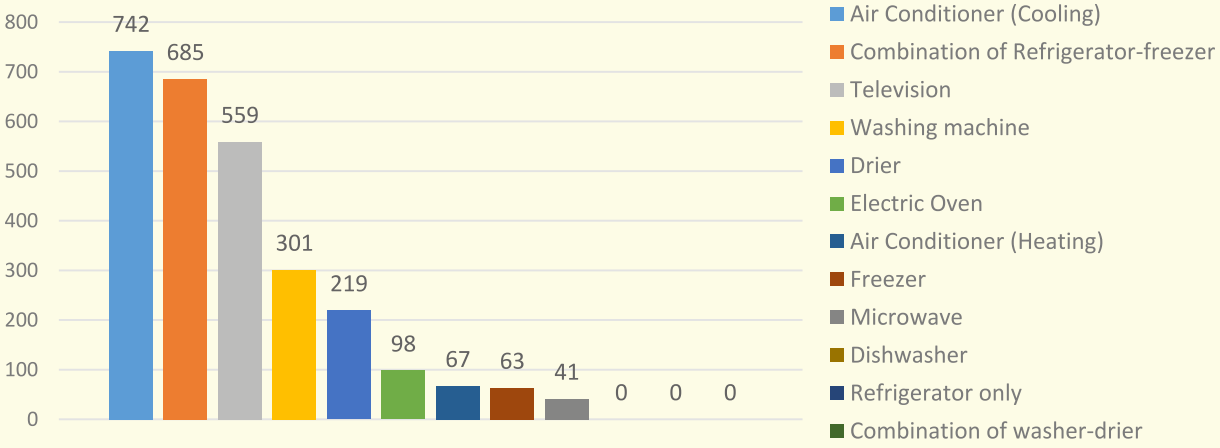

Figure 37 Average annual electricity consumption from selected appliances, per type of appliance, per household, in Inland (in kWh/yr)

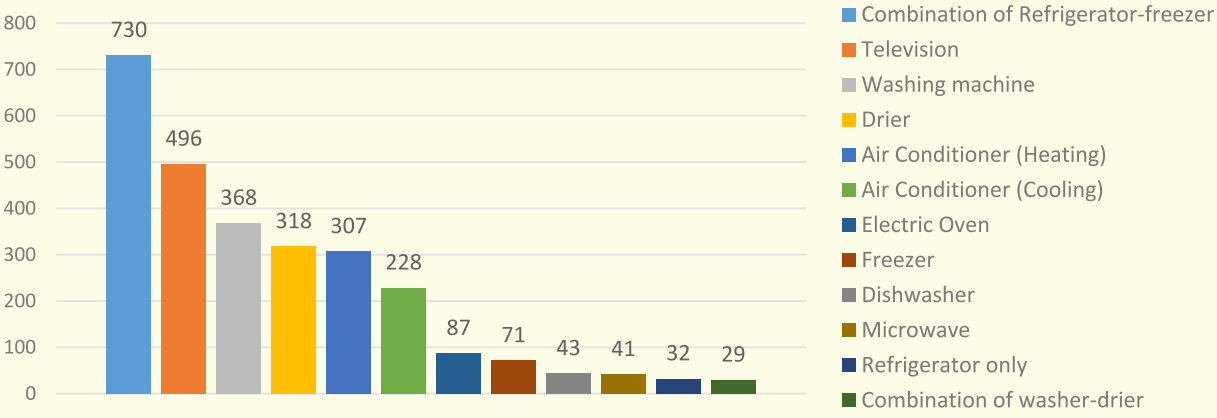

Figure 38 Average annual electricity consumption from selected appliances, per type of appliance, per household, in Western Mid-Mountain (in kWh/yr)

6. Electricity demand of the residential sector

The results presented in the previous section of this report are extrapolated to estimate the overall annual electricity consumption of the residential sector in Lebanon. The number of households and distribution per zone are based respectively on the total number of occupied dwellings in Lebanon in 2015[21] and on the distribution of EDL subscribers.

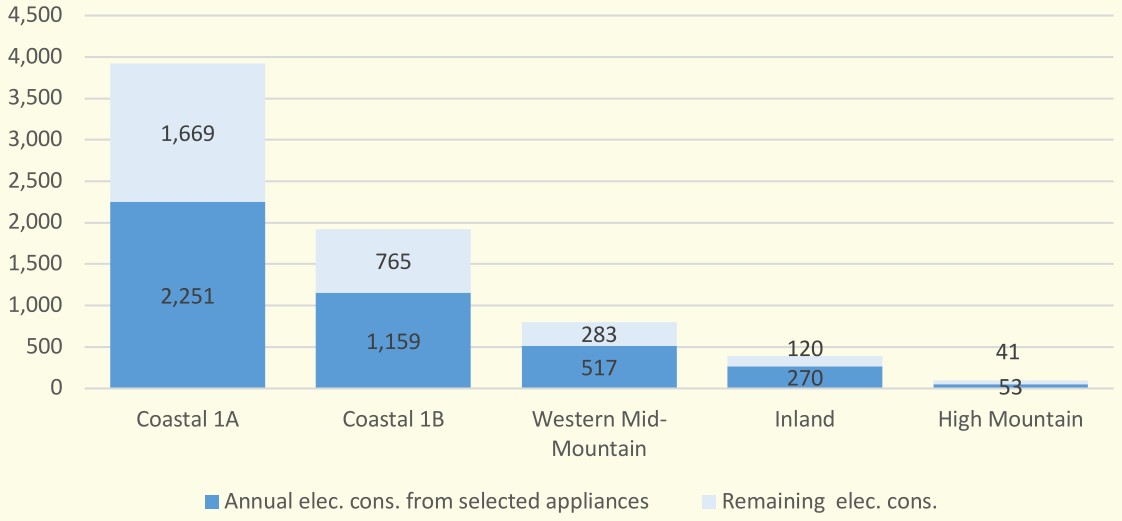

Figure 39 Overall national electricity consumption of the residential sector, per climate zone, in GWh/yr

[21] There were 1,080,000 of occupied dwellings in Lebanon in 2015, as per The First Energy Indicators Report of the Republic of Lebanon, LCEC, 2018.

Figure 39 reveals that electricity consumption in coastal areas is greater, mainly because of the greater number of dwellings compared to other climate zones, and to a lesser extent, due to a greater use of split air conditioners for cooling. The remaining electricity consumption is the difference between electricity consumption from selected home appliances and the total energy consumption deducted from the energy bill for households. As mentioned before, it can be accounted for by the electricity needed for water heating, space heating (excluding split ACs for heating), lighting and smaller electrical appliances. The following figures detail the total annual electricity consumption from selected appliances, per type of appliance for each climate zone (in GWh/yr).

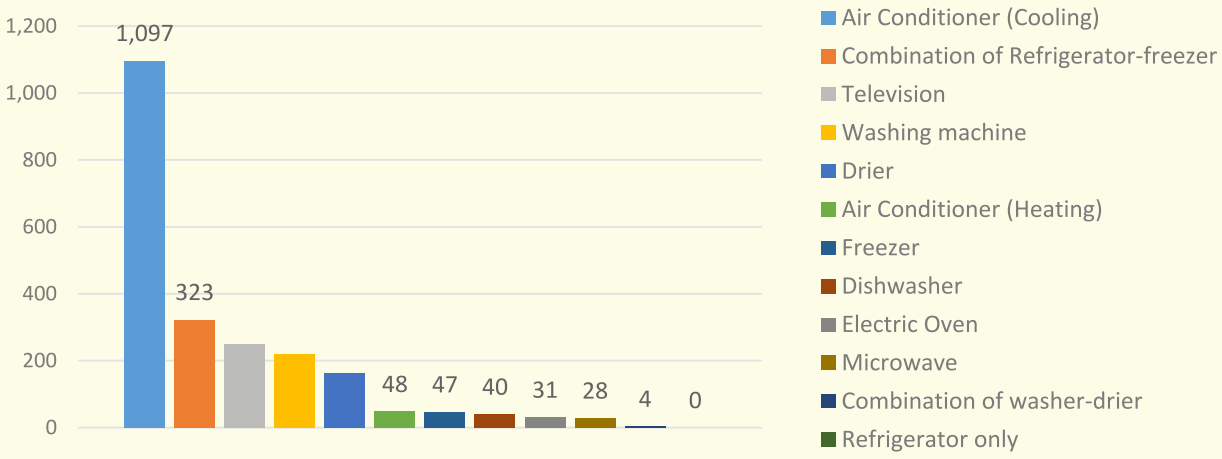

Figure 40 Overall annual electricity consumption from selected appliances, per type of appliance, for Coastal 1A, in GWh/yr

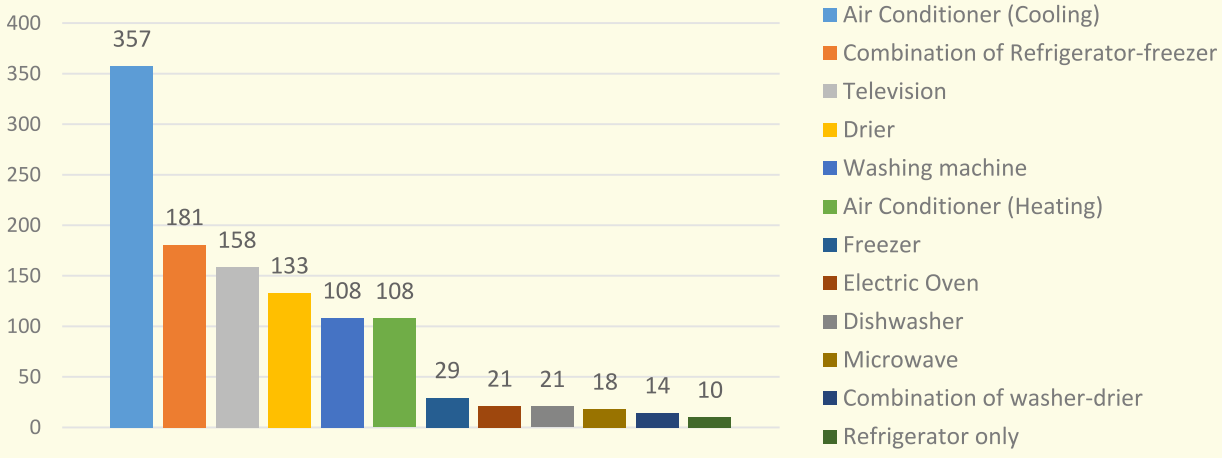

Figure 41 Overall annual electricity consumption from selected appliances, per type of appliance, for Coastal 1B, in GWh/yr

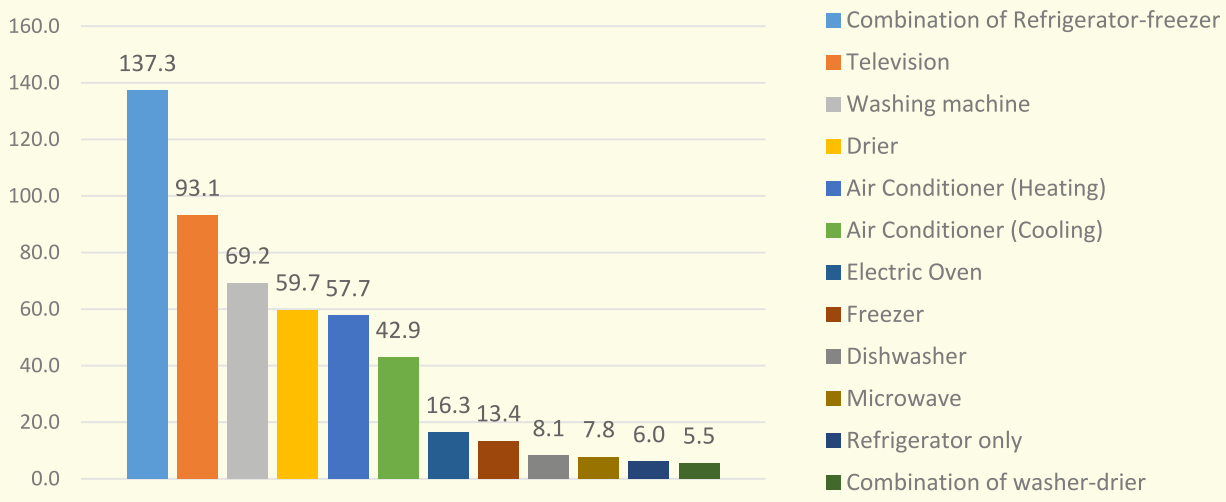

Figure 42 Overall annual electricity consumption from selected appliances, per type of appliance, for Mid-Mountain, in GWh/yr

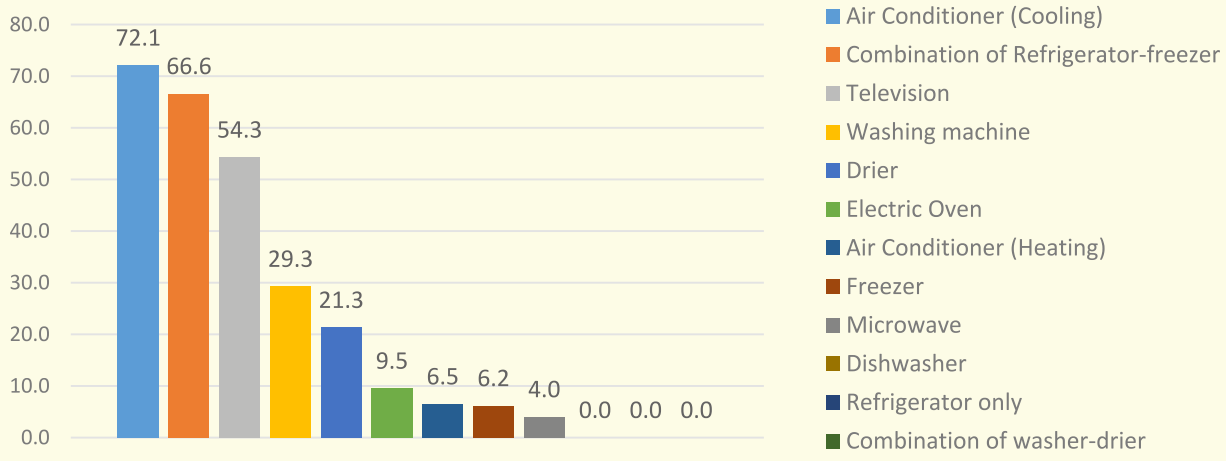

Figure 43 Overall annual electricity consumption from selected appliances, per type of appliance, for Inland, in GWh/yr

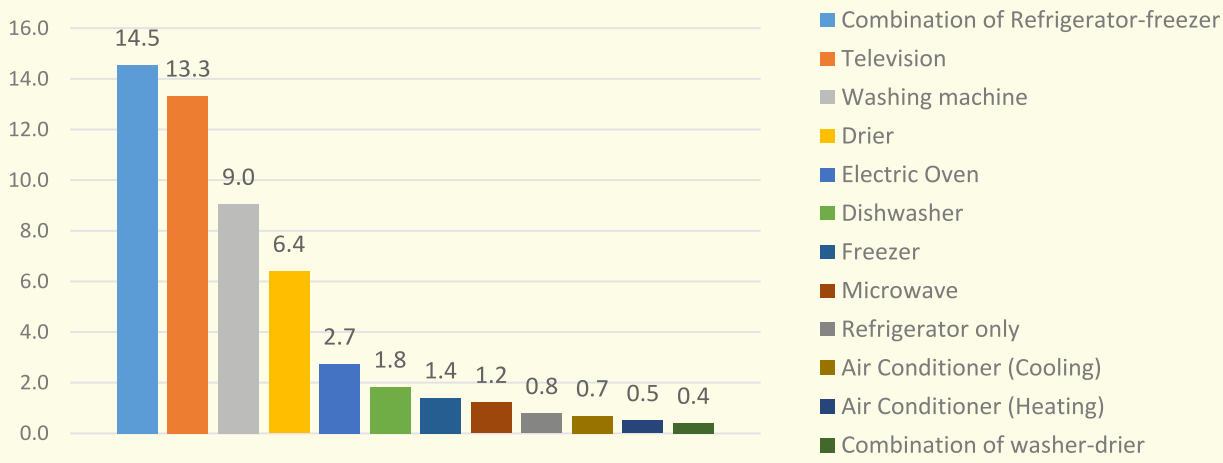

Figure 44 Overall annual electricity consumption from selected appliances, per type of appliance, for High Mountain, in GWh/yr

7. Scenarios and estimated savings

Based on the conducted surveys, different scenarios can be developed to estimate the possible national savings that could be obtained from the replacement of home appliances at the end of their lifetime in existing households.
Three different scenarios are being considered:

1. Business-As-Usual (BAU): Households replace appliances at the end of their lifetime with appliances that have similar levels of energy efficiency.
2. Available Technology (AT): Households replace appliances at the end of their lifetime with most-common appliances available at local retailers.
3. Best-Available Technology (BAT): Households replace appliances at the end of their lifetime with those that have the best-available energy rating from local retailers.

To calculate global energy consumption and savings associated with each scenario compared to BAU, the following assumptions are made:

1. Energy consumption and consequently the level of energy efficiency is the same throughout the lifetime of the equipment – whereas energy consumption is meant to increase while appliances are frequently used and are aging;
2. The total number of appliances is constant from 2018 until 2025, not adding new appliances purchased by newly established households;
3. In the AT and BAT scenarios, appliances are replaced every year depending on their lifetime:[22] For example, the lifetime of refrigerators is ten years.

[22] The lifetime of each appliance is based on figures published in table 19 in the "Energy efficient home appliances" report, CEDRO, August 2018.

Therefore, during the first year, one tenth of the initial stock would be replaced, and so on, until the full initial stock is replaced by year ten;

4. As data was not available from retailer surveys for air conditioners, ovens, microwaves and combinations of washers and driers, these appliances were not considered to be replaced throughout the years. Consequently, they are not part of the total presented savings.

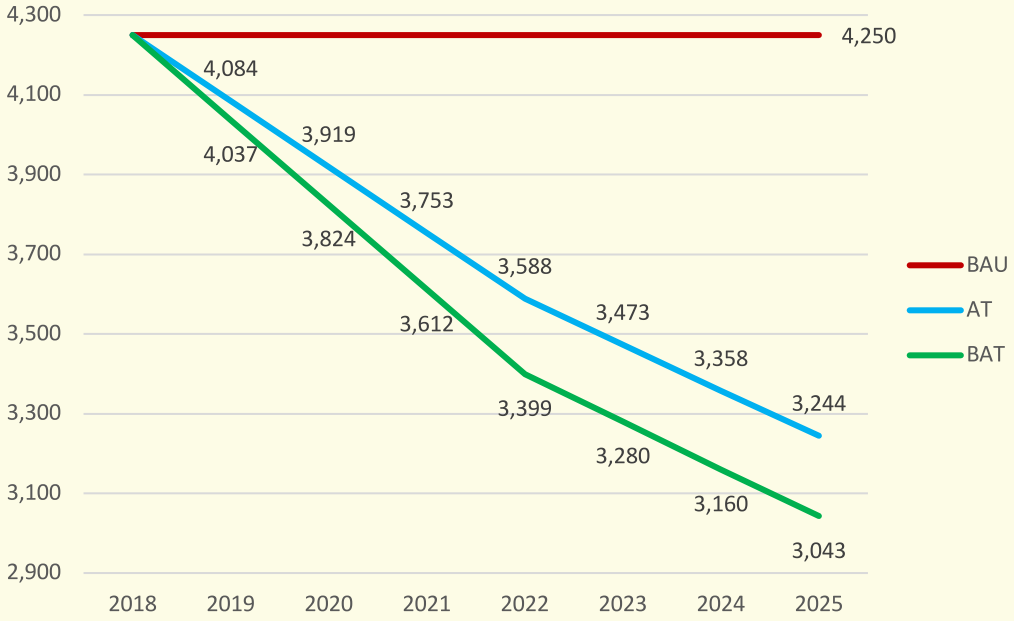

Figure 45 Overall electricity consumption from selected appliances in three different scenarios, in GWh/yr

Given the stock of equipment in households in 2018 and considering the annual replacement rate of selected appliances, if those appliances are replaced with average technology instead of the same technology (BAU) at the end of their lifetime, the total national electricity consumption from these appliances would drop from 4,250 GWh per year to 3,244 GWh per year in 2025 (Figure 45). This amounts to 1,005 GWh of annual savings, or a 24% improvement (Figure 46).

Similarly, if the same appliances are replaced with the best-available technology instead of the same technology (BAU), the total national electricity consumption from selected appliances would drop from 4,250 GWh per year to 3,043 GWh per year in 2025 (Figure 45). This amounts to 1,207 GWh of annual savings in 2025, representing a 28% improvement compared to the BAU scenario and a 6.2% improvement compared to the AT scenario (Figure 46).

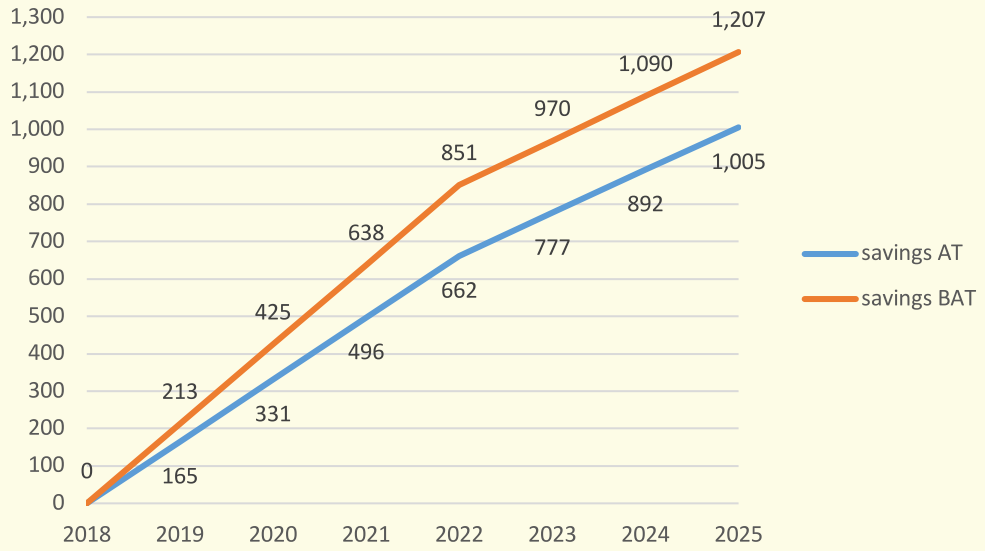

Figure 46 Annual savings from both scenarios, in GWh/yr

8. Promoting energy-efficient home appliances

As part of the Italian Energy-Efficient Home Appliances (IEEHA) Program, up to 15,000 household appliances will be promoted through the distribution of coupons with a cashback value. The list of eligible products comprises the following appliances, either made in Italy and/or of an Italian brand: Washing machines, driers, combinations of washing machines and driers, refrigerators, freezers, combinations of refrigerators and freezers, electric and gas ovens, dishwashers, and air conditioners. For each type of appliance, an energy-rating threshold has been defined, as well as the value of cashback, between USD 100 and 150 in equivalent Lebanese Pounds (LBP). The number of coupons varies depending on the type of appliance. Table 13 gives an estimation of their quantity, knowing that it might be readjusted throughout the program's development.

Table 13 Quantity of coupons to be distributed per type of appliance – IEEHA Program

Type of appliance	Quantity
Washing machines	4,500
Driers	1,000
Combinations of washing machines and driers	1,000
Refrigerators	500
Freezers	500
Combinations of refrigerators and freezers	1,500
Dishwashers	1,000
Air conditioners	500
Electric or gas ovens	2,000

To calculate savings associated with the promotion of these Italian energy-efficient equipment, quantities were reallocated among other types of appliances to cover for the lack of data for air conditioners, ovens, and combinations of washers and driers.
Compared to the Business-As-Usual (BAU) scenario, the IEEHA program will encourage consumers to replace their appliances at the end of their lifetime with those with the best-available energy rating from local retailers for a limited number of appliances per year.

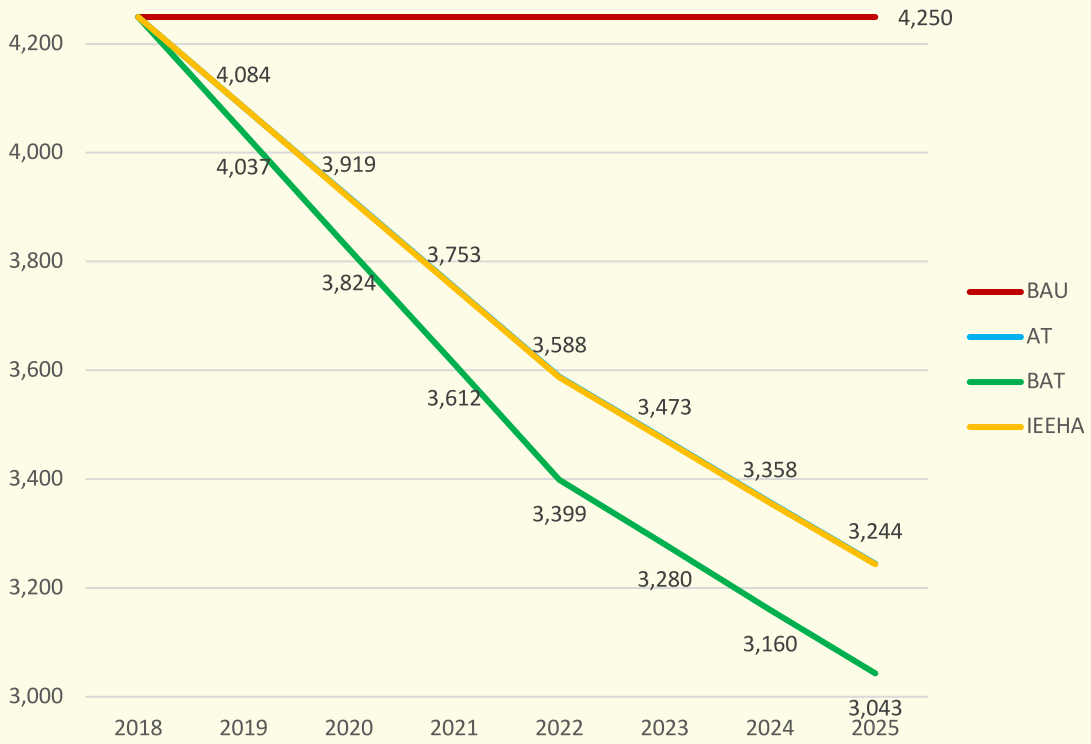

Figure 47 Overall annual electricity consumption from selected appliances in four different scenarios, in GWh/yr

In the IEEHA scenario (Figure 47), it is assumed that most households will switch their appliances at the end of their lifetime with average-available technology (AT scenario). It is also assumed that households that benefited from a coupon in the framework of the IEEHA program[23] will switch to the best-available technology (BAT scenario). Given the small number of targeted appliances in the IEEHA scenario (a total of approximately 15,000 appliances), the resulting savings are comparable to those of the AT scenario, highlighting the need for a larger national initiative in this regard.

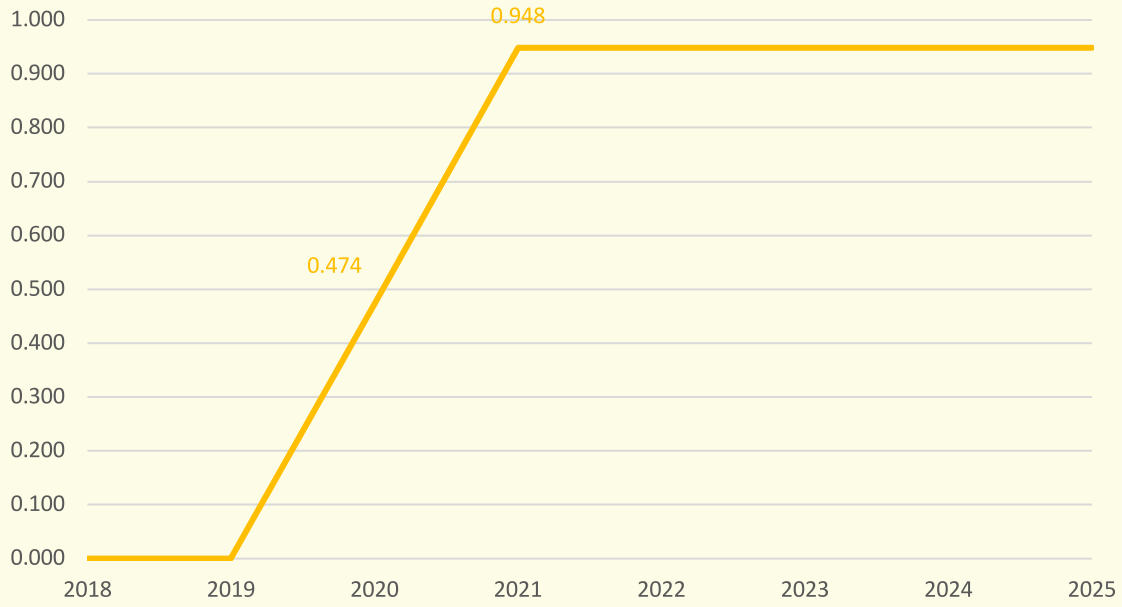

Figure 48 Annual electricity savings from the IEEHA program compared to the AT scenario in GWh/yr

In the IEEHA scenario compared to AT, some households will be switching to the best-available technology instead of the average-available technology during 2020 and 2021. Thus, the IEEHA program will create annual savings of 0.474 GWh in 2020 and 0.948 GWh in 2021 (Figure 48).

9. Conclusion

Ongoing cooperation between IMELS and LCEC will help Lebanon build momentum towards the improvement of energy efficiency and higher levels of technology for home appliances. To achieve a greater result, the promotion of energy-efficient home appliances can be achieved through implementing a national standard and labeling scheme as well as supporting policies and measures that incentivize all stakeholders including manufacturers, importers, suppliers, and consumers.

[23] It is assumed that coupons are distributed evenly during the two years of the program (2020 and 2021). Starting 2022, in the IEEHA scenario, remaining appliances are being replaced by average-available technology (AT scenario).

Even though targeted savings represent only a small share of the global electricity consumption in the country, other indirect savings are also expected to result from the IEEHA program, notably through the awareness it raises, the capacity building it creates and through hatching a new culture. The four retailers which partnered in the program so far have a valuable network of participating stores all over Lebanon. They are actively engaged in the promotion of energy-efficient technologies and in the dissemination of new habits among Lebanese consumers.

A widespread communication and marketing campaign was launched within the program with straightforward messages to teach the importance of saving energy. This campaign is visible at retail stores, online through a dedicated website, a mobile application, radio, and social media. Alongside the campaign, sales staff at retail stores will be part of an intensive training program to improve their skills, learn about the European energy label, and methods to sell more energy-efficient appliances to consumers.

Hopefully, this program will be followed by other initiatives to push the market towards higher levels of technology and more energy-efficient equipment to address the great potential of energy savings in the residential sector and to contribute to decreasing the national electricity demand.