GCF Readiness and Preparatory Support

Development of Action Plan for Designing and Implementing Standards and Labelling Programme in Lao PDR

Lighting and Appliance Market Study and Assessment Report

Prepared for

UNITED NATIONS ENVIRONMENT PROGRAMME

By

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Leading the Transition to Clean Energy

Table of Contents

Table of Figures

Table of Tables

Acronyms and Abbreviations

AC	Air Conditioner
Btu/hr	British Thermal Unit per Hour
CFL	Compact Fluorescent Lamp
CRT	Cathode Ray Tube
DEM	Department of Energy and Mines
EDL	Electricite Du Laos
EE	Energy Efficiency
EGAT	Electricity Generating Authority of Thailand
GCF	Green Climate Fund
GWh	Giga-Watt Hour
HPC	Housing and Population Census
IIEC	International Institute for Energy Conservation
IREP	Institute of Renewable Energy Promotion
kWh	Kilo-Watt-hour
LED	Light-emitting Diode
LSB	Lao Statistics Bureau
LSIS II	Lao Social Indicators Survey II
MECON	Effective energy efficiency policy implementation targeting “New Modern Energy Consumer” in the Greater Mekong Subregion (project)
MEM	Ministry of Energy and Mines
MEPS	Minimum Energy Performance Standard
MPI	Ministry of Planning and Investment
PDEM	Provincial Department of Energy and Mines
PHC	Population and Housing Census
TV	Television
TWh	Tera-Watt Hour
UEC	Unit Energy Consumption
W	Watt

EXECUTIVE SUMMARY

The main objective of the lighting and appliance market study and assessment is to investigate household ownership of electrical appliances, and determine saturation levels. The market study also aims at collecting information on the supply-side of household appliances in Lao PDR, and households' awareness and behavior on energy efficiency (EE). The results of the market study and assessment will serve as the inputs for identification of priority household appliances for designing and implementing standards and labelling programmes in Lao PDR.

The market study and assessment included field survey activities which covered 435 households and 124 appliance shops 10 provinces across the country. It should be noted that household and shop survey activities were carried out in the third quarter of 2020 during which the partial lock down and travel restriction were imposed in Lao PDR due to COVID-19 pandemic. Despite these limitations, collections of household and appliance shop data were successfully carried out through face-to-face interviews and self-completed questionnaires depending on local travel restriction. The Department of Energy and Mines (DEM) in each province also contributed significantly to the success of field activity implementation.

Ownership and Saturation of Household Appliances

Analysis of household data shows that ownerships of large household appliances (such as air conditioners, refrigerators/freezers and washing machines) among Lao households increase when compared with the Population and Housing Census (PHC) in 2015, and the Lao Social Indicators Survey in 2017. The analysis also reveals that adoption of energy efficient technologies has become a common practice among Lao households, and ownerships and saturation of specific energy efficient technologies, such as LED lamps and flat screen televisions, have already surpassed their inefficient counterparts (i.e., CFLs and incandescent lamps for lighting, and cathode ray tube or CRT televisions). However, energy savings potential through MEPS and labelling is still significant, considering that conventional technologies such as fluorescent lamps and fixed speed ACs are still widely used and purchased by Lao households.

It is estimated that there are 8.4 light points in each Lao household, and fluorescent lamps are still the most popular lighting technologies, followed by LED lamps. Apart from lighting products and electric fans, the three most popular household appliances in Lao PDR are refrigerators/freezers, TVs, and rice cookers. Top 20 appliances in terms of ownerships and saturations are summarized below.

No	Appliance/ Electrical Equipment	Household Ownership (%)	Saturation (Unit/HH)
1	Fluorescent Lamp (Tube & Circular)	70%	4.33
2	CFL	16%	0.98
3	LED (Bulb, Tube & Downlight)	34%	2.55
4	Incandescent Lamp	18%	0.58
5	Air Conditioner	19.7%	0.33
6	Refrigerator/ Freezer	**73.1%**	0.79
7	Ventilation/Exhaust Fan	27%	0.88
7	Ceiling Fan	21%	0.40
8	Wall/Ceiling Mounted Oscillating Fan	26%	0.81

No	Appliance/ Electrical Equipment	Household Ownership (%)	Saturation (Unit/HH)
9	Table Fan	42%	0.93
10	Floor Standing Fan	25%	0.58
11	Washing machine	45.4%	0.47
12	TV	**71.0%**	0.91
13	Rice cooker	**65.5%**	0.71
14	Electric Frying Pan	57%	0.62
15	Iron	47%	0.53
16	Electric Kettle	47%	0.52
17	Electric Water Pump	35%	0.36
18	Electric Shower Heater	19%	0.19
19	Electric Water Boiler	9%	0.09
20	Microwave	5%	0.05

Awareness and Knowledge of Energy Efficient Products

More than 95% of surveyed households and appliance shops recognize the Thai No. 5 energy labels, and more than 70% of the respondents were able to associate energy labels with energy efficiency. 80% of household respondents also recall the Thai No. 5 energy labels on refrigerators, ACs and electric fans. It is perceived that awareness and knowledge on energy efficiency in Lao PDR are partly driven by Thai TV commercial as well as perception and recognition of the Thai No. 5 energy label.

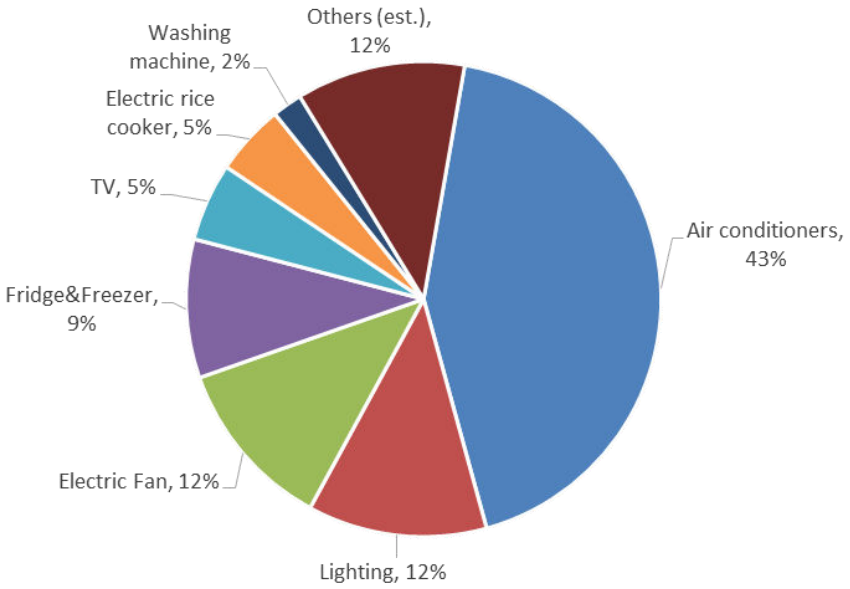
Secondhand Appliances

Secondhand appliances are not popular in Lao PDR, and they are available through small shops that repair electrical appliances and sell some of repaired products. Common secondhand appliances in Lao PDR mainly include washing machines, refrigerators, freezers, electric fans and ACs. These secondhand appliances are purchased by low income households, and small commercial premises, such as apartments, restaurants, and Karaoke bars.

Household Energy Consumption Profile

Analysis of appliance ownerships and saturations in Lao households found that major energy end-uses include cooling (ACs and fans), refrigeration (refrigerators/freezers) and lighting. Although AC ownership in Lao households is only about 20% which is much lower than ownerships of other large appliances (e.g., refrigerators/freezers and washing machines), high power consumption and relatively long operating hours of ACs make them the largest end-use in the residential sector, accounting for about 43% of the total residential electricity consumption. On average, cooling and refrigeration appliances (ACs, fans and refrigerators/freezers) contribute about 64% of the annual electricity

consumption in Lao households, and lighting end-uses account for about 12%. These findings are in line with the home energy audits conducted in four provinces in Thailand in 2019[1].



Key Recommendations

Recommendations on priority products and possible approaches to develop and implement MEPS and energy labelling in Lao PDR are as follows:

- **Priority products for immediate and short-term implementation:** With high ownership and saturation rates among Lao households, and high energy savings potential, ACs, fluorescent lamps, electric fans, refrigerators/freezers, and rice cookers are recommended as priority products for MEPS and labelling programmes in Lao PDR. MEM has already initiated a regulation for MEPS and labelling for ACs, and is currently participating in the ASEAN regional effort for development and harmonization of lighting MEPS. In view of these ongoing developments, the immediate and short-term focus of MEPS and labelling in Lao PDR shall be on ACs and lighting products.

- **Collaboration with neighboring countries:** Considering that household appliances and electrical equipment in Lao PDR are imported mainly from China and Thailand, and most of Lao households and appliance shops are well aware of No. 5 energy labels issued by the Electricity Generating Authority of Thailand (EGAT), it is recommended for MEM to explore collaboration opportunity with EGAT to maximize benefits from the existing high awareness on energy labels among Lao households and appliance shops. The collaboration could be further expanded to include recognition of energy performance test results for products certified under the No. 5 energy labelling programme.

[1] Promoting Household Energy Conservation through Feedback Services and Home Energy Audit on Residential Sustainable Lifestyle Programs, Final Report, 2019

1 INTRODUCTION

1.1 BACKGROUND

Rapid social and economic development in Lao PDR has resulted in significant increase of energy consumption, particularly electricity consumption in the residential sector. Residential electricity consumption grew at the rate of 11% per year from 2005 to 2015[2]. In 2019, the residential electricity consumption accounted for 32.4% of the total electricity consumption in Lao PDR, the second largest share just behind the industrial sector. High growth of electricity consumption in Lao PDR would probably be driven by the success of Lao PDR in increasing household electrification rate, from 15% in 1995[3] to 94% in 2019[4], and higher ownership of appliances among Lao households as a result of economic development. In general, increase of households' electricity's bills can either cause by increase of the electric appliances use or consumers selves behavior. However, evaluating impacts of household appliances on residential electricity consumption and potential energy savings in Lao PDR is a challenging task given limited reliable information and data.

1.2 OBJECTIVE

The main objective of the lighting and appliance market study and assessment is to investigate household ownership of electrical appliances, and determine saturation levels. The market study also aims at collecting information on the supply-side of household appliances in Lao PDR, and households' awareness and behavior on energy efficiency (EE). The results of the market study and assessment will serve as the inputs for identification of priority household appliances for designing and implementing standards and labelling programs in Lao PDR.

1.3 SURVEY TEAM

The International Institute for Energy Conservation (IIEC) was contracted by the United Nations Environment Programme (UNEP) to manage the local survey team led by Associate Professor Sengratry Kythavone. The local survey team carried out the field activities in close collaboration with the Institute of Renewable Energy Promotion (IREP) under the Ministry of Energy and Mines (MEM), and supervision of the GCF project national consultant, Dr. Khamphone Nantavong. A list of core survey team members is shown in the table below.

[2] Report on electricity energy demand and supply forecast for 2016-2030. Jointly Developed by Ministry of energy and Mines, and Electricite du Laos. Available at www.edl.com.la, www.laoenergy.com.la

[3] Achievement of Electricite du Laos under 40th anniversary of Lao PDR, 1975-2015. EDL 2016.

[4] Electricity statistics 2019. Electricite du Laos 2020.

Table 1: Local Survey Team

No.	Name	Responsibility
1	Assoc. Prof. Sengratry Kythavone	Team leader
2	Mr. Phonesavanh Sipaseuth	Team member – Coordination with the Provincial Department of Energy and Mines
3	Dr. Sounthisack Phommachanh	Team member – Survey Planning
4	Mr. Xayalak Vilayda	Team member - Budgeting
5	Dr. Lemthong Chanphavong	Team member
6	Mr. Vongsavanh Chanthaboune	Team member
7	Ms. Khamlar	Team member

1.4 SURVEY APPROACH AND METHODOLOGY

1.4.1 Review of Past Relevant Surveys

There have been few ad-hoc household appliance surveys funded by government, private sector, and donor agencies since 2014. The relevant surveys identified by the local survey team include the followings:

- Household Energy Efficiency: A Socio-Economic Perspective Lao PDR (2014) funded by the New Modern Energy CONsumers (MECON) project;
- Population and Housing Census (PHC) 2015, conducted by the Lao Statistics Bureau (LSB) under the Ministry of Planning and Investment (MPI);
- Lao Lighting Market Research (2015) funded by Philips Electronics Thailand; and
- Lao Social Indicators Survey (2017) conducted by LSB.

Relevant findings of the abovementioned surveys are discussed below.

1.4.1.1 Household Energy Efficiency: A Socio-Economic Perspective Lao PDR (2014)

The household surveys conducted by the MECON project is directly relevant to the scope of the lighting and appliance market study and assessment under the GCF project, as it discussed households' ownership of electrical appliances, sales of electrical appliances in Lao PDR, and respondents' knowledge and awareness on EE. However the MECON household surveys did focus only on the specific, so-called "New Emerging" consumer groups, who earn daily income between USD 2-5 per capita per day[5]. In addition, the surveys covered only most selected representative areas in terms of social-economic development and specific geographical conditions.

[5] These are people who have just left national poverty status (earning income of USD 1.5 per capita per day) but yet become wealthy

The MECON household survey interviewed only 275 households (urban: 202 and rural: 73) and 68 electrical appliance shops in three provinces: Vientiane capital as the most important social-economic development hub, Champasak (Most important southern social-economic development hub) and Xiengkhouang Province (with subtropical climate). Therefore, in terms of geographical and population coverage, as well as number of samples, The MECON household surveys were unlikely able to capture real household ownerships of electrical appliances. Key findings of the MECON household surveys on household ownership of electrical appliances in 2014 are summarized in Table 2.

Table 2: MECON Project's Findings on Household Ownership of Electrical Appliances and Equipment (2014)[6]

Items	Total	Urban	Rural
Hot plate electric stove	80%	81%	77%
Rice cooker	92%	93%	90%
Microwave	16%	15%	19%
Incandescent lamp	32%	34%	29%
Fluorescent tube	97%	97%	99%
Compact Fluorescent Lamp(CFL)	51%	50%	52%
Light Emitting diode (LED) lamps	1.5%	0.5%	4.1%
Box TV	73%	67%	88%
Flat TV	45%	53%	25%
Mobile phone	98%	98%	99%
Radio	17%	13%	29%
Video	59%	58%	62%
Computer	55%	56%	51%
Sound system/Hi-fi	56%	54%	63%
Electric fan	96%	95%	99%
Air conditioner	34%	38%	23%
Refrigerator	97%	98%	95%
Electric kettle	75%	80%	62%
Iron	89%	91%	85%
Electric water heater	25%	25%	23%
Washing machine	68%	69%	66%
Water pump	24%	25%	22%
Vacuum cleaner	8%	9%	5%

[6] Household energy efficiency: a socio-economic perspective. MECON, 2014

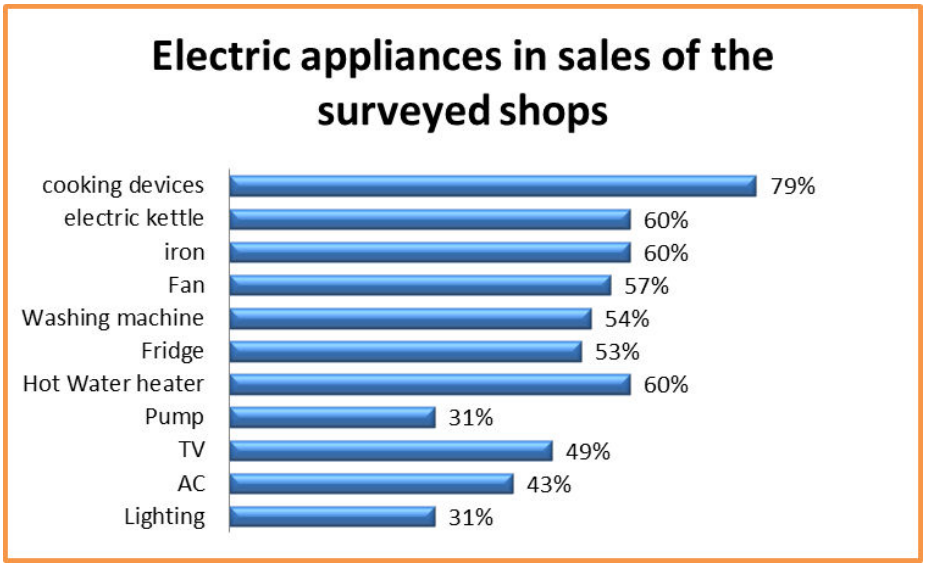


Figure 1: Types of Electrical Appliances sold by Shops in Vientiane Capital, Champasak and Xiengkhouang (2014)

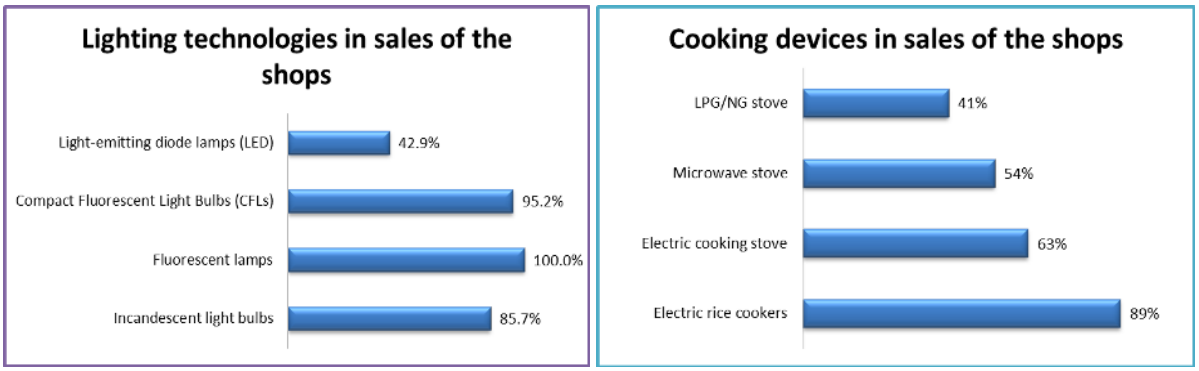


Figure 2: Types of Lighting Technologies and Cooking Appliances sold by Shops in Vientiane Capital, Champasak and Xiengkhouang (2014)

1.4.1.2 Population and Housing Census (2015)

The most comprehensive national level survey in Lao PDR is Population and Housing Census (PHC), conducted every 10 years. The most recent (the fourth) PHC was carried out in 2015[7], and questions about household ownership of popular electrical appliances were added into the questionnaire. The ownership rates of these household electrical appliances reported by the PHC 2015 are shown in Table 3.

[7] Results of Population and Housing census 2015. Lao Statistics Bureau, 2016. Available at www.laosis.lsb.gov.la

Table 3: Household Ownership of Popular Electrical Appliances in Lao PDR (PHC, 2015)

No	Items description	Total	Urban	Rural
1	TV	77.3%	91.5%	73.4%
2	Mobile phone	86.2%	94.7%	83.4%
3	Computer	10.5%	24.5%	3.3%
4	Washing machine	19.7%	41.9%	8.9%
5	Air Conditioner	7.6%	11.4%	1.5%
6	Ventilation devices	67.3%	88.4%	60.2%
7	Refrigerator/Freezer	59.1%	82.9%	50.4%

1.4.1.3 Lighting Market Research (2016)

The lighting market research in Lao PDR in 2016 was funded by Philips Electronics Thailand Co., Ltd. The market research exercise specifically focused on retails of lighting related products, including all kinds of lamps and lighting accessories (battens, luminaries, cables, breakers), lighting products sourcing, as well as large potential buyers of lighting products (e.g., hotels and guest houses). The study also estimated market size and shares of some major brands of lighting products in the Lao market.

The Lao lighting market research surveyed 258 retail shops and 133 hotels & guest houses in all provinces of Lao PDR, and thus, can be considered as the most covered sales surveys for electric lighting products and accessories. The lighting market research results, as shown in Figure 3, may be used as the reference to understand how lighting product supply and demand are shifted or driven by rapid research and development of LED lighting products over the past five years.

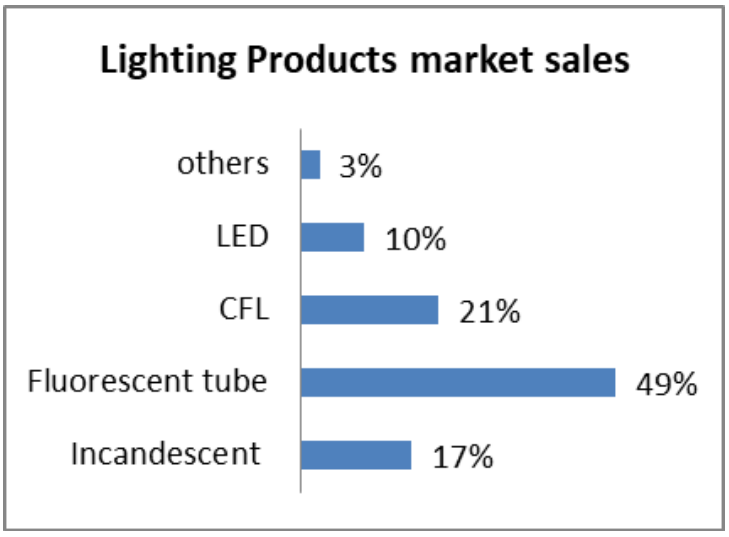


Figure 3: Shares of Lighting Product Sales in Lao PDR (2016)

1.4.1.4 Lao Social Indicator Survey (2017)

The most recent relevant survey which provides information on household ownerships of electrical appliances is the "Lao Social Indicators Survey" II (LSIS II), conducted in 2017. The first LSIS I was carried out in 2012, without consideration of household ownership of electrical appliances. In LSIS II, more questions about ownership of some common electrical appliances were added into the questionnaire. LSIS II investigated 23,233 households, where 33% are classified as urban households, and 67% as rural households. Some survey findings are presented in Table 4.

Table 4: Household Ownership of Electrical Appliances (source: LSIS II, 2018)

No	Items description	Total	Urban	Rural
1	TV	79.3%	94.1%	72.2%
2	Mobile phone	90.1%	97.5%	86.6%
3	Computer	13.5%	31.0%	5.2%
4	Washing machine	26.4%	53.2%	13.5%
5	Air Conditioner	10.1%	25.9%	2.5%
6	Ventilation devices	71.9%	91.5%	61.1%
7	Refrigerator/Freezer	65.4%	90.1%	53.6%
8	Rice cooker	54.7%	83.2%	41.1%
9	CD/DVD player/Home theatre	30.2%	41.2%	24.9%
10	Iron	33.3%	63.2%	19.0%
11	Water pump	38.8%	41.3%	37.6%

1.4.2 Sampling Design Framework

Although split-type room air conditioners with cooling capacity less than 12,000 W (or 40,944 Btu/hr) have been identified as the first household appliance for the energy standards and labeling programme in Lao PDR, the lighting and appliance market study and assessment still aim to provide evidence to determine other priority household appliances. In view of this, the study and assessment focus on few key parameters, including household ownership of electrical appliances, household saturation levels, and usage patterns by household members. The study and assessment also aim at collecting information on the supply side of household appliances in Lao PDR which will support the Government of Lao PDR to develop effective supporting policies addressing needs of the local private sector stakeholders.

The recent PHC and LSIS II have already provided information on household ownership of different types of household appliances. These two national level surveys covered very large sample sizes nationwide, and the results on household ownership levels are considered to be more representative than a smaller sample size survey funded by the GCF project. However PHC and LSIS II did not collect the saturation level of household appliances, and how these appliances are used. Considering this, the sampling design framework adopted by this study and assessment aims at covering all electrified household in Lao PDR which will be stratified based on electricity consumption in each province. Selection of households in each stratum will follow the convenient sampling approach with an objective to balance household samples located in urban, sub-urban and rural areas.

The sampling design framework also considers factors which affect adoption and usage of household electrical appliances, such as geographical locations (border towns or gateways with neighboring countries) and climatic conditions.

1.4.2.1 Selection of Target Provinces

Figure 4 shows electricity consumption by provinces in 2018[8]. Around 87% of electricity consumption nationwide are accounted for nine major provinces. Proportion of grid-connected households in these nine provinces against the total number of grid-connected households nationwide is identical to the electricity consumption (see Figure 5). Based on these statistics, the sampling design framework targeted these nine provinces with high electricity consumption. In addition, the study and assessment cover three additional provinces, i.e., Bokeo and Luangnamtha province which respectively serve as the border towns with Thailand and China, and Xiengkhouang province in which its subtropical climate could affect types and usage of household appliances. In total, the study and assessment covered twelve provinces in Lao PDR, as summarized in Table 5

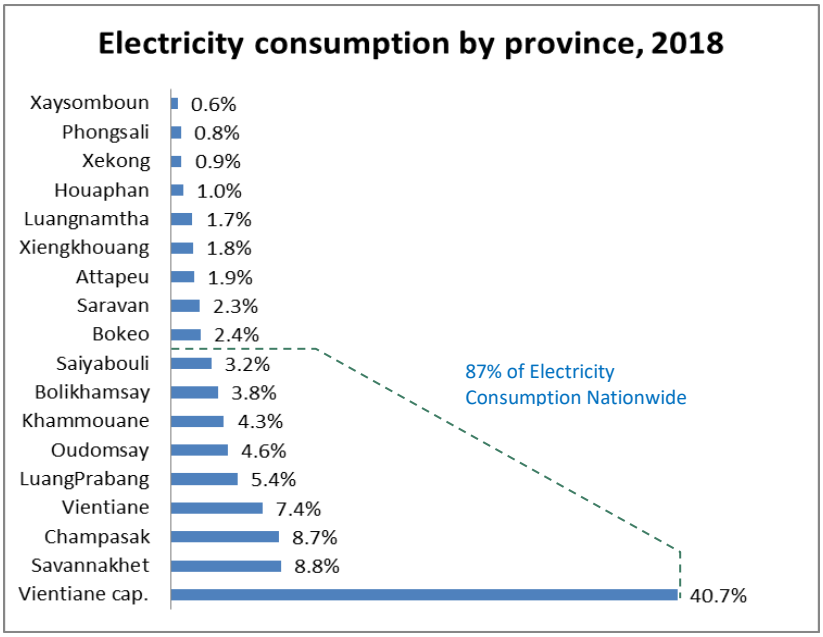


Figure 4: Proportion of Electricity Consumption by Province (source: MEM, 2018)

[8] Electricity statistics 2018. Department Energy policy and planning, Ministry of Energy and Mines 2018.

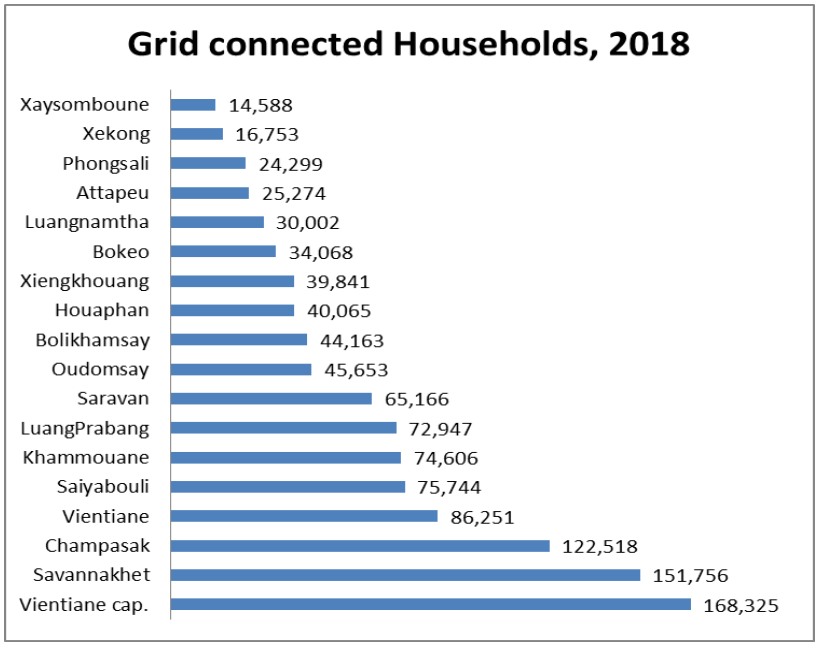


Figure 5: Grid-Connected Households by Province (MEM, 2018)

Table 5: Target Provinces

No.	Province	Social-Economic Development Importance	Specific Geographical Condition
1	Bokeo	Special economic zone	Bordering with Thailand, Myanmar
2	Luang Namtha	Special economic zone	Bordering with China, Myanmar
3	Oudomxay		Northern communication node Bordering with Vietnam
4	Luangprabang	Most important social economic hub of Northern Laos Tourism destination (world heritage site)	Bordering with Vietnam Significant Urbanization Major city
5	Xiengkhouang	Third Lao world heritage site: plane of stone jars	Highland Subtropical climate, Northern-Eastern communication node Bordering with Vietnam
6	Xayabouly		Bordering with Thailand Populated province
7	Vientiane province		Bordering with Thailand Populated province Surrounded Vientiane capital
8	Vientiane capital	The Most important social economic hub of Lao PDR	Capital city Significant Urbanization Bordering with Thailand
9	Bolikhamxay		Communication node Bordering with Thailand, Vietnam
10	Khammuane		Bordering with Thailand, Vietnam Populated province
11	Savannakhet	Special economic zone	Bordering with Thailand, Vietnam Significant Urbanization and major city Most populated province

No.	Province	Social-Economic Development Importance	Specific Geographical Condition
12	Champasack	Southern Hub, Second Lao world heritage site Special economic zone	Bordering with Thailand, Cambodia Major city Significant Urbanization

1.4.2.2 Determination of Sample Size

The total numbers of survey samples (n) for households and appliance shops were calculated based on the total number of households and shops using the following simplified Yamane formula[9].

$$n = \frac{N}{1 + Ne^2}$$

Where N- population size (total number of households in our case)

e - precision level (0.05)

With the household population of about 1.2 million households, the above formula gave a maximum sample size of 400 samples which were then distributed across the twelve selected provinces in accordance with their electricity consumption proportions. With some contingencies built in the total sample size was 430 households, as shown in Table 6.

Table 6: Total Sample Size and Distribution of Household Samples in Target Provinces

No	Provinces	% of Electrical Energy Consumption	Initial Sample Size	Contingency	Total Sample Size
1	**Luangnamtha**	1.5%	7	2	9
2	**Oudomsay**	1.9%	8	2	10
3	**Bokeo**	2.8%	12	2	14
4	**Luangprabang**	4.7%	20	2	22
5	**Saiyabouli**	3.1%	14	2	16
6	**Xiengkhuang**	1.6%	7	2	9
7	**Vientiane**	6.2%	27	2	29
8	**Vientiane Cap.**	42.7%	185	6	191
9	**Bolikhamsay**	4.0%	17	2	19
10	**Khammouane**	5.0%	22	2	24
11	**Savannakhet**	9.6%	42	2	44
12	**Champasak**	9.4%	41	2	43
Total Household Sample			**402**	**28**	**430**

[9] Yamane, Taro. (1967). Statistics: An Introductory Analysis, 2nd Edition, New York: Harper and Row.

Determination of the sample size for appliance shops in the target provinces followed the same approach as for households. The final sample size and distribution across the target provinces are summarized in Table 7.

Table 7: Total Sample Size and Distribution of Appliance Shop Samples in Target Provinces

No	Provinces	% of Total Appliance Shop	Initial Sample Size	Contingency	Total Sample Size
1	**Luangnamtha**	2.0%	2	1	3
2	**Oudomsay**	1.0%	3	1	4
3	**Bokeo**	2.8%	3	2	5
4	**Luangprabang**	2.8%	3	2	5
5	**Saiyabouli**	2.8%	3	2	5
6	**Xiengkhuang**	2.8%	3	2	5
7	**Vientiane**	5.0%	5	2	7
8	**Vientiane Cap.**	57.8%	58	2	60
9	**Bolikhamsay**	4.1%	4	2	6
10	**Khammouane**	5.5%	6	2	8
11	**Savannakhet**	8.3%	8	2	10
12	**Champasak**	8.3%	8	2	10
Total Appliance Shop Sample			**106**	**22**	**128**

1.4.3 Questionnaire Design

The questionnaires for household and appliance shop surveys were separately designed to allow surveyors to collect as much data as possible. Face-to-face interview and/or questionnaire distribution will be selected by the field survey team to balance the effectiveness and quality of data collected. The questionnaire for household surveys comprises three parts:

A. General information on the household
B. Household's Electric appliances, including type, rated power consumption or capacity, quantity or/and usage hours
C. Awareness/knowledge on energy efficiency (energy label, energy consumption, price difference)

The questionnaire for appliance shop surveys also comprise three parts:

A. General information on the appliance shop
B. Types of electrical household appliance sold in the shop, customers' preferences
C. Awareness/knowledge on energy efficiency (shop's owner or customers).

The full questionnaires for household and appliance shop surveys are given in Annex I.

1.4.4 Data Collection and Analysis

The surveys team comprises staff of the Faculty of Engineering, National University of Laos, in cooperation with the Energy efficiency and Energy Conservation Division of the Institute of Renewable Energy Promotion (IREP), Ministry of energy and Mines (MEM. The procedures involved in implementation of data collection activities are illustrated in the below diagram.

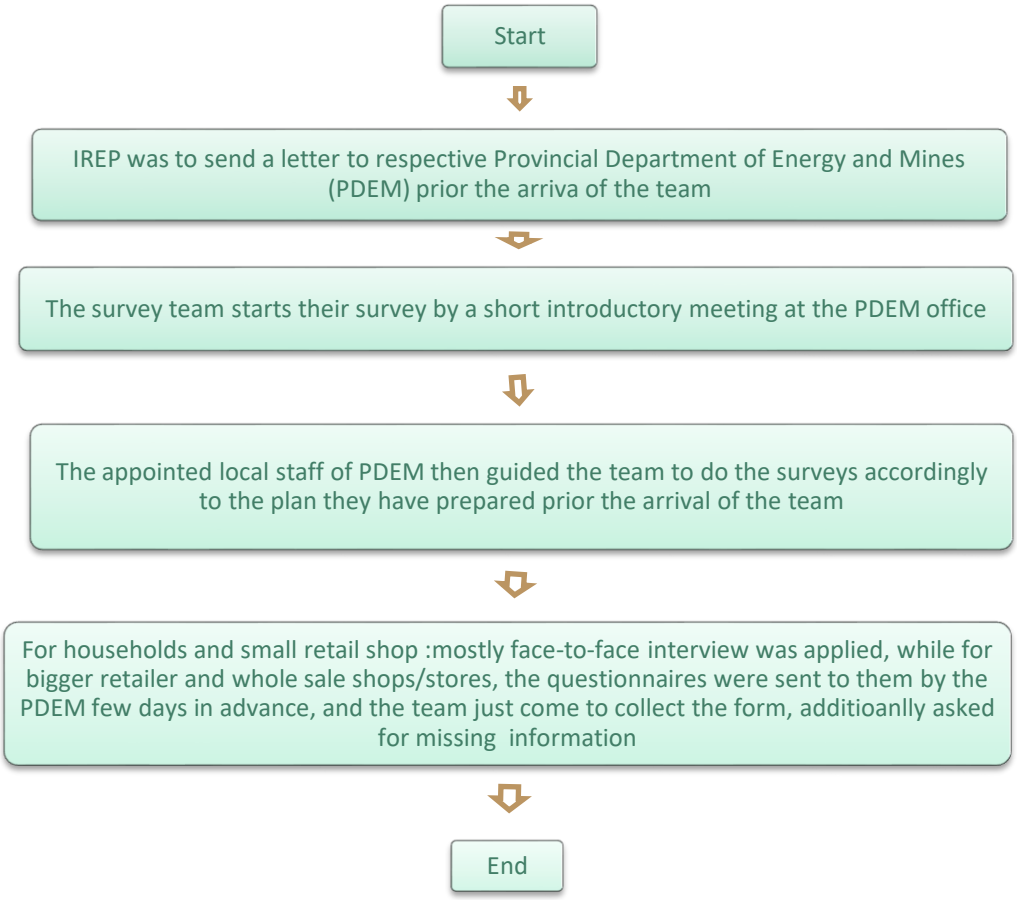


Figure 6: Implementation of Field Survey Activities

In this study and assessment, Microsoft Excel spreadsheets are used as the main tool in data analysis, and appliance ownership refers to the share of households owning one or more type of appliance, while saturation refers to the quantity of a given appliance per household. The data analysis aims at gathering the information on current situation of Lao market of electric appliances, such as:

- Appliances ownership and saturation per household
- Power consumption levels/size
- Energy efficiency of appliances
- Users behavior/preference trend
- Appliances import sources and distribution channels
- Households' awareness on energy efficiency

2 SURVEY FINDINGS

2.1 DATA COLLECTION ISSUES

Field data collection activities were carried out in the fourth quarter of 2020 during which the second wave of COVID-19 pandemic began to impact travels in Lao PDR, and implementation of social distancing became more stringent. As a result, the field survey teams were unable to balance the numbers of target households across the low, medium and high electricity consumption groups as originally planned, and majority of target households included in the surveys are medium to high electricity usage households. These deviations, however, were unlikely to be evitable given the tight project timeframe amid the COVID-19 pandemic.

2.2 RESPONDENTS' PROFILES

2.2.1 Households

In total, 435 households were actually interviewed, of which 72% are in urban areas (313 households). It should be noted that the rural household respondents in this survey, 61% of respondents are male (see Figure 7).

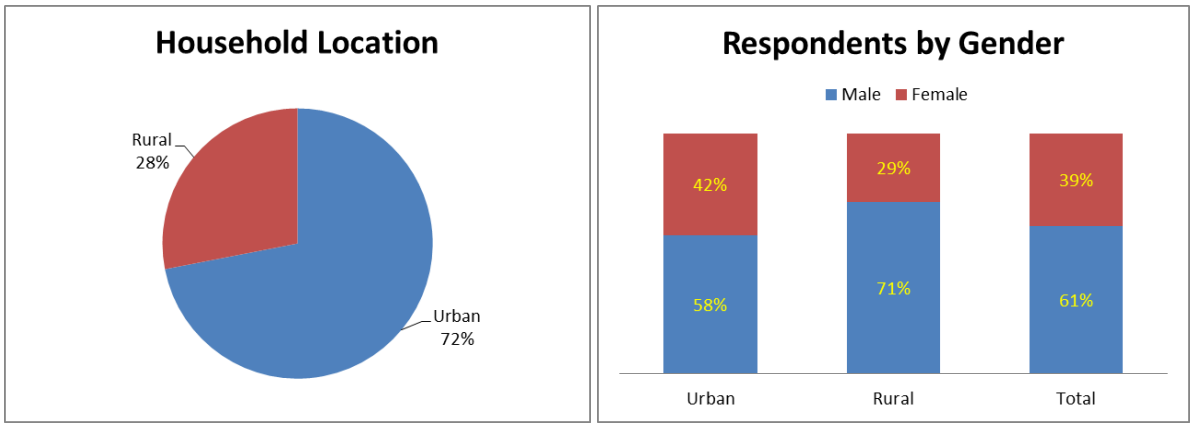


Figure 7: Locations of Household Surveyed and Genders of Respondent

Respondents with ages between 30-39 years old account for 37% of all respondents, followed by group 40-49 (21%), 60-59 (16%), while younger and older groups shared equally (16%), as shown Figure 8. 67% of respondents are also the main income earners of the households. In terms of household sizes, around 80% of household respondents are large families with more than three members. Around 50% of respondents' have household's size between 4 and 5 members, while income earning one from 2 to 4 accounted for 85% of the respondents

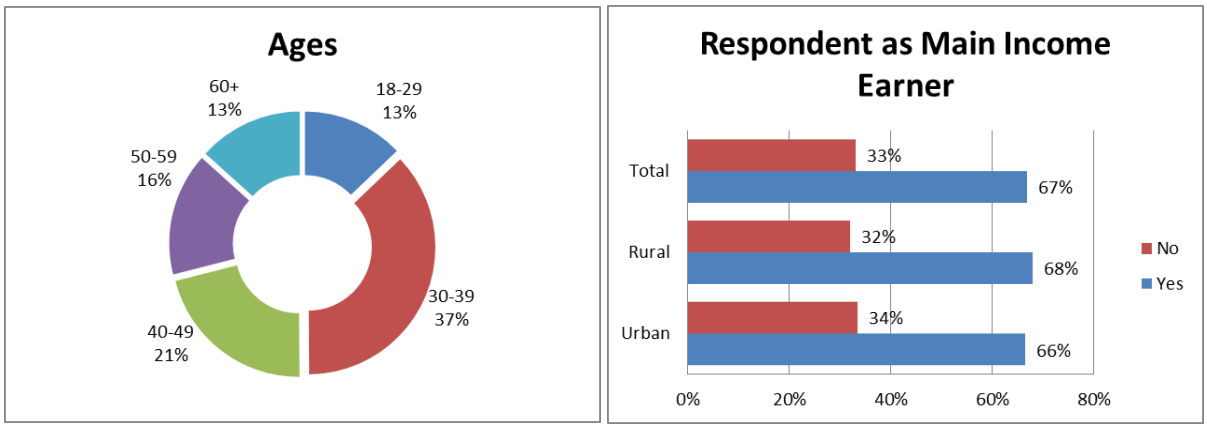


Figure 8: Respondents Distribution by Ages and income earners

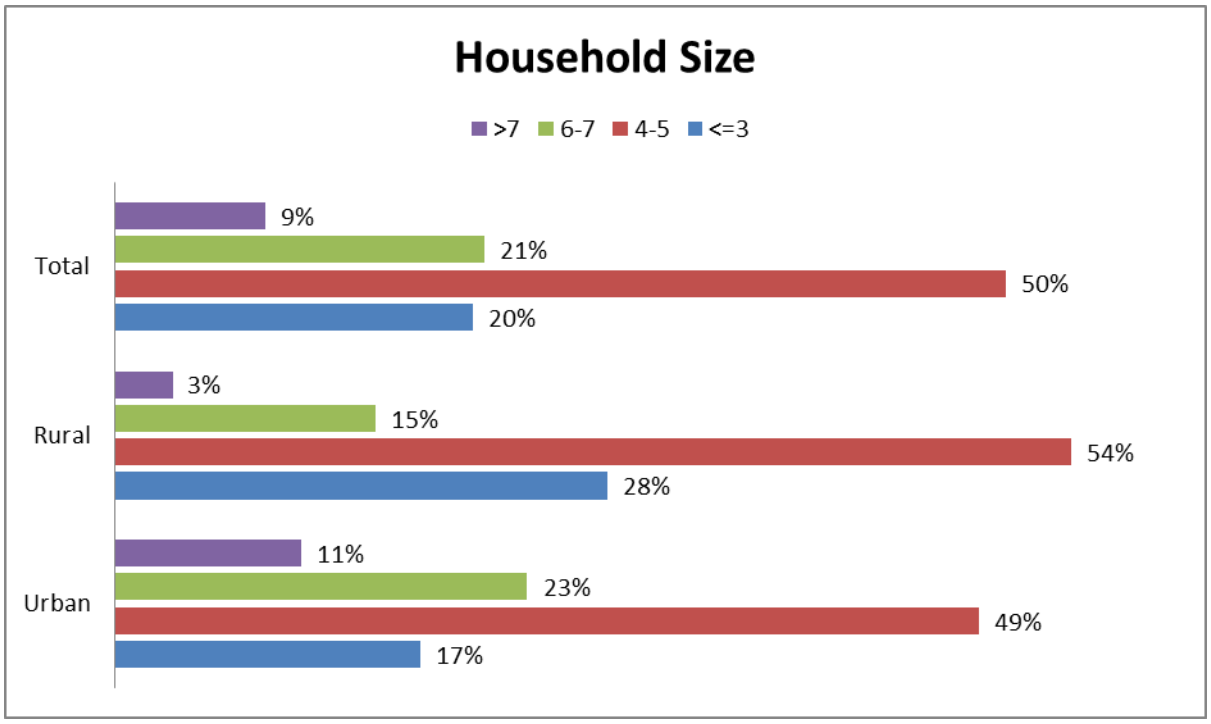
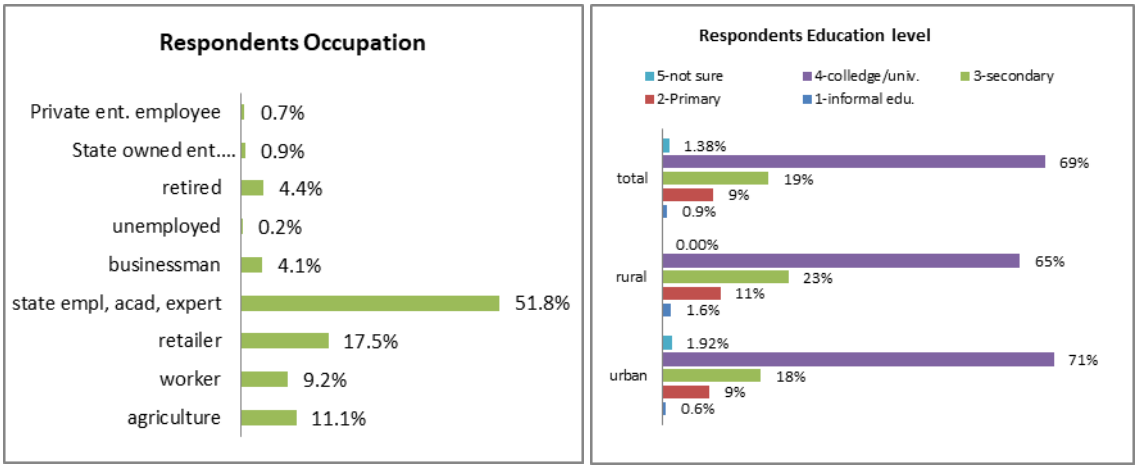


Figure 9: Household Size

Around 52% of respondents are state employees or academic staffs, 18% are retails owners, 11% - agriculture, etc. (Figure 10, a). The highest share of state-employees and academic staffs also matched distribution of monthly income levels of respondents (70% of respondents have income between 1.5-4.5 million kips). Most of respondents (88%) have college/university or secondary education degrees (b).



a) b)

Figure 10: Respondents Occupation (a) and Education Levels (b)

78% of respondents have 4 to 10 rooms in their houses, and about 7% of the respondents have more than 10 rooms (Figure 11).

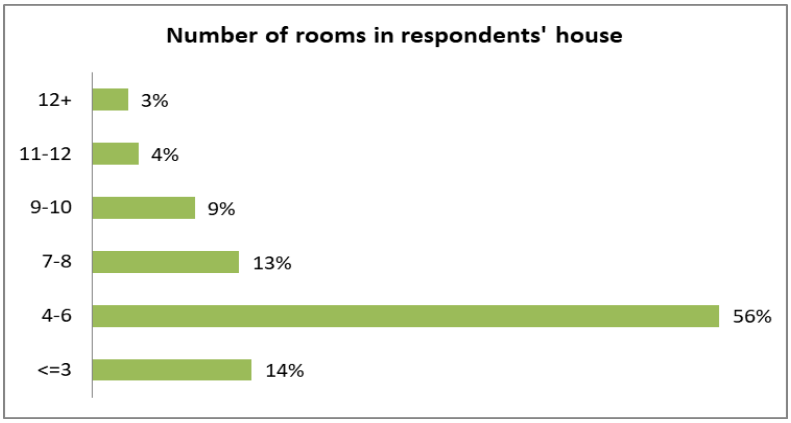


Figure 11: Number of Rooms in Respondents' House

Electricite du Laos (EdL) has divided the electricity tariffs for residential consumers into 6 levels, as shown in the table below.

Table 8: Residential Electricity Tariffs (EdL, 2020)

Levels	Electricity consumption (kWh/month)	Tariff (Kip/kWh)	Range of Monthly Electricity bills including 10% VAT (Kip)
1	0-25	355	0 - 19,222.50
2	26-150	422	19,222.51 - 86,707.50
3	151-300	815	86,707.51 - 221,182.50
4	301-400	898	221,182.51 - 319,962.50
5	401-500	984	319,962.51 - 428,202.50
6	>500	1,019	>428,202.50

According to EdL's customer database in 2019, about 94% of EdL's residential customers consume less than 300 kWh per month, and 55% of residential customers have monthly electricity consumption between 26 kWh to 150 kWh per month.

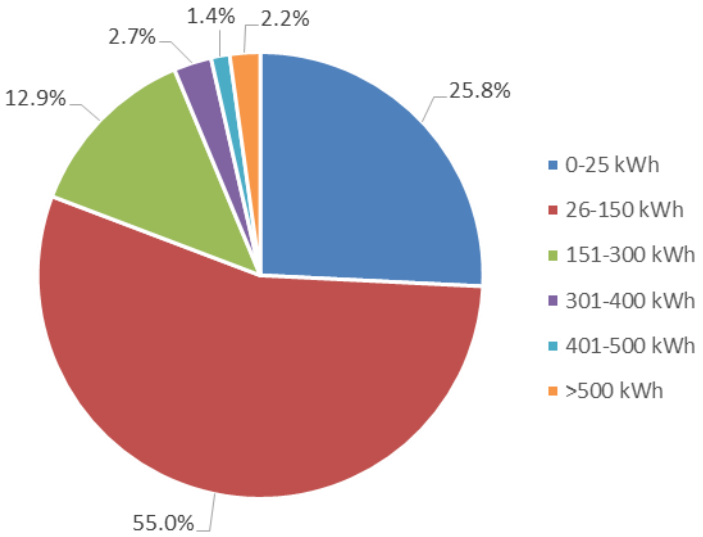


Figure 12: % Share of EdL's Residential Customers by Tariff Category

The average monthly electricity bills of the respondents were mapped against the residential monthly electricity bills, shown in Table 8. It is found that households covered by this study are those consume more than 25 kWh per month, and 40% of the respondent households consume between 151 kWh to 300 kWh (see Figure 13). The field survey team was not able to reach out to small rural households consuming less than 25 kWh per month, due to limitation in accessing to low electricity consumption households during the COVID-19 pandemic.

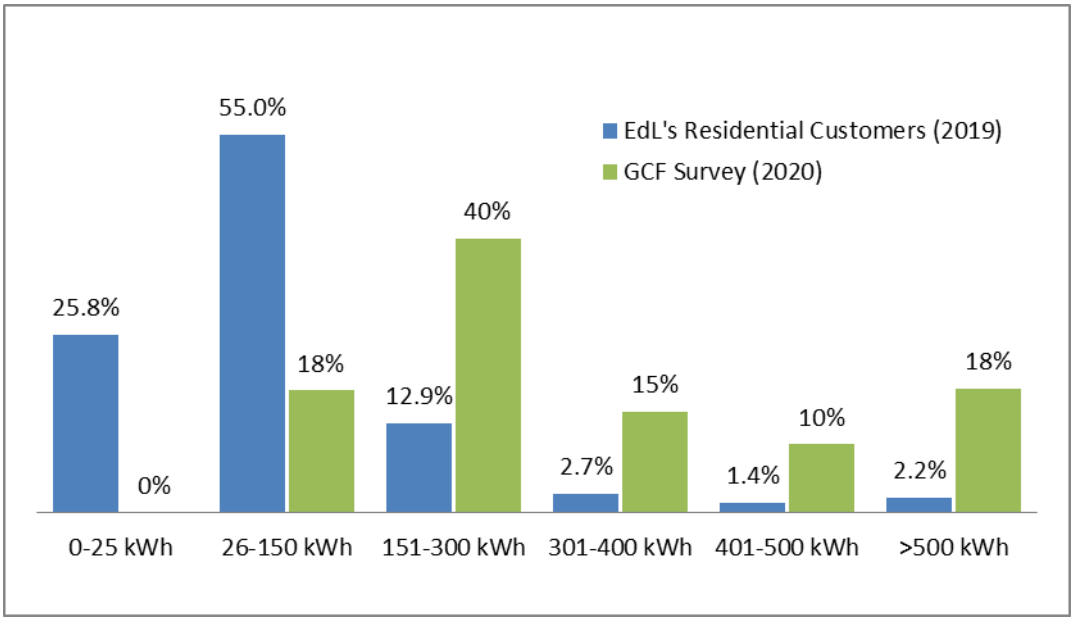


Figure 13: Mapping of Respondents against EdL's Residential Electricity Tariff

It is envisioned that greater distribution of the sample size across all the high consumption categories would result in higher overall ownership rates of electrical appliances as compared with the ownership rates reported by PHC 2015 and LSIS 2018. To mitigate the impact of this uneven distribution, the overall ownership and saturation rates of each type of lighting products and household appliances will be normalized with number of EdL's residential customers in each tariff category. The normalized results will be subsequently discussed in more details in a dedicated section for each lighting product/appliance.

2.2.2 Appliance Retailers/Shops

The surveys interviewed a total of 125 appliance retailers/shops. 83% of which are located in urban areas, and 64% are family businesses (see Figure 14). It is should be noted that appliance shops in rural areas are small businesses run by families or individuals.

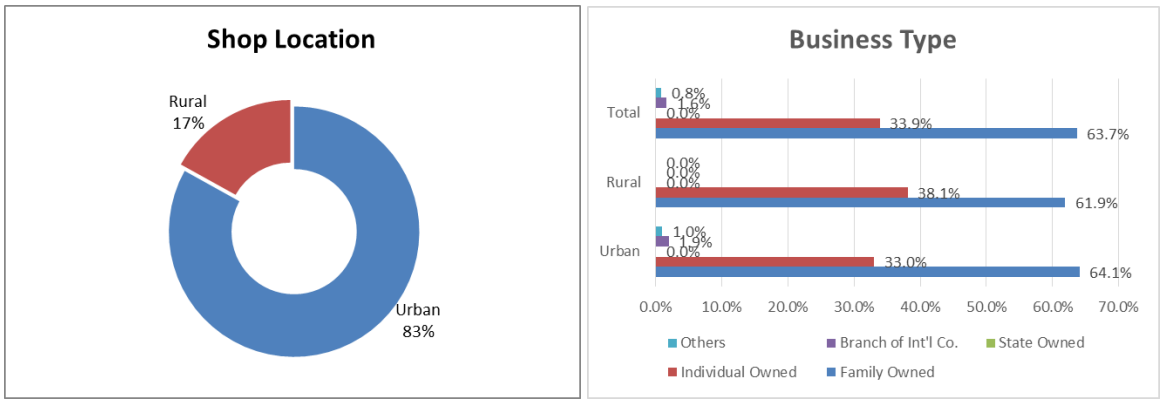


Figure 14: Location of Appliance Shops and Business Type

Overall almost 80% of the surveyed shops employ not more than 5 employees, especially those in rural areas (96%). Nearly half of the shop respondents declined to reveal information about their annual turnovers (Figure 15).

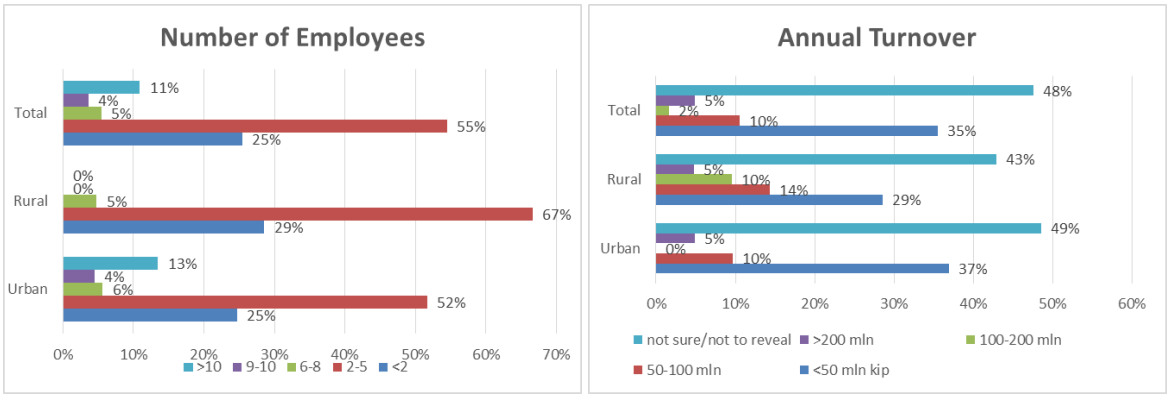


Figure 15: Number of Employees and Annual Turnover of the Survey Shops

2.3 APPLIANCE OWNERSHIP AND SATURATION

In this study, appliance ownership refers to the share of households owning one or more type of appliance while saturation refers to the quantity of given appliance per household. Analyses of appliance ownerships and saturation by type of appliances are discussed below.

2.3.1 Lighting Products

2.3.1.1 Lighting Product Ownership and Saturation

Figure 16 shows ownership levels of different lighting technologies used in Lao households. Fluorescent lamps (tube and circular) are the most common lighting technologies among Lao households with the ownership rate of 70%, followed by LED (34%). Note that utilization of incandescent lamps is still common among Lao households with an ownership rate of about 18%. When comparing these ownership rates of lighting technologies with the MECON project surveys, it can be seen that LED lighting products have become more popular among Lao households, while the ownership rates of other lighting technologies declined. However, fluorescent tubes are still the most popular lighting technologies among households in Lao PDR.

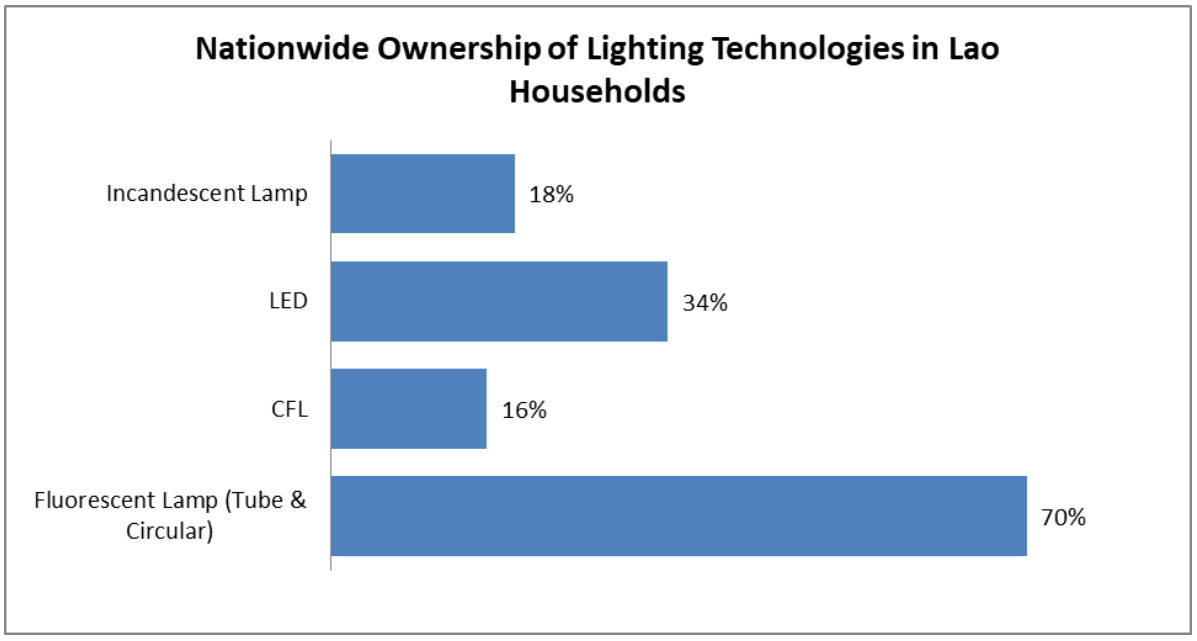


Figure 16: Household Ownerships of Different Lighting Products

It is estimated that each Lao household has 8.4 light points, with combination of 4.3 fluorescent lamps (tubes and circular), 2.5 LED lamps (bulbs, tubes and downlight), 1 CFL and 0.6 incandescent lamp (see Figure 17).

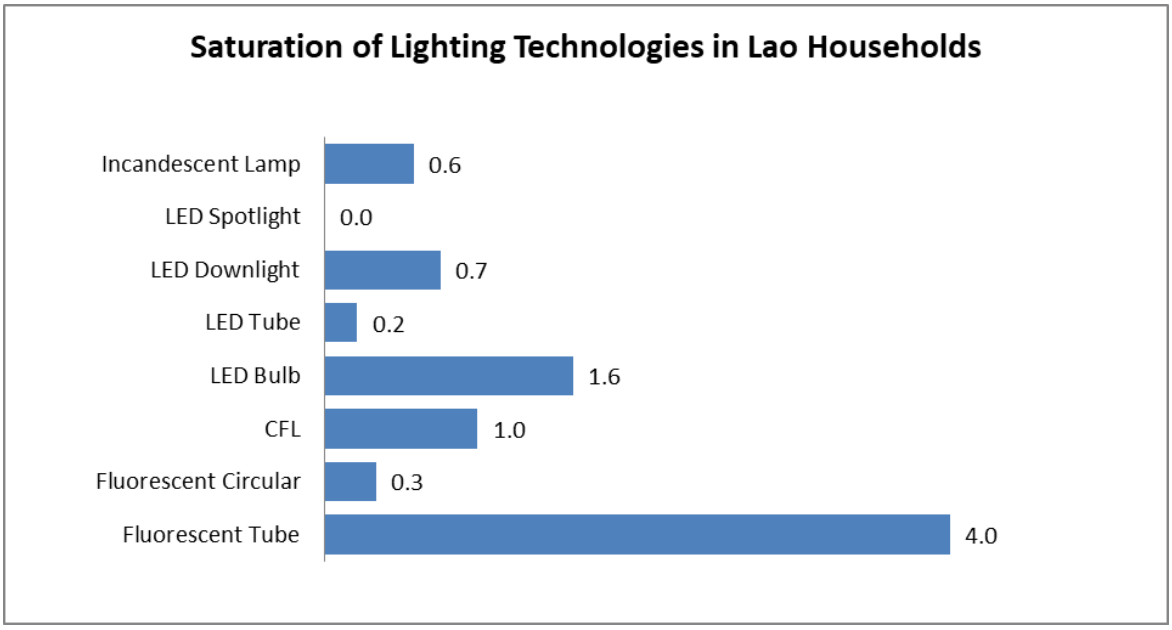


Figure 17: Saturation of Different Lighting Technologies in Lao Households

Figure 18 illustrates number of light points for each key lighting technology by household electricity consumption. It is clear that LED lighting technologies have become common lighting technologies among Lao households, and adoption of different LED lighting technologies (bulb, tube, downlight and spotlight) has already surpassed the use of CFLs. Combined lighting points of LED bulbs and downlights are even higher than fluorescent tubes in Lao households consuming more than 301 kWh/month. However, adoption of LED tubes among Lao households consuming up to 150 kWh per month is still limited.

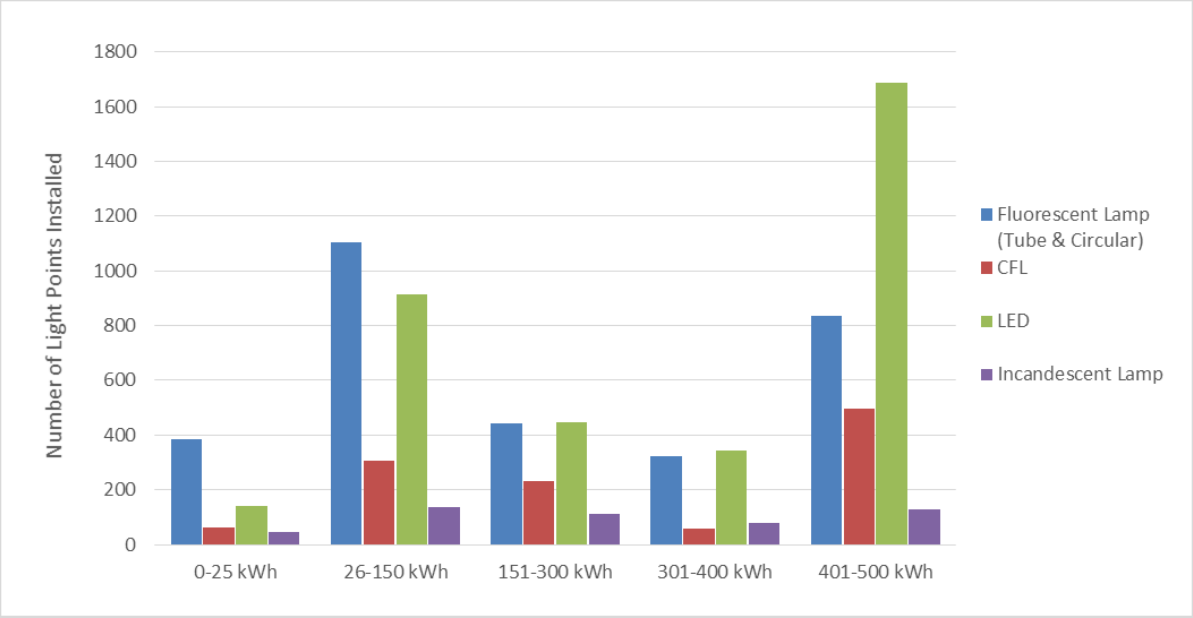


Figure 18: Popular Lighting Technologies by Household Electricity Consumption

In terms of typical lamp wattages, incandescent lamps used by Lao households are between 31 to 40 watts. As for fluorescent lamps, the most popular wattages are those between 20 to 40 watts which typically include 4-foot (1,200 mm) fluorescent tube lamps and 32 watts circular lamps. For CFLs, high wattage CFLs (>17 watts) appear to be more popular than lower wattage lamps. LED lamps are more diverse than other lighting technologies, and 8 to 10 watts are the most popular wattages for LED bulbs and downlight, while the common wattages of LED tubes are over 15 watts which again can be related to 4-foot LED tubes.

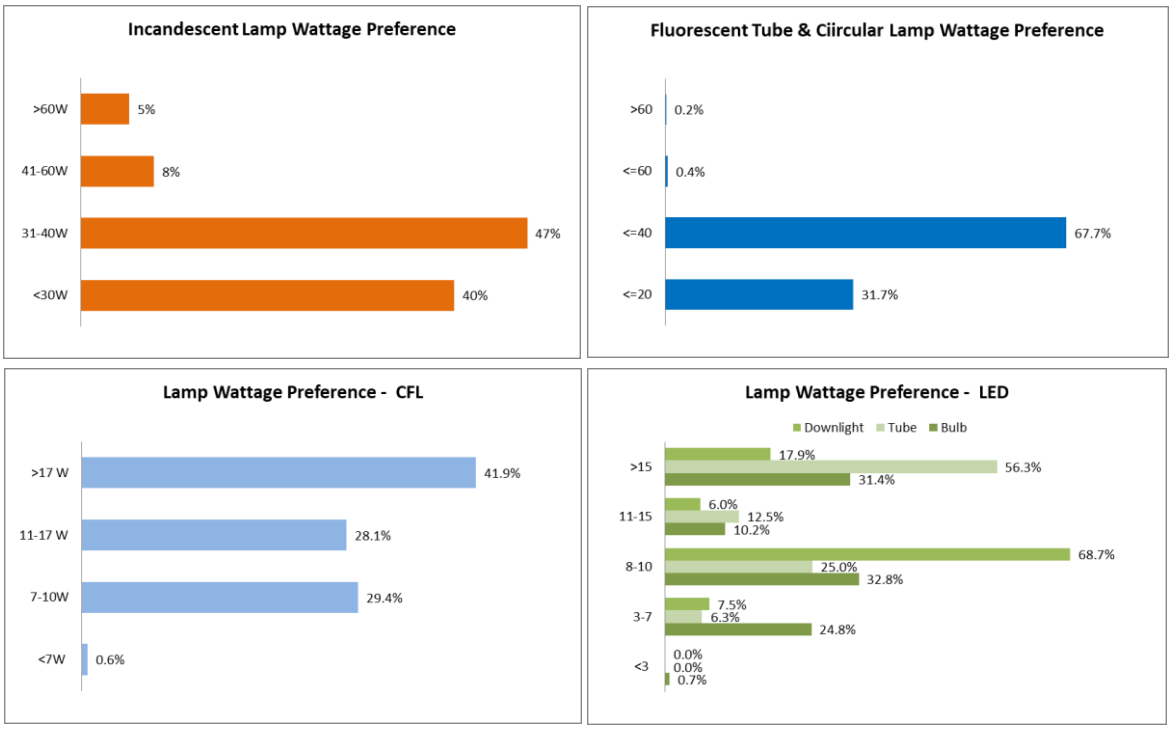


Figure 19: Lamp Wattage Preference in Lao Households

2.3.1.2 Residential Lamp Stock

Based on the saturation of lighting technologies in each residential tariff category, the residential lamp stock in Lao PDR is about 12 million lamps. Fluorescent tube is the most popular lighting technology among Lao households, accounting for about 47% of the total residential lamp stock or about 5.6 million lamps. LED bulb is the second most popular, accounting for about 19% or about 2.23 million lamps, followed by CFLs with 12% (about 1.4 million lamps).

Table 9: Residential Lamp Stock

Technology	Stock (2020)	%
Fluorescent Tube	5,601,243	47%
Fluorescent Circular	463,603	4%
CFL	1,373,418	12%
LED Bulb	2,227,311	19%
LED Tube	296,358	3%
LED Downlight	1,043,120	9%

Technology	Stock (2020)	%
LED Spotlight	3,103	0.03%
Incandescent Lamp	806,129	7%
Total	**11,814,286**	100%

2.3.2 Air Conditioners

2.3.2.1 AC Ownership and Saturation

Virtually all air conditioners (ACs) in Lao households are split unit ACs. According to the reports published by LSB, household ownership of ACs in Lao PDR increased from 7.6% in 2015 (PHC 2015) to 10.1% in 2017 (LSIS II 2017). Household ownership and saturation of ACs by residential electricity tariff category based on the 435 household respondents in this survey are shown in Figure 20. Ownership and saturation of ACs in Lao households varies depending on monthly electricity consumption data which is likely to be correlated with household income.

More than 66% of households consuming more than 300 kWh per month have more than one ACs. , High electricity consumption households consuming more than 500 kWh per month have more than 3 ACs per household. However these high consumption households account for about 39% of all EdL's residential customers, while those household with lower ownership and saturation rates and electricity consumption less than 300 kWh per month account for about 61% of the total residential customer. Normalization of the ownership and saturation rates of each tariff category with the total residential customer results in a nationwide ownership level of 19.7% and a saturation rate of 0.33 units of AC per household.

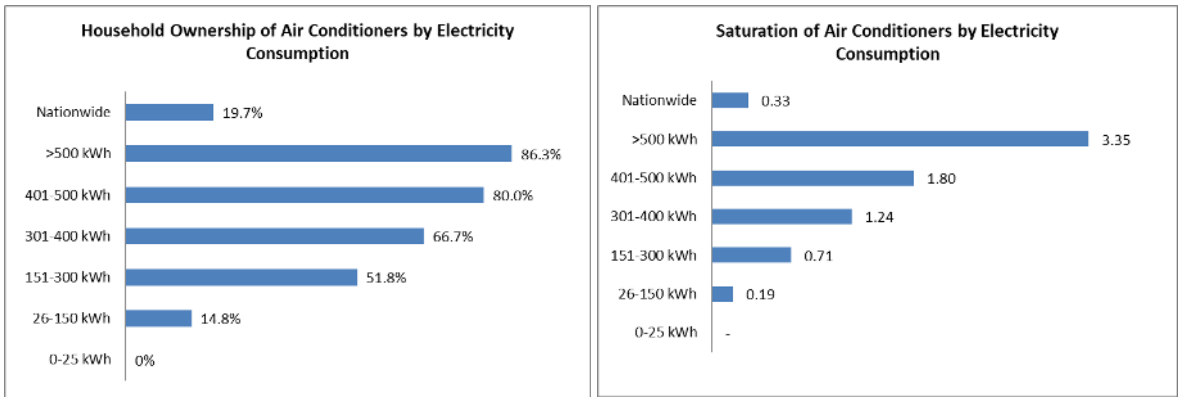


Figure 20: Household Ownership and Saturation of Air conditioners

Table 10 compares AC ownership data reported by the previous survey in Lao PDR, and nationwide household ownership of ACs have increased from 7.6% in 2015 to 10.1% in 2017, and recently reached 19.7% in 2020. It should be noted that PHC 2015 and LSIS II 2017 are the nationwide survey with large sample size, but this GCF funded survey covered much smaller sample sizes which could lead to greater uncertainties. However the GCF survey provides additional insights on how AC technologies are used among Lao households with different levels of electricity consumption.

Table 10: Comparison of AC Ownership Data reported by different Household Surveys

Household Location	PHC (2015)	LSIS II (2017)	This Survey (2020)
Urban	11.4%	25.9%	65%
Rural	1.5%	2.5%	32%
Nationwide	**7.6%**	**10.1%**	**19.7%**

Based on the GCF survey findings, the most popular rated cooling capacities of ACs reported by the respondent households are about 12,000 BTU/hr (or about 3.5 kW), and the second most popular are 9,000 BTU/hr (or about 2.6 kW). These two popular rated cooling capacities account for 87% of all ACs installed in the respondent households.

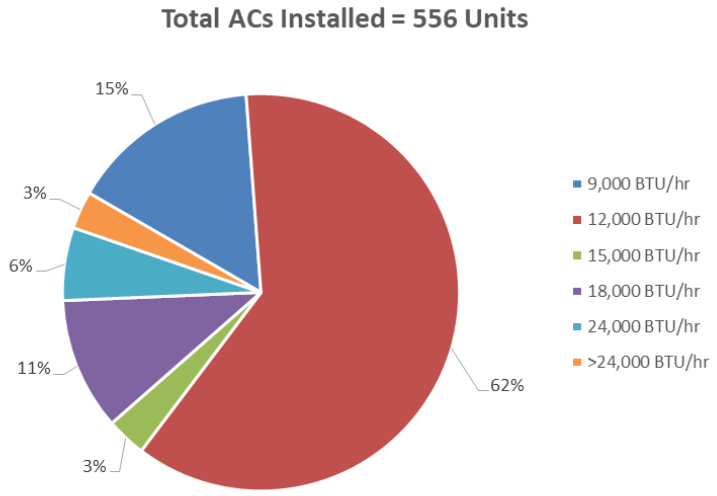


Figure 21: Popular Rated Cooling Capacities of Air conditioners in Lao Households

Figure 22 shows distribution of AC cooling capacities across different levels of electricity consumption by respondent households, and it can be seen that 12,000 BTU/hr ACs are the most popular cooling capacities among Lao households. Although variety of AC cooling capacities can be found in high electricity consumption households, number of 12,000 BTU/hr ACs is still higher than number of all other cooling capacities combined.

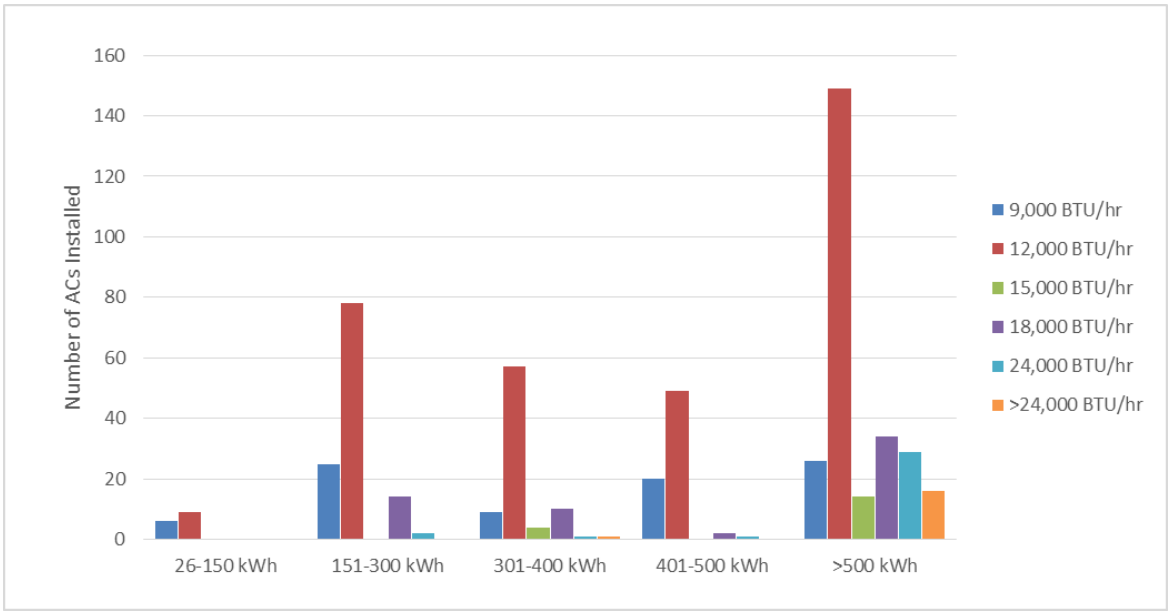


Figure 22: AC Cooling Capacities by Electricity Consumption Level

In terms of AC technologies (i.e., fixed speed and variable speed compressors or inverter), fixed speed ACs are still common among Lao households, accounting for about 80% of ACs installed in the respondent households. Ownerships of inverter ACs are only reported by households consuming more than 150 kWh per month.

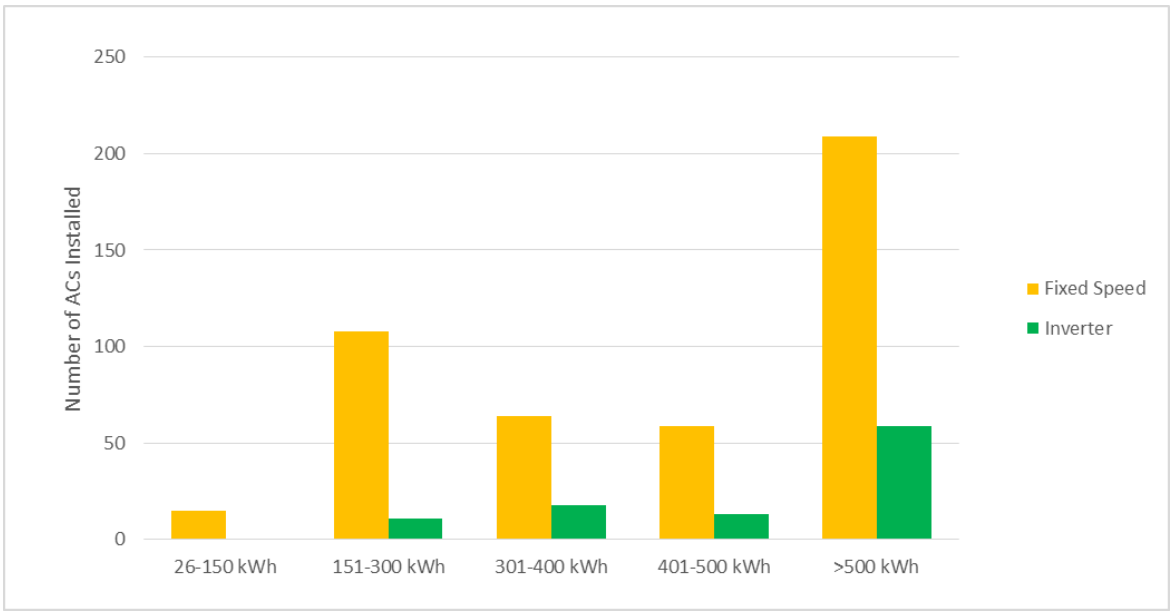


Figure 23: Adoption of AC Technologies in Lao Households

2.3.2.2 Residential AC Stock

Based on findings on nationwide ownership and saturation of ACs in Lao households, it is estimated that the residential AC stock in Lao PDR was about 457,000 units in 2020. 9,000 and 12,000 BTU/hr

ACs account for about 86% of the total residential ACs, and adoption of inverter ACs among Lao households is still low at only about 11% (see Figure 24).

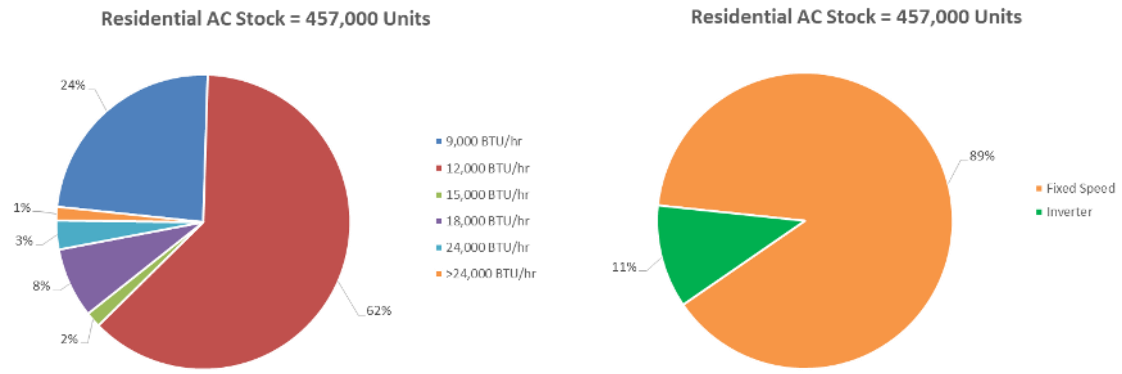


Figure 24: Profiles of Residential AC Stock in Lao PDR

2.3.3 Refrigerator and Freezer

2.3.3.1 Refrigerator/Freezer Ownership and Saturation

Household ownership and saturation of refrigerators and freezers by residential electricity tariff category based on the 435 household respondents are shown in Figure 25. Similar to ACs, ownership and saturation of refrigerators and freezers in Lao households varies depending on monthly electricity consumption data which is likely to be correlated with household income. It should be noted that most refrigerators in Lao households are actually refrigerators with freezer compartments, and most freezers are chest freezers.

Most households captured by this survey have at least one refrigerator, and high electricity consumption households consuming more than 500 kWh per month have about 1.5 refrigerators per households. Although most of the household respondents have refrigerators, those Lao households consuming less than 25 kWh are unlikely to own refrigerators and freezers. Considering this, normalization of the ownership and saturation rates in each tariff category with the total residential customer results in a nationwide ownership level of 73% and 18% for refrigerators and freezers respectively. The nationwide saturation of refrigerators is 0.79 unit per household, while that of freezers is 0.06 unit per household.

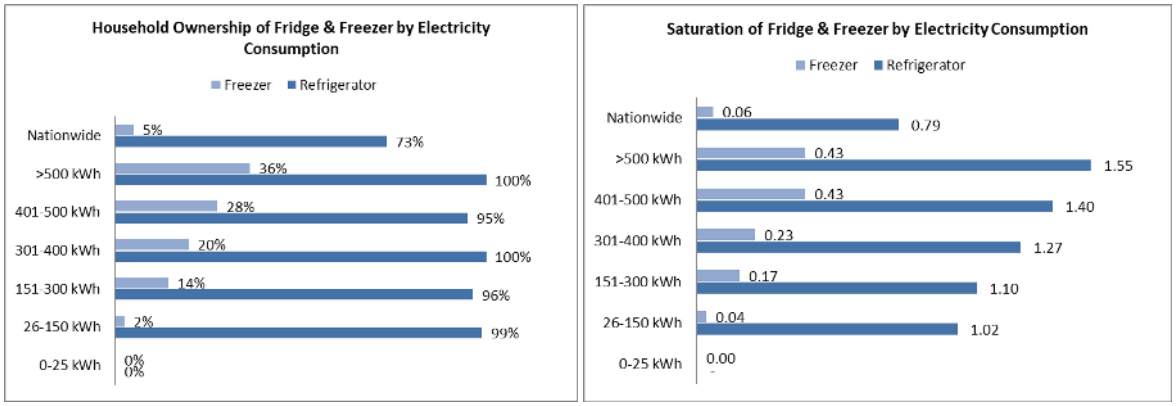


Figure 25: Household Ownership and Saturation of Refrigerators and Freezers

Ownerships of refrigerators in Lao households are relatively high compared with ownership of other large home appliances. Comparison of household ownership of refrigerators reported by the previous surveys and this GCF survey is shown in see Table 11.

Table 11: Comparison of Refrigerator/Freezer Ownership Data reported by different Household Surveys

Household Location	PHC (2015)	LSIS II (2017)	This Survey (2020)
Urban	82.90%	90.10%	99%
Rural	50.40%	53.60%	96%
Nationwide	**59.10%**	**65.40%**	**73.1%**

There are two most popular categories of storage volume for refrigerators, i.e., below or equivalent to 6 cubic feet (170 liters), and more than 6 cubic feet up to 10 cubic feet (280 liters). These two popular storage volumes combined account for about 83% of all refrigerators used in the respondent households (see Figure 26). The most popular storage volume of freezers are those between 6 to 10 cubic feet, as shown in Figure 27.

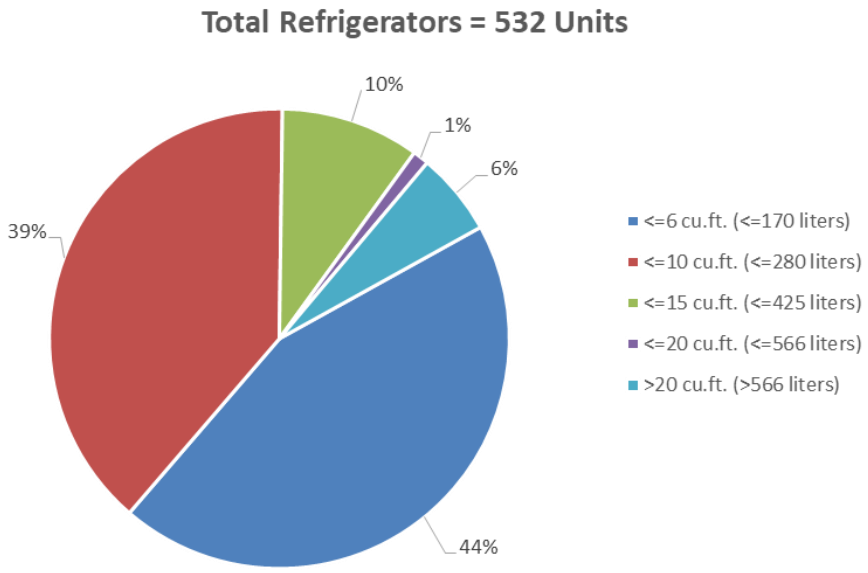


Figure 26: Popular Storage Volumes of Refrigerators in Lao Households

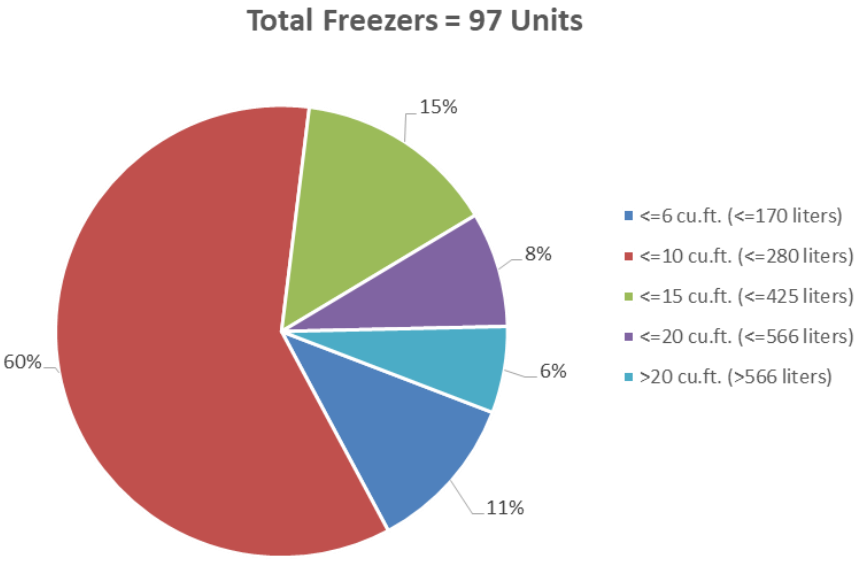


Figure 27: Popular Storage Volumes of Freezers in Lao Households

Figure 28 and Figure 29 show distribution of refrigerator storage volumes across different levels of electricity consumption by respondent households. Refrigerators with storage volumes up to 10 cubic feet (about 280 liters) are popular across all electricity consumption levels. As for freezers, those with storage volume from 6 cubic feet (170 liters) up to 10 cubic feet are the most popular sizes among Lao households.

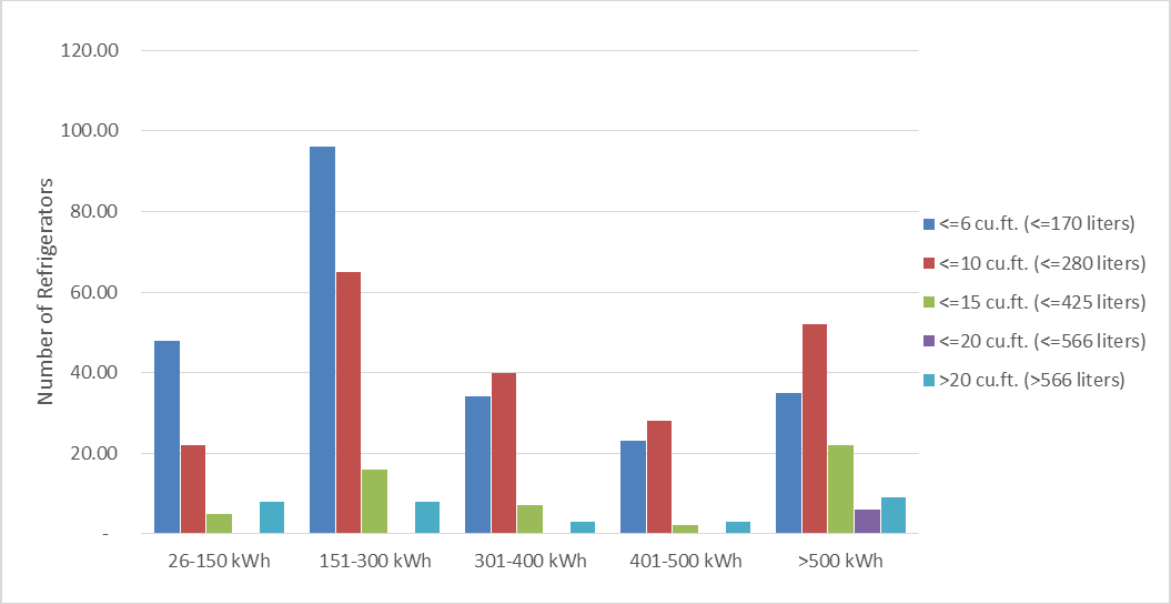


Figure 28: Refrigerator Storage Volumes by Electricity Consumption Level

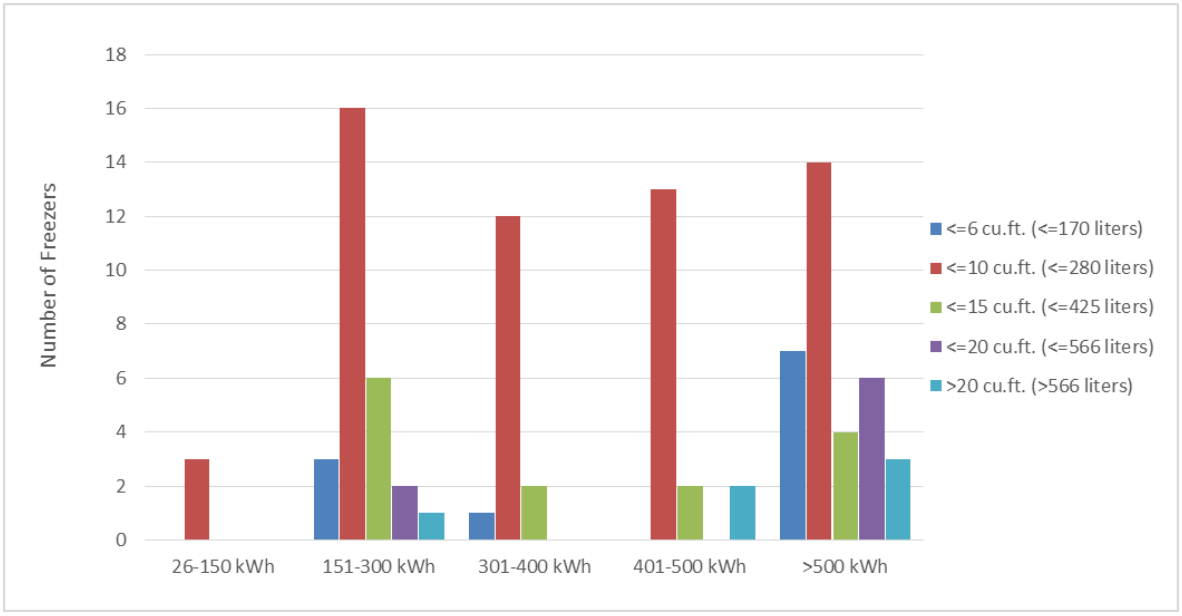


Figure 29: Freezer Storage Volumes by Electricity Consumption Level

In terms of compressor technologies (i.e., fixed speed and variable speed compressors or inverter) for refrigerators and freezers, fixed speed compressors are still common among Lao households, accounting for more than 85% of refrigerators and freezers used in the respondent households.

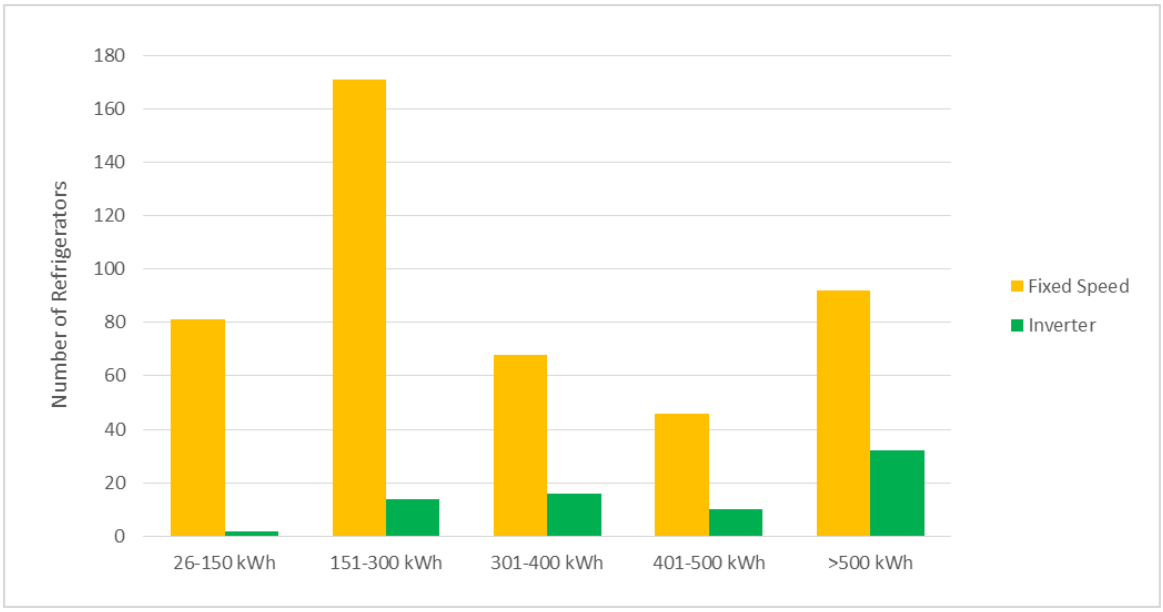


Figure 30: Technologies of Refrigerators in Lao Households

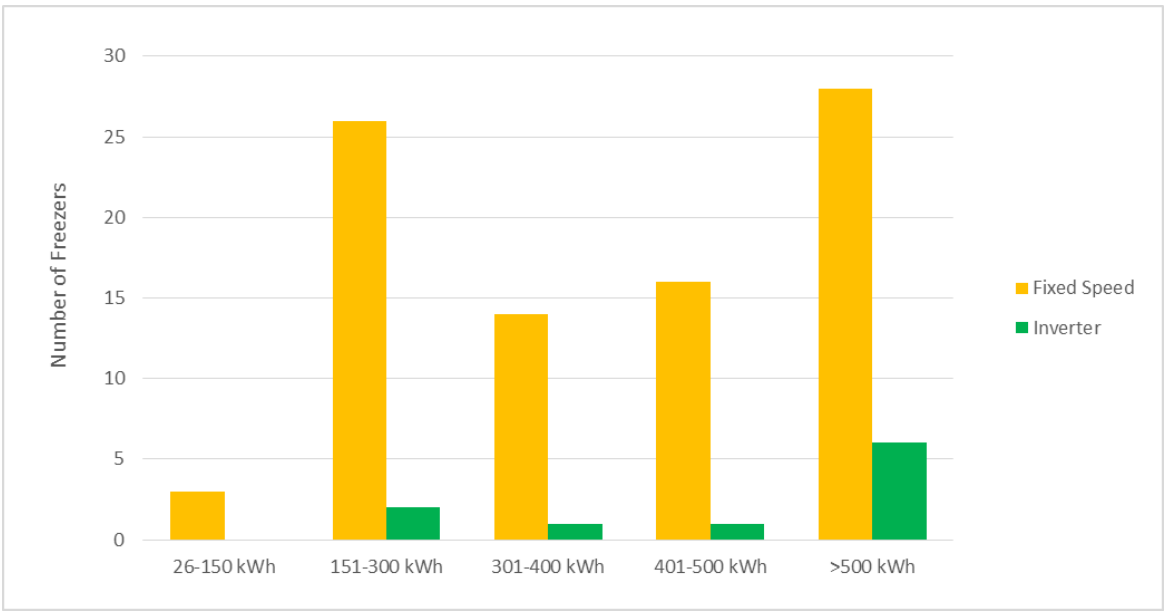


Figure 31: Technologies of Freezers in Lao Households

2.3.3.2 Residential Refrigerator/Freezer Stock

It is estimated that the residential refrigerator stock in Lao PDR was about 1.1 million units in 2020, and the residential freezer stock was about 89,000 units in the same year. Refrigerators with storage volumes up to 10 cubic feet (280 liters) accounted for about 85% of the total stock in 2020. While the freezer stock is dominated those with storage volumes from 6 up to 10 cubic feet. Majority of refrigerators and freezers in Lao households are fixed speed models.

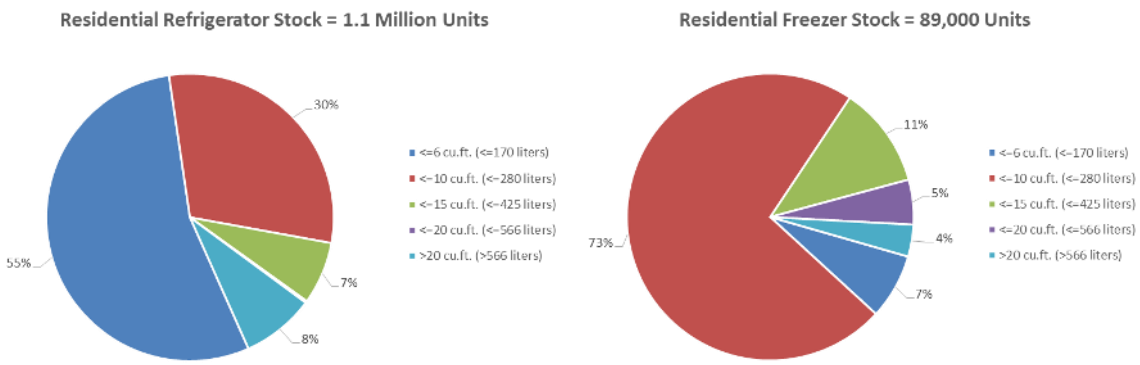


Figure 32: Profiles of Residential Refrigerator and Freezer Stock in Lao PDR

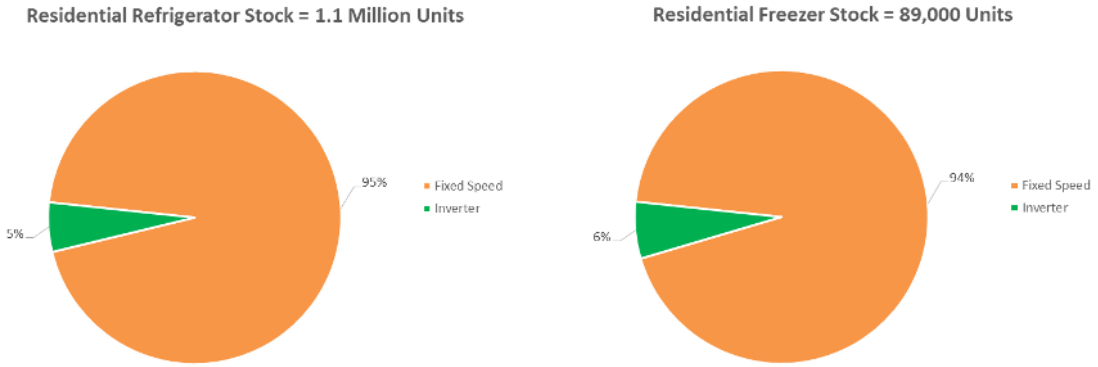


Figure 33: Compressor Technologies of Residential Refrigerator and Freezer Stock in Lao PDR

2.3.4 Electric Fan

2.3.4.1 Electric Fan Ownership and Saturation

Common types of electric fans used in Lao households include portable and fixed installation fans, as shown in Figure 34. Sizes of electric fans in Lao PDR are defined by their blade diameters. Standard design ceiling fans are usually the largest type, with blade diameters of about 48 to 52 inches. Floor standing fans, table fans and wall/ceiling mounted oscillating fans generally have less than 18 inches in blade diameters. Ventilation/exhaust fans are usually small in blade diameters, about 6 to 10 inches. In terms of blade designs and types of electric motors, portable electric fans (floor standing fans and table fans) and wall/ceiling mounted oscillating fans are similar, and measurement of energy performance of these similar designed fans can be undertaken with the same instrument set up and measurement procedures.

Figure 34: Common Types of Electric Fans in Lao Households

Ownerships of electric fans among the surveyed households vary depending on types of electric fan, as shown in Figure 35. The four most popular types of electric fans in the surveyed households include table fan, exhaust fan, wall/ceiling mounted oscillating fan, and floor standing fan, with the nationwide ownership rates of 42%, 27%, 25% and 25% respectively. With these nationwide ownership rates, it is clear that portable fans (i.e., table and floor standing fans) are the most popular types of electric fans among Lao households.

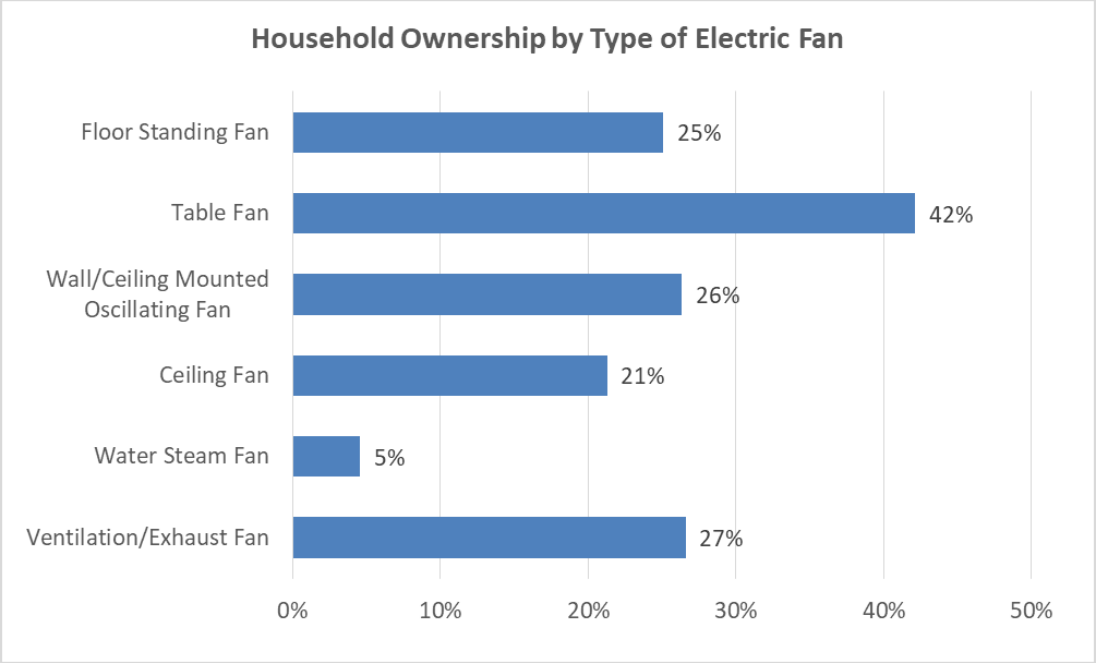


Figure 35: Household Ownership of Electric Fans by Household Location

Shown in Figure 36 are nationwide saturations by type of electric fan which are in line with the household ownership rates. It is found that there are at least one portable fan in each Lao household. Although ventilation/exhaust fans in Lao households have high saturation rate of 0.88 units per household, their usage are unlikely to impact the household energy consumption due to their low rated power consumption, and short operating hours.

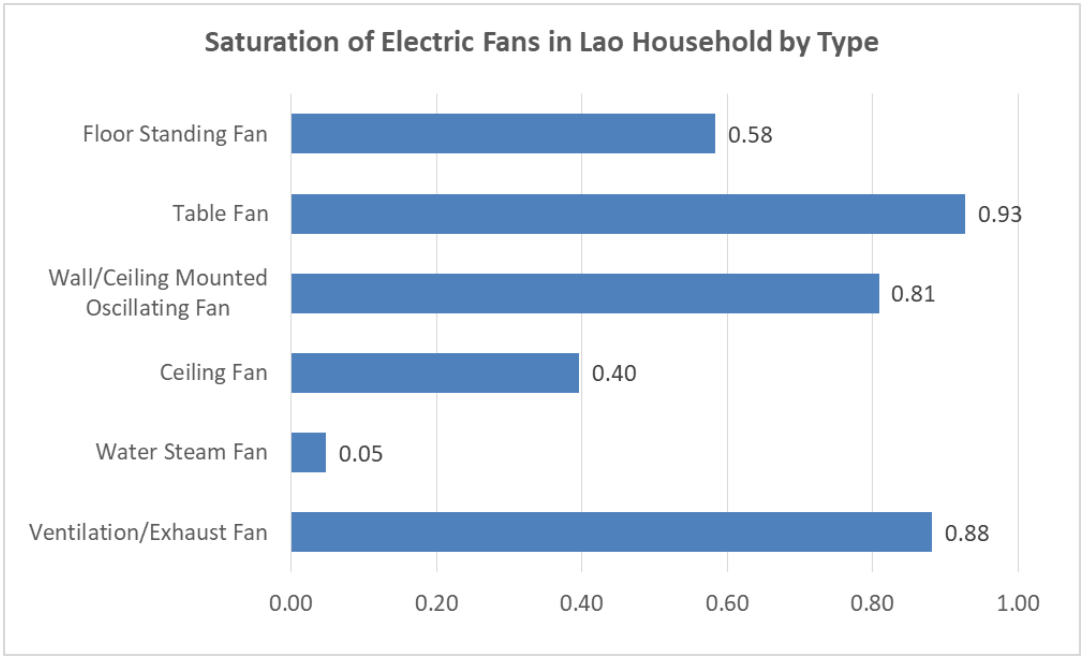


Figure 36: Saturation of Electric Fans in Lao Households

Findings from the surveyed households in terms of popular sizes of different types of electric fans are shown in Figure 37, Figure 38, Figure 39 and Figure 40. It clear that electric fans are the basic choices of cooling appliances for Lao households, especially those with monthly electricity consumption from 151 kWh to 300 kWh. 10 to 12 inches portable fans (table and floor standing fans) and wall/ceiling mounted oscillating fans are the most popular sizes among the surveyed households.

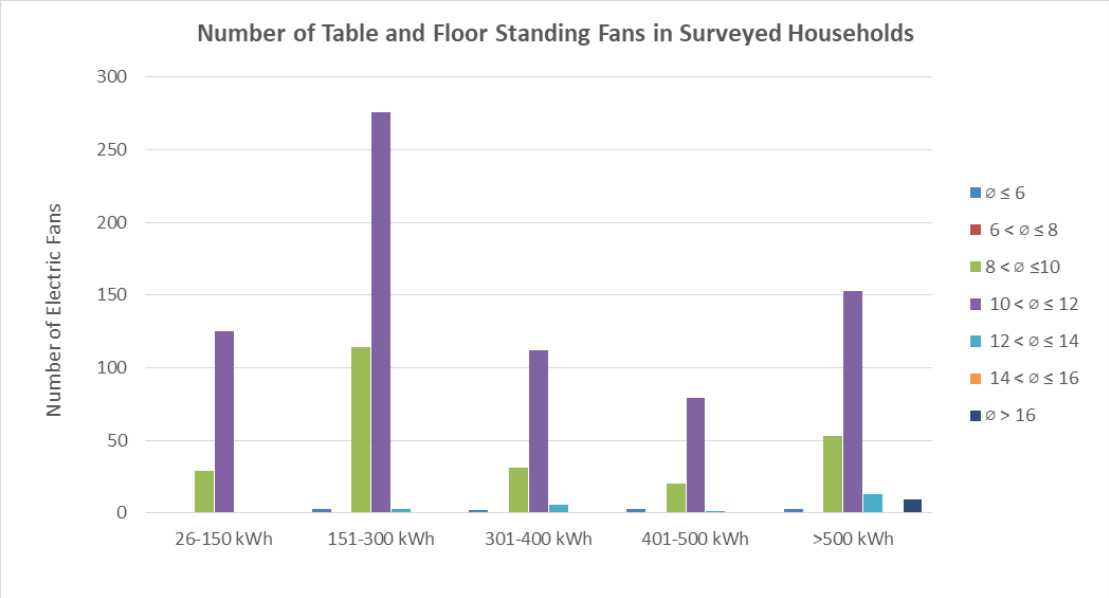


Figure 37: Popular Sizes of Table and Floor Standing Fans

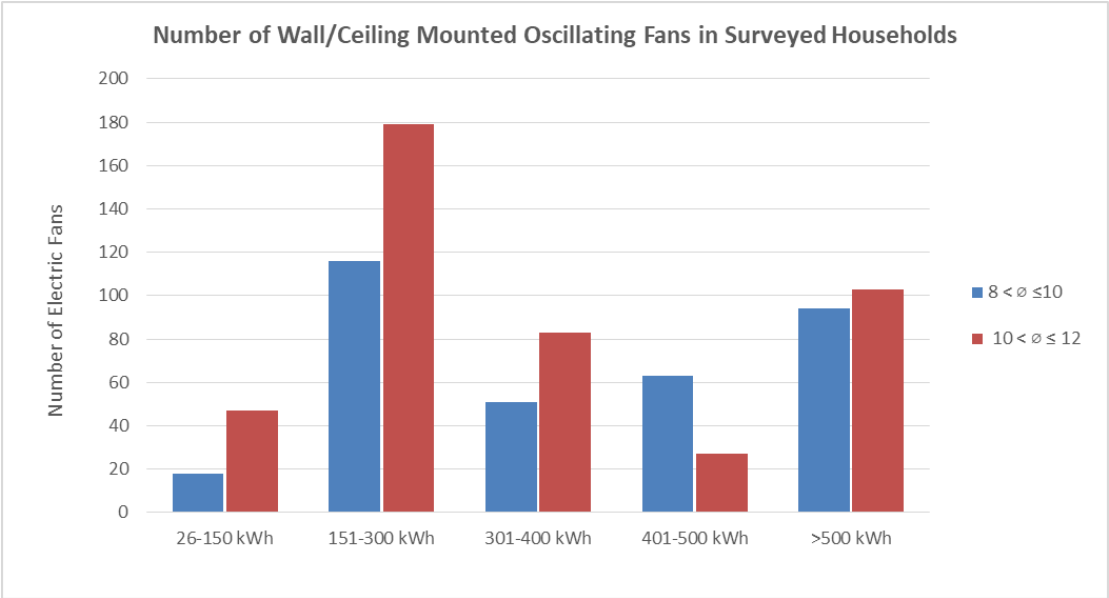


Figure 38: Popular Sizes of Wall/Ceiling Mounted Oscillating Fans

The most popular sizes of ceiling fans are those between 50 to 60 inches, and the second most popular are between 50 to 60 inches.

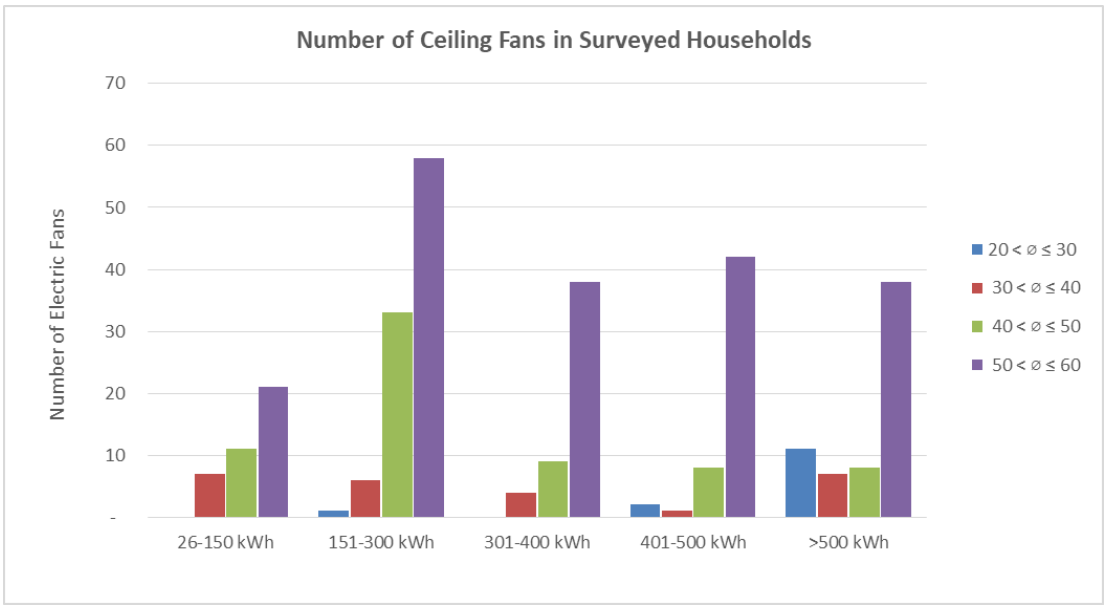


Figure 39: Popular Sizes of Ceiling Fans

Most of ventilation/exhaust fans are between 6 to 12 inches. High electricity consumption households with monthly electricity consumption more than 500 kWh have more of this type of electric fans.

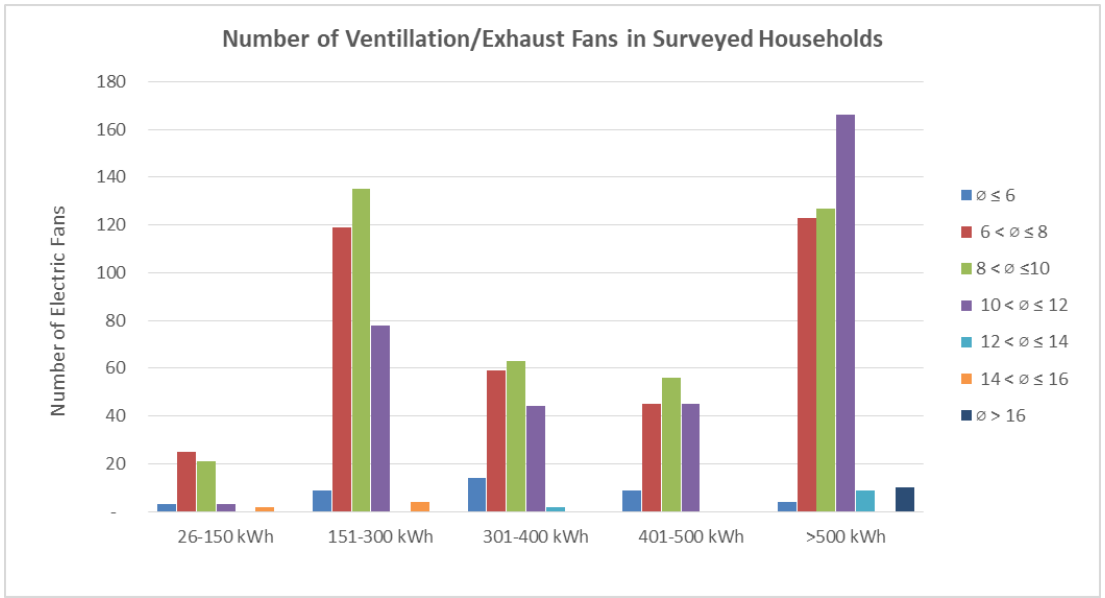


Figure 40: Popular Sizes of Ventilation/Exhaust Fans

2.3.4.2 Residential Electric Fan Stock

It is estimated that the residential electric fan stock in Lao PDR was about 5.1 million units in 2020. About 42% of the estimated stock (or about 2.1 million units) are portable fans (table and floor

standing fans). Ventilation/exhaust fans and wall/ceiling mounted oscillating fans account for about 24% (about 1.2 million units) and 22% (about 1.1 million units) respectively. Ceiling fans account for only about 11% of the estimated stock (about 550,000 units).

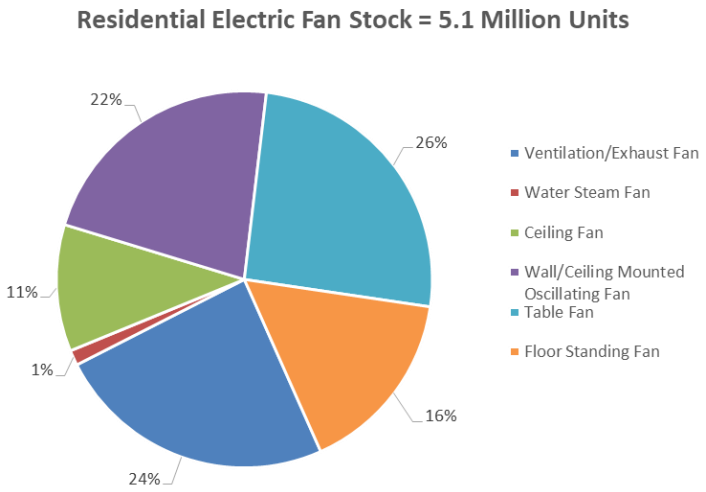


Figure 41: Profiles of Residential Electric Fan Stock in Lao PDR

2.3.5 Television

2.3.5.1 Television Ownership and Saturation

The respondent households reported more than 95% ownerships of televisions (TVs) in all tariff categories, and, on average, each respondent household owns more than one TV. Without surveyed data for low electricity consumption households (≤ 25 kWh/month), the nationwide TV ownership rate is estimated at 71%, and the nationwide saturation rate is about 0.9 unit per household (see Figure 42). It is envisioned that the estimated nationwide ownership and saturation rates will be higher if surveyed data from low electricity consumption households is included.

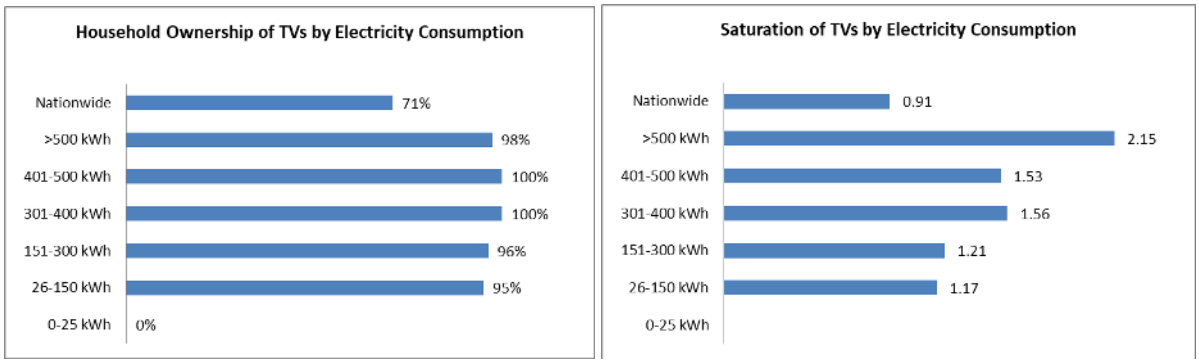


Figure 42: Household Ownership and Saturation of Televisions

As shown in Figure 43, adoption of flat TVs among the respondent households has surpassed the Cathode Ray Tube (CRT) type TV (or commonly referred to as "Box" TVs in Lao PDR) in almost all tariff

categories, except for the low consumption category (26-150 kWh per month) where more numbers of box TVs are still in use.

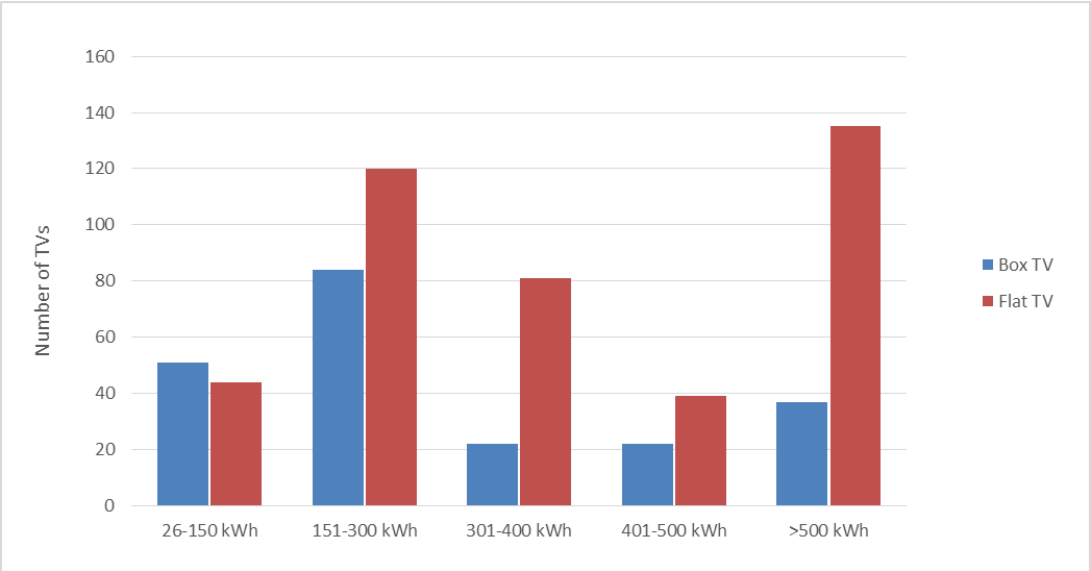


Figure 43: Types of TV reported by Respondent Households

Figure 44 and Figure 45 show popular screen sizes of TVs in the respondent households. Box TVs generally have screen sizes between 21 to 30 inches, while flat TVs have larger screen sizes between 31 to 40 inches. The survey results reveal that Lao households spend less time watching TVs, and they indicated that smart phone and social media are now the main sources for news and information.

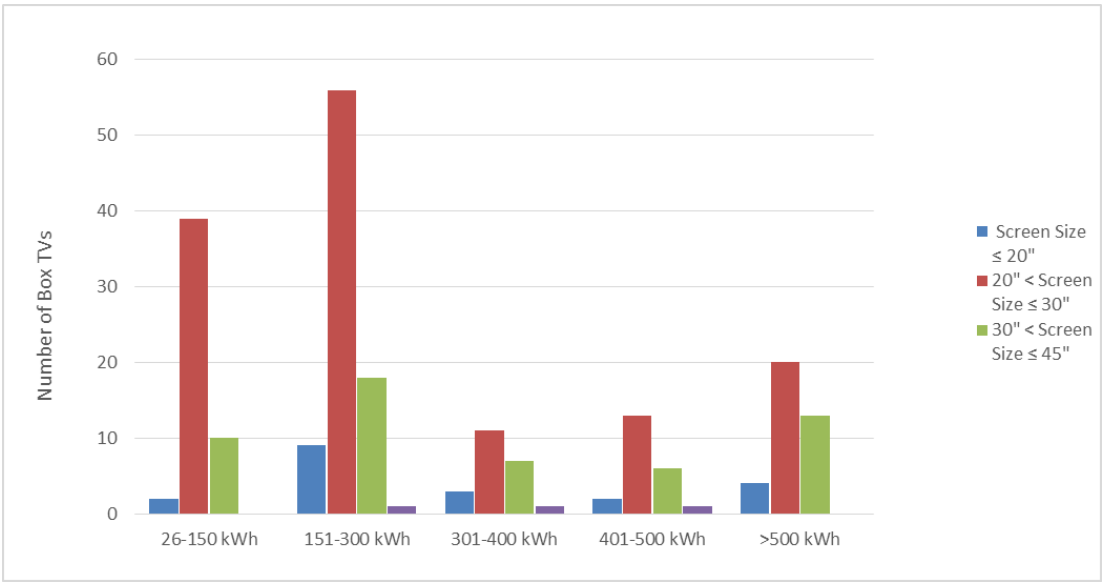


Figure 44: Popular Screen Sizes of Box TVs

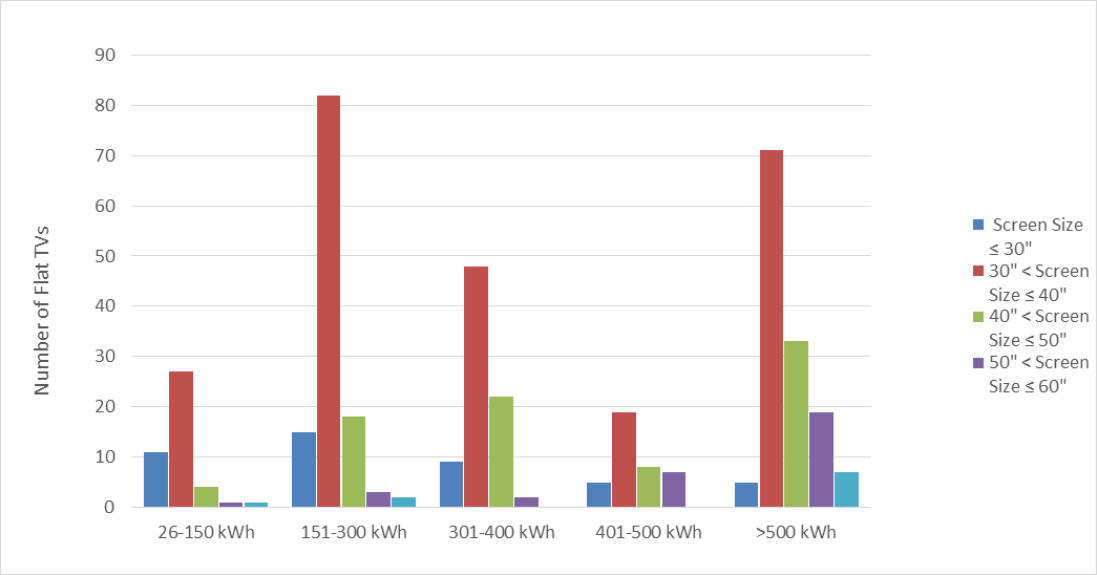


Figure 45: Popular Screen Sizes of Flat TVs

2.3.5.2 Residential Television Stock

It is estimated that the residential TV stock in Lao PDR was about 1.3 million units in 2020. About 52% of the estimated stock (or about 670,000 units) are flat TVs.

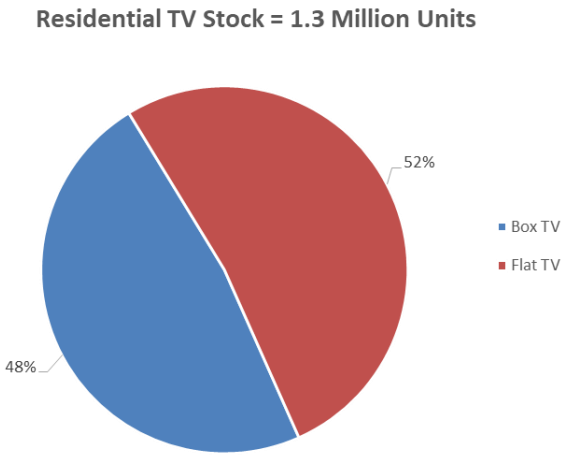


Figure 46: Profiles of Residential TV Stock in Lao PDR

2.3.6 Washing Machine

2.3.6.1 Washing Machine Ownership and Saturation

Household ownership and saturation of washing machines by residential electricity tariff category are shown in Figure 47. Similar to other large appliances (e.g., ACs and refrigerators/freezers), ownership and saturation of washing machines in Lao households varies depending on monthly electricity

consumption data which is likely to be correlated with household income. Most high electricity consumption households consuming more than 400 kWh per month have at least one washing machine per households, and household ownerships of washing machines in these two tariff categories are about 95%. About half of households consuming between 26 to 150 kWh have washing machines. Normalization of the ownership and saturation rates in each tariff category with the total residential customer results in the nationwide ownership and saturation rates of washing at 45% and 0.47 unit per household respectively.

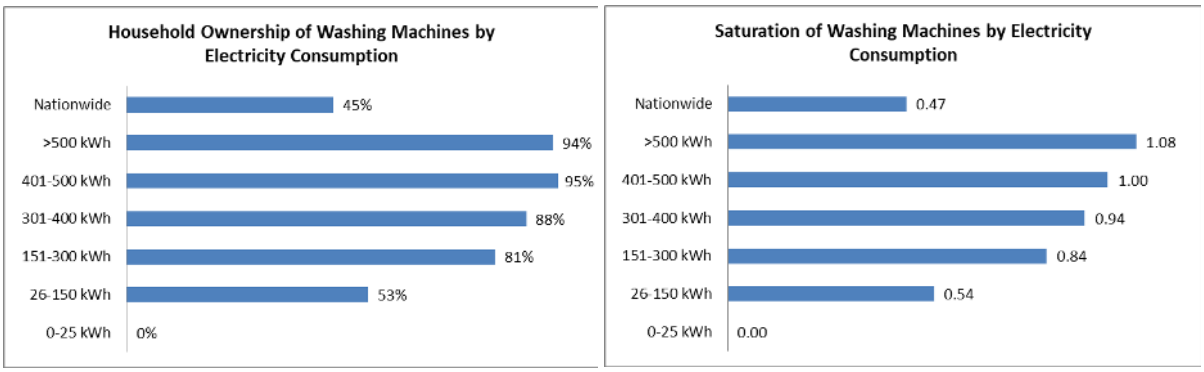


Figure 47: Household Ownership and Saturation of Washing Machines

The most popular capacity range for washing machines in Lao households are from more than 10 kg. up to 15 kg. washing capacities, accounting for slightly more than half of the units reported by the respondent households (see Figure 48). The second and third most popular capacity ranges are from 8 kg. up to 10 kg., and those below or equivalent to 8 kg.

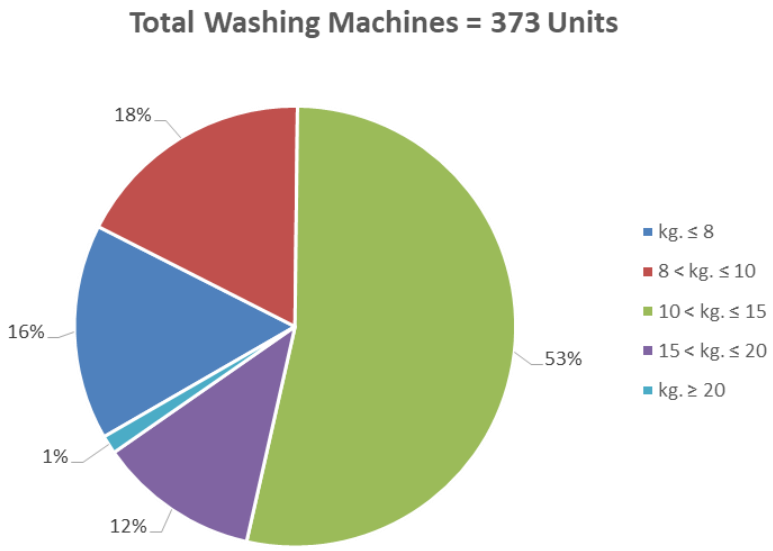


Figure 48: Popular Capacities of Washing Machines in Lao Households

Figure 49 shows distribution of washing capacities across different levels of electricity consumption by the respondent households, and those from more than 10 kg. up to 15 kg. are the most popular ranges across of the tariff categories.

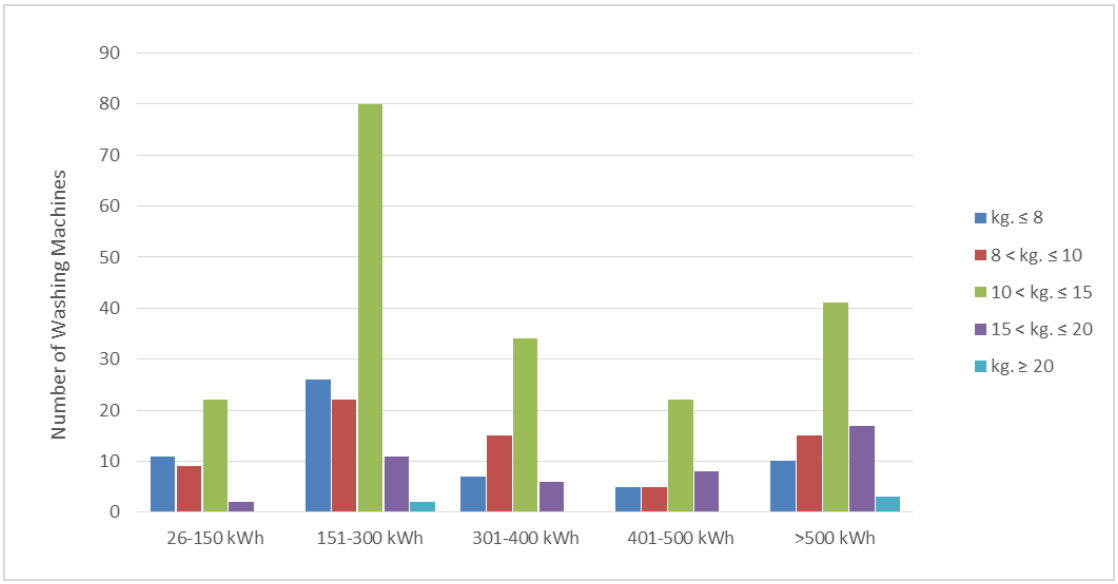


Figure 49: Refrigerator Storage Volumes by Electricity Consumption Level

In terms of motor control technologies (i.e., fixed speed and variable speed control for motors used in washing machines), fixed speed washing machines still dominate washing machine technologies, accounting for about 88% used in the respondent households.

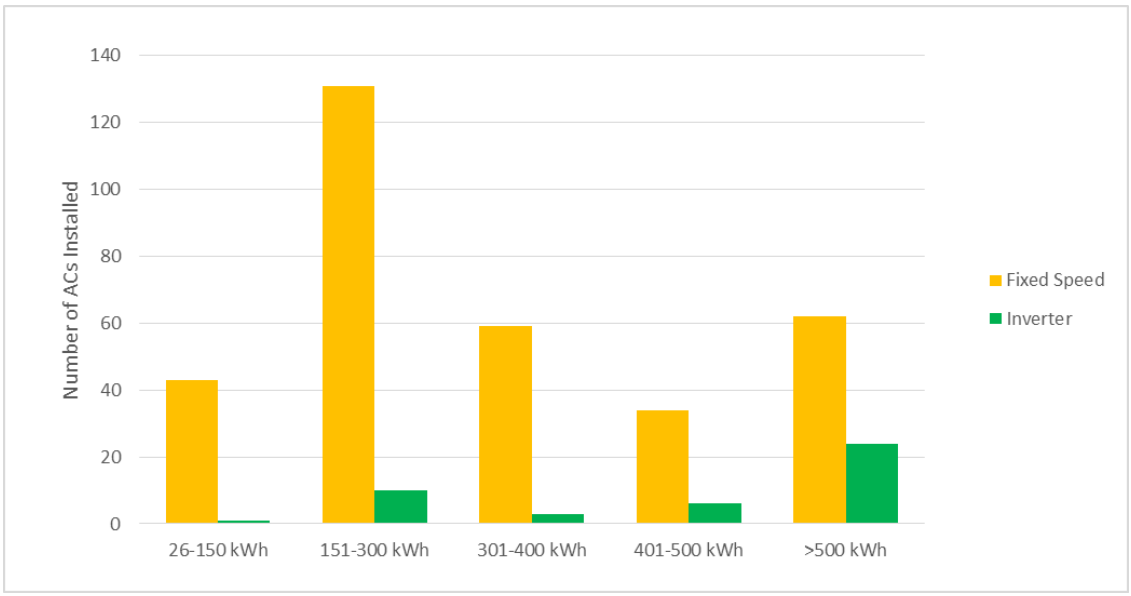


Figure 50: Technologies of Refrigerators in Lao Households

2.3.6.2 Residential Washing Machine Stock

Based on findings on nationwide ownership and saturation of washing machines in Lao households, it is estimated that the residential washing machine stock in Lao PDR was about 659,000 units in 2020. Washing machines with capacity more than 10 kg. up to 15 kg account for about 52% of the total stock, followed by capacity up to 8 kg. (22%), and capacity more than 8 kg. up to 10 kg. (19%). Adoption of inverter washing machines among Lao households is still low at only about 5% (see Figure 24).

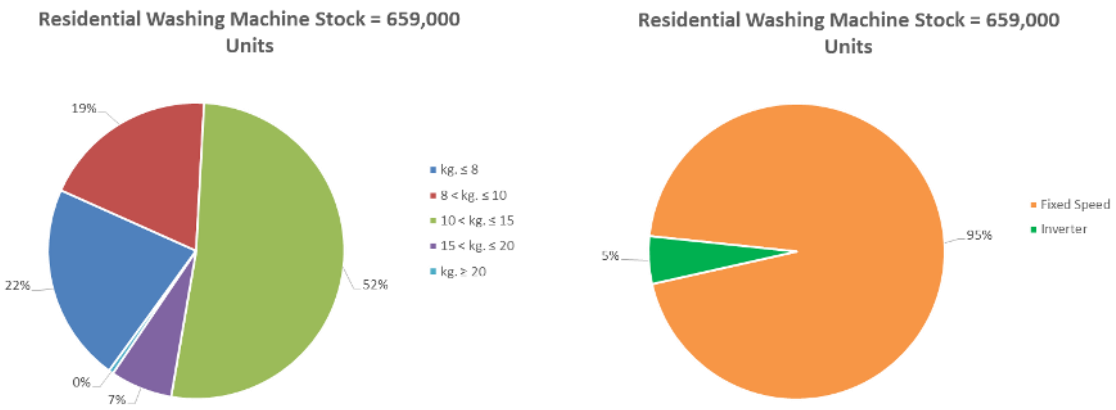


Figure 51: Profiles of Residential Washing Machine Stock in Lao PDR

2.3.7 Rice Cooker

2.3.7.1 Rice Cooker Ownership and Saturation

Household ownerships of rice cookers are more than 85% across all residential electricity tariff categories, as shown in Figure 52. However normalized nationwide ownership and saturation rates for rice cookers are 66% and 0.71 unit per household respectively. The lower ownership and saturation rates are due to lack of respondent households in the 0-25 kWh/month category, as it is very likely that households in this tariff would own rice cookers. It is envisioned that the nationwide ownership and saturation rates would increase if the survey was able to capture adequate household samples in this tariff category.

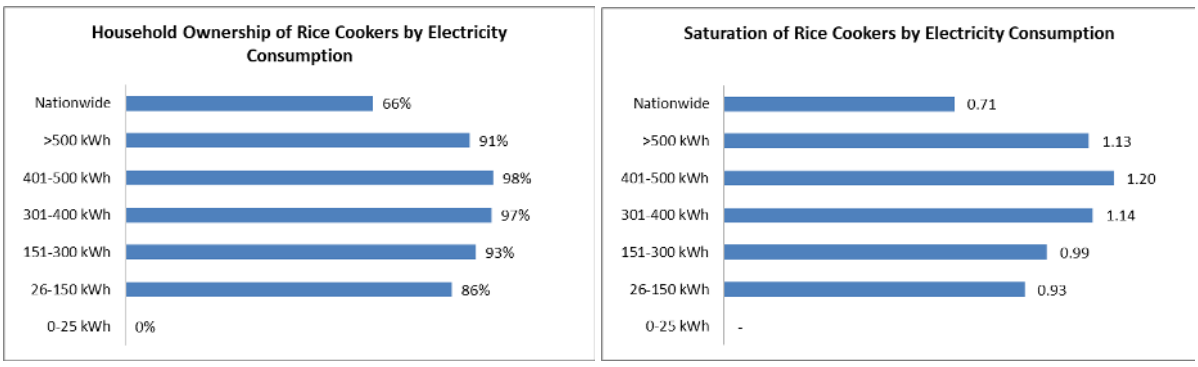


Figure 52: Household Ownership and Saturation of Rice Cooker

Most rice cookers (95%) owned by the respondent households have cooking capacities equivalent to or less than 3 liters (see Figure 53). The most popular capacities range from more than 1 liter up to 2 liters, accounting for 68% of rice cookers in the respondent households, and rice cookers within this range are popular across all tariff categories, as shown in Figure 54.

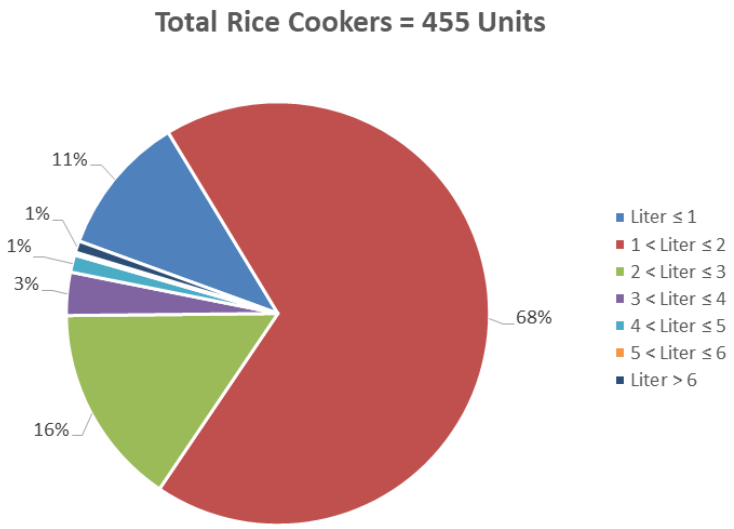


Figure 53: Popular Capacities of Rice Cooker in Lao Households

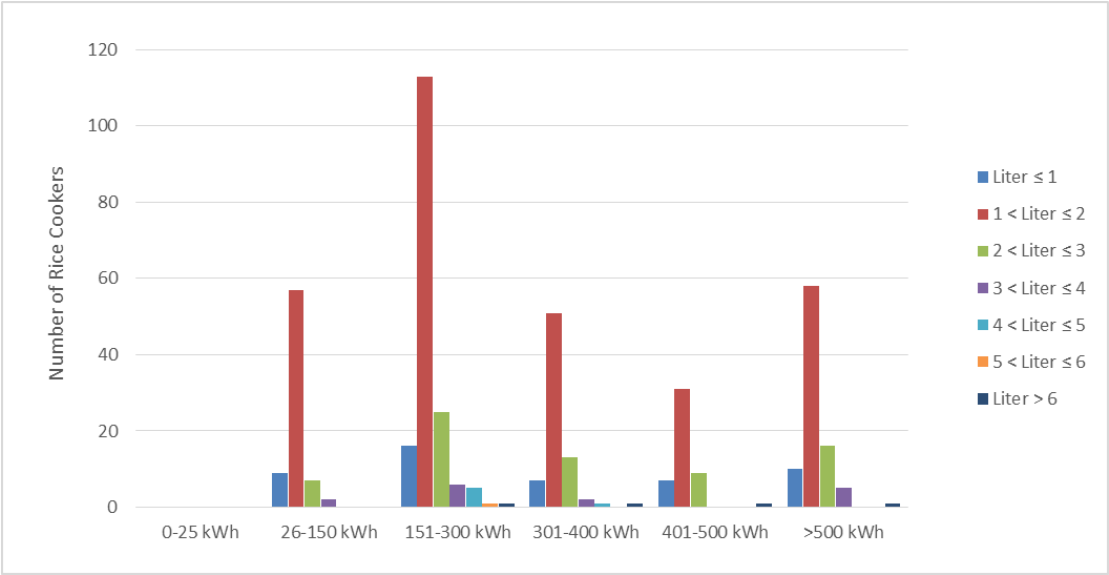


Figure 54: Rice Cooker Capacity by Electricity Consumption Level

2.3.7.2 Rice Cooker Stock

Based on findings on nationwide ownership and saturation of rice cookers in Lao households, it is estimated that the rick cooker stock in Lao PDR was close to 1 million units in 2020, and 74% of which have cooking capacities from more than1 liter up to 2 liters.

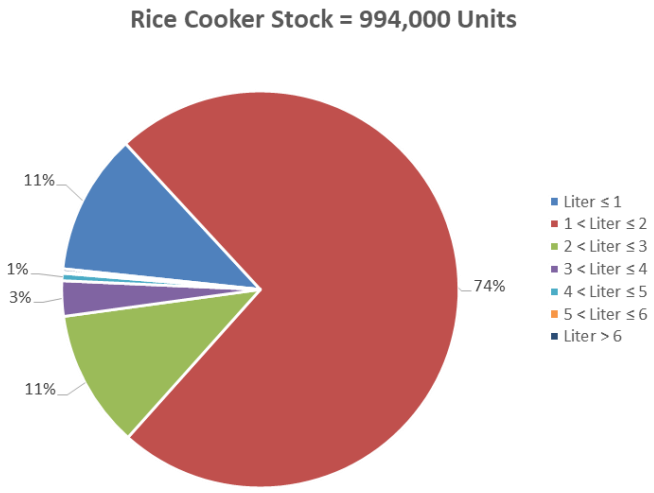


Figure 55: Profiles of Rice Cooker Stock in Lao PDR

2.3.8 Other Household Appliances and Electrical/Electronic Equipment

Ownership and saturation rates of other common appliances and electrical/electronic equipment in the respondent households are summarized in Table 12, and popular appliances and electrical/electronic equipment include electric frying pans, electric kettles, irons and electric water pumps.

Table 12: Ownership and Saturation of Other Appliances and Electrical/Electronic Equipment in Lao Households

No	Appliance/Equipment	Ownership (%)	Saturation (Unit/Household)
1	Electric Frying Pan	56.6%	0.62
2	Iron	47.5%	0.53
3	Electric Kettle	47.1%	0.52
4	Electric Water Pump	35.0%	0.36
5	Notebook	24.8%	0.29
6	Audio/Hi Fi Systems	23.1%	0.27
7	Electric Shower Heater	18.8%	0.19
8	Electric Water Boiler	8.9%	0.09
9	Microwave	5.4%	0.05
10	Vacuum Cleaner	3.4%	0.03
11	Desktop computers	2.8%	0.04

2.4 APPLIANCE RETAIL CHARACTERISTICS

This section summarizes supply characteristics of lighting products and few selected household appliances with high ownership rates among Lao households, including ACs, refrigerators/freezers and electric fans.

2.4.1 Lighting Products

Figure 56 shows the percentage shares of surveyed appliance retailers/shops that sell lighting products in the total surveyed shops (124 appliance shops). Note that 103 shops are in urban areas, while only 21 shops are in rural areas.

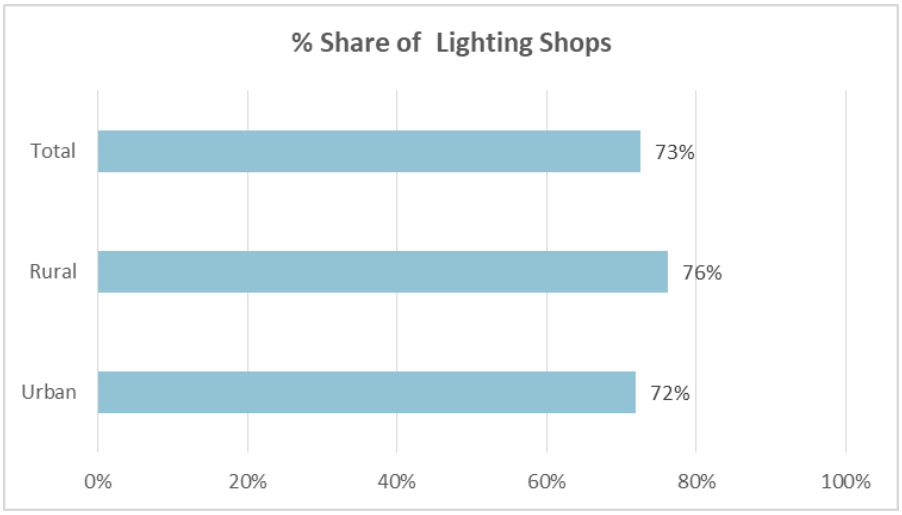
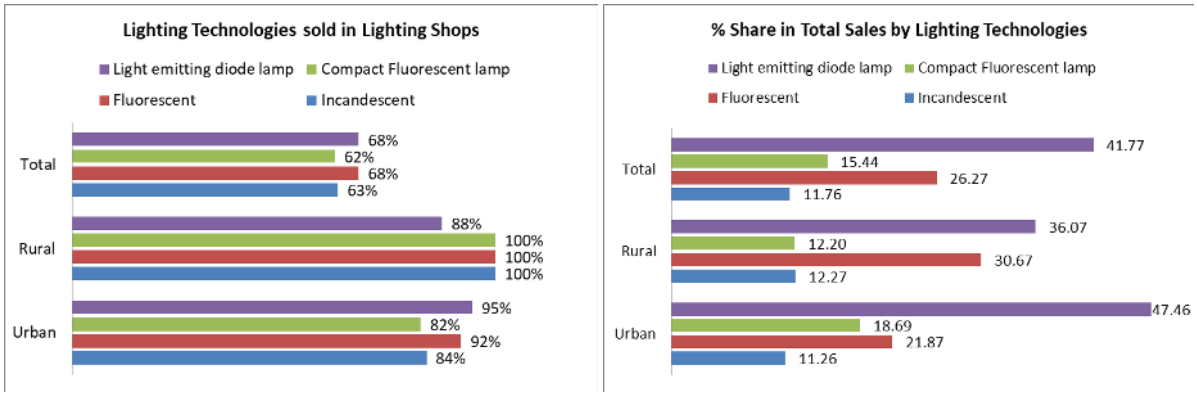


Figure 56: Appliance Shops Selling Lighting Products

Although conventional lighting technologies (incandescent, fluorescent and CFL) can still be found in most lighting shops (Figure 57, a), percentage shares in total sales of these conventional lighting technologies have significantly dropped as compared to LED lighting technologies (Figure 57, b). The surveyed lighting shops reported about 42% of lighting products sold are LED lamps.



(a) (b)

Figure 57: Lighting Technologies Sold and Estimated Shares in Total Sales

Figure 58 summarizes popular lamp wattages sold by the surveyed shops. For each group of lighting technologies, the most popular lamp wattages account for about 40% to 50% of the total sales.

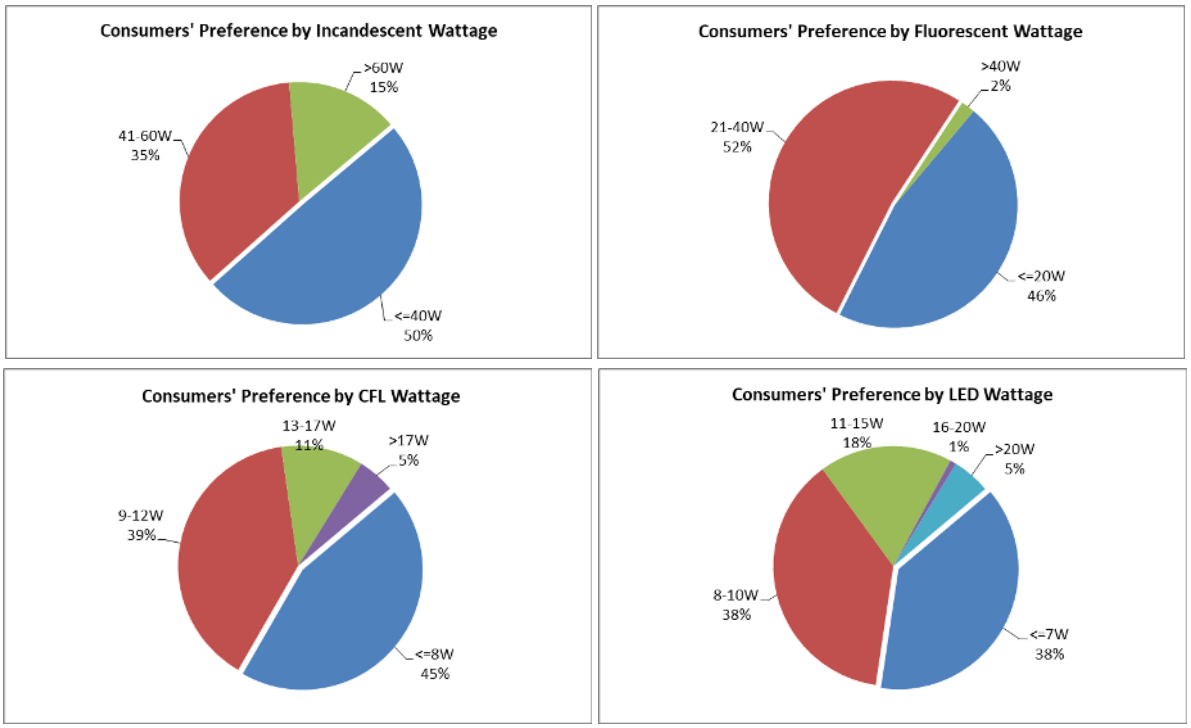


Figure 58: Customers' Preference of Lamp Wattages

2.4.2 Air Conditioner

46% of the surveyed appliance shops (57 out of 124 shops) supply ACs which normally include installation services (Figure 59). In terms of locations, about half of appliance shops in urban areas sell ACs, while only 19% of rural appliance shops sell ACs.

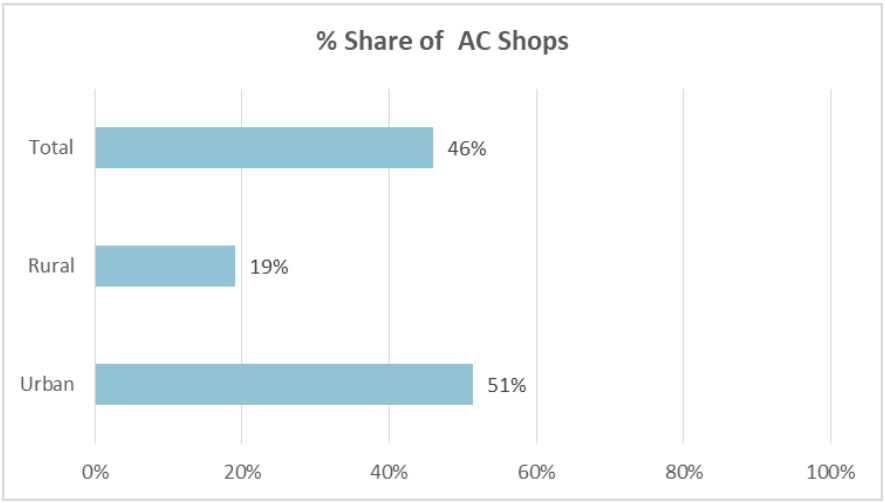


Figure 59: Appliance Shops Selling ACs

The surveyed AC shops reported that most ACs (83%) are sold to residential customers, and the remaining sales are for project customers (for non-residential applications), as shown in Figure 60). Large number of AC units are usually sold per project customer.

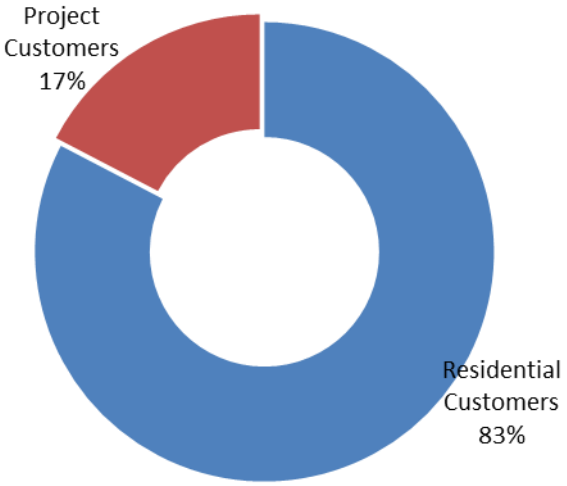


Figure 60: Target Customers for AC Sales

70% of AC shops sell inverter ACs, however sale volumes of inverter ACs reported by the surveyed shops are already still lower than sale volumes of fixed speed ACs. Vientiane capital is the most important AC supply hub in Lao PDR, followed by direct import from Thailand and China.

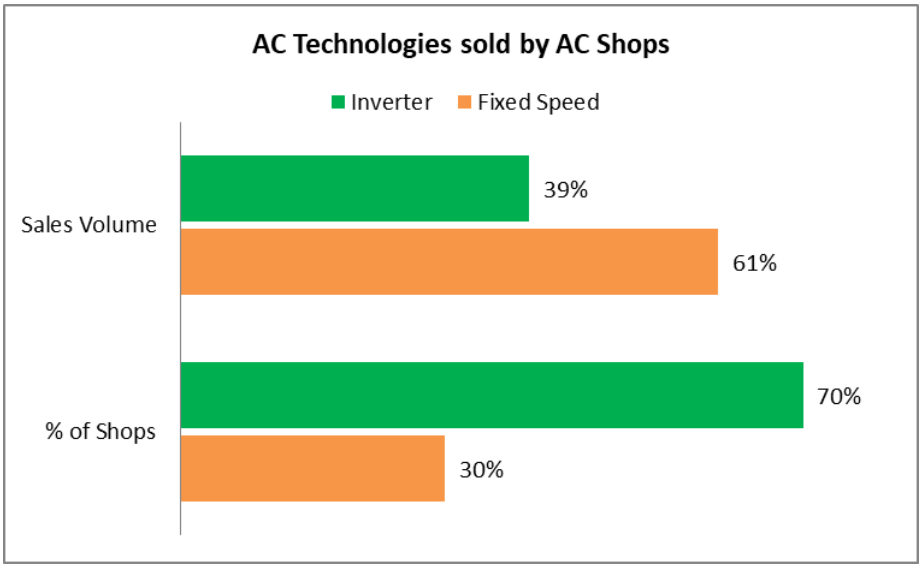


Figure 61: AC Technologies sold by AC Shops

2.4.3 Refrigerator

57 of the total 124 shops (55%) reported selling of refrigerators (52% of rural shops and 45% of urban shops) as shown in Figure 62. Refrigerators with storage volumes between 5-9 cubic feet are the most preferred choices by households in Lao PDR (Figure 63). The surveyed shops also reported that fixed speed compressor refrigerators are still more popular among Lao consumers.

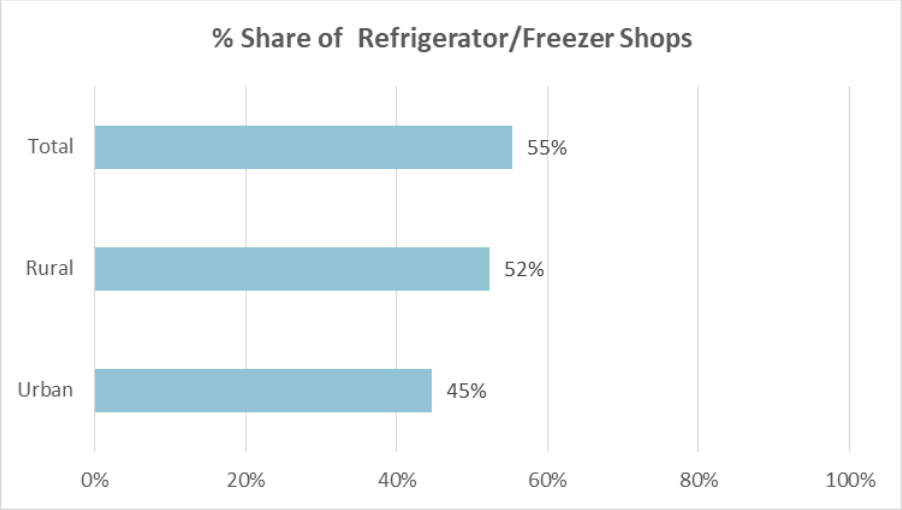


Figure 62: Appliance Shops Selling Refrigerators/Freezers

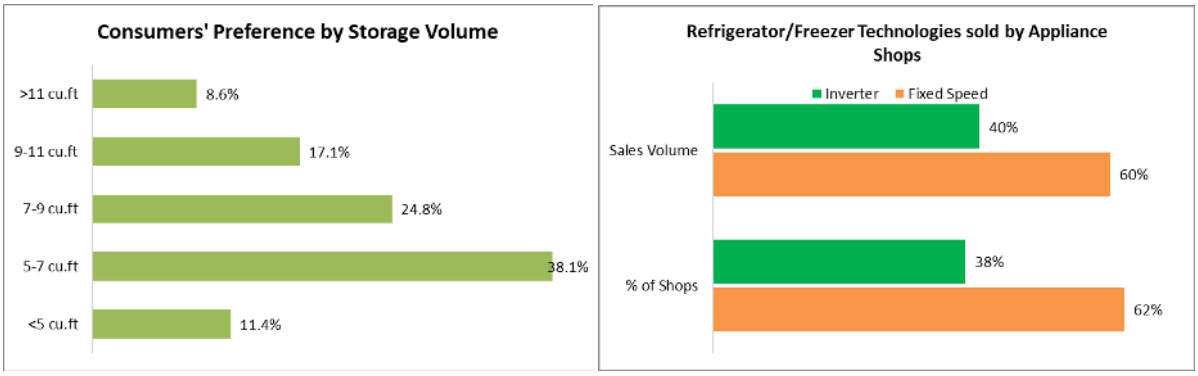


Figure 63: Popular Storage Volumes and Compressor Technologies for Refrigerators

2.4.4 Electric Fan

About 80% of the surveyed shops sell all common types of electric fans used in Lao households, including floor standing fans, ceiling fans, wall mounted fans and ventilation/ exhaust fans (see Figure 64).

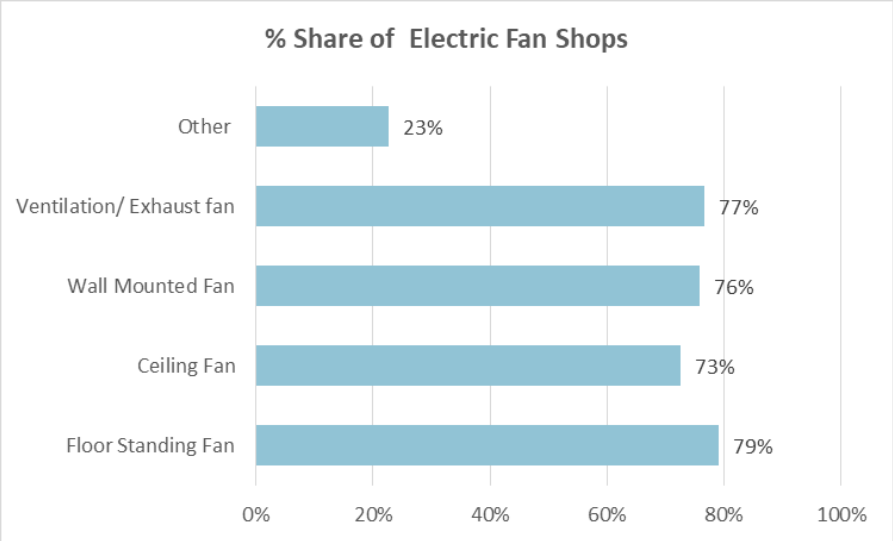


Figure 64: Appliance Shops Selling Electric Fans

Each electric fan shop was asked to rank the most selling type of electric fan, and 51% of electric fan shops reported floor standing fans as the most selling electric fans in their shops. The two other types of most selling electric fans are ceiling fans and ventilation/ exhaust fans, accounting for 18% and 16% of the total electric fan shops being surveyed.

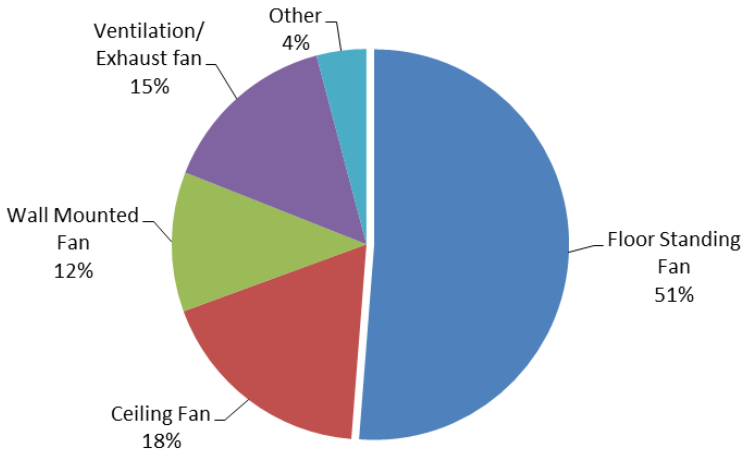


Figure 65: Most Selling Types of Electric Fans reported by Electric Fan Shops

2.4.5 Supply Sources of Appliances in Lao PDR

Vientiane Capital and other major cities across the country serve as the main supply sources of electrical appliances for appliance shops in Lao PDR. Some shops directly import appliances from wholesalers in China and Thailand, instead of getting appliances from local wholesalers in Vientiane Capital and other major cities. Note that the shops surveyed in this study were mainly operated by Lao owners.

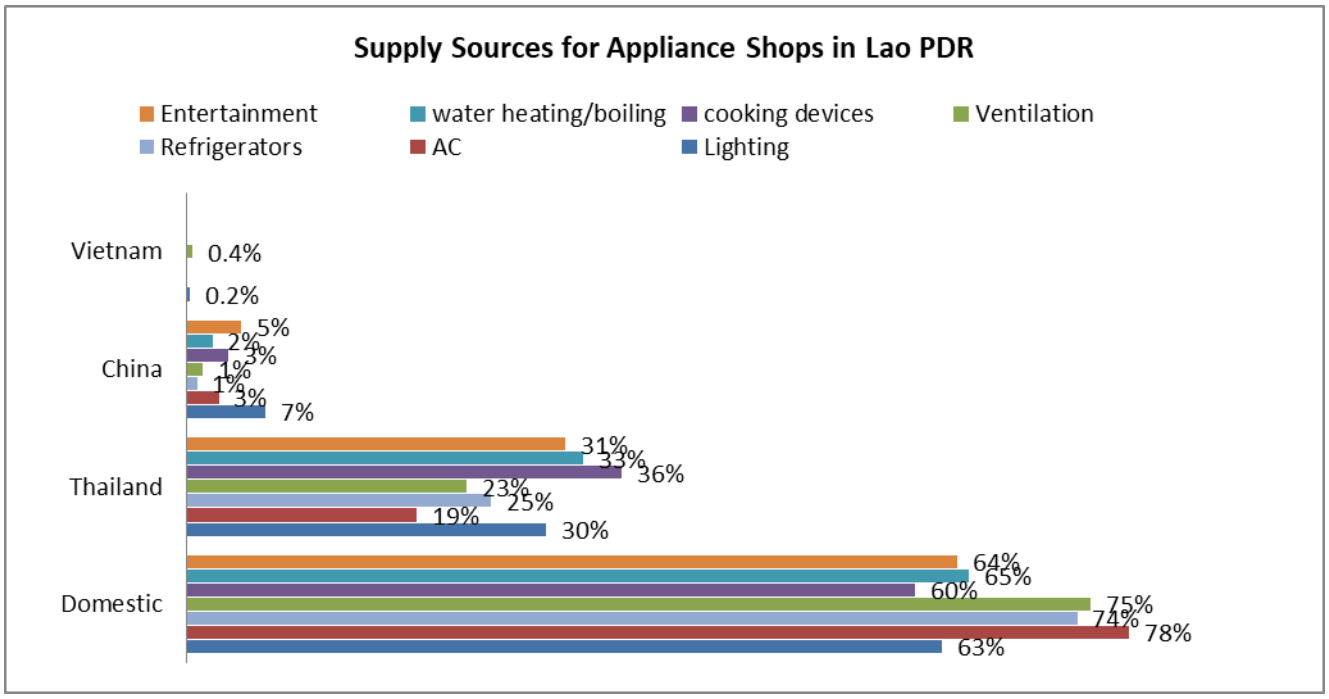
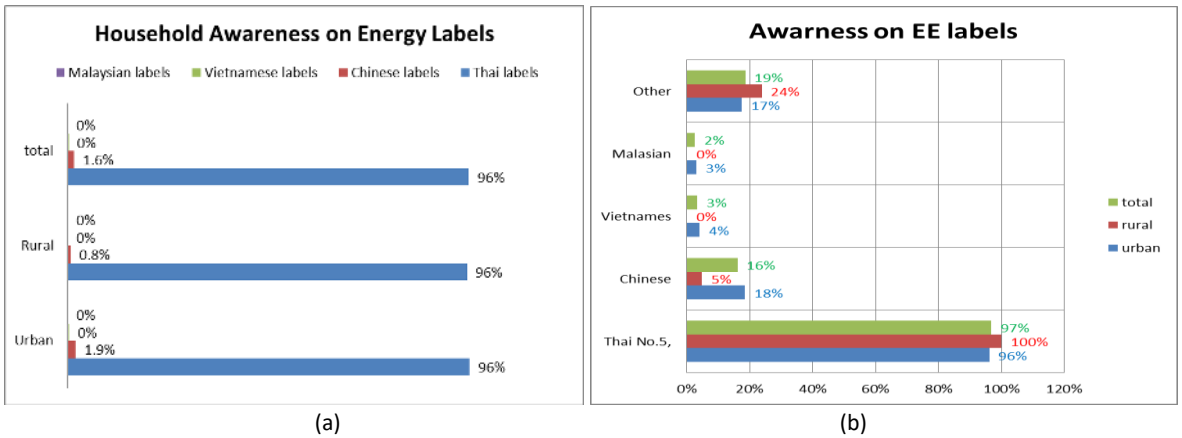


Figure 66: Supply Sources for Appliance Shops in Lao PDR

2.5 KNOWLEDGE AND AWARENESS ON EE

Almost all household and appliance shop respondents (96% of household respondents and 97% of surveyed shops) are aware of Thai No. 5 energy labels, as shown Figure 67. Very few household respondents have seen energy labels from other countries, however some appliance shops have seen energy labels from China, Malaysia and Vietnam.



(a) (b)

Figure 67: Awareness of Energy Labels of Households (a) and Appliance Shops (b)

Two possible reasons to explain such popularity of Thai No. 5 energy labels would include: 1) most Lao people can easily access and understand marketing information and messages delivered by Thai

Medias (i.e., TVs and others) as there is no language barrier between these two neighboring countries, and, therefore, communication and awareness campaigns on Thai No. 5 energy labels through various Thai Medias can easily get across the border to Lao consumers; and 2) many appliances are imported from Thailand, and majority of which carry the Thai No. 5 energy labels.

80% of household respondents recall Thai No.5 energy labels on refrigerators, followed by ACs (68%), and fans (38%), as shown in Figure 68. Very few household respondents recall household appliances in Lao PDR with Chinese energy labels.

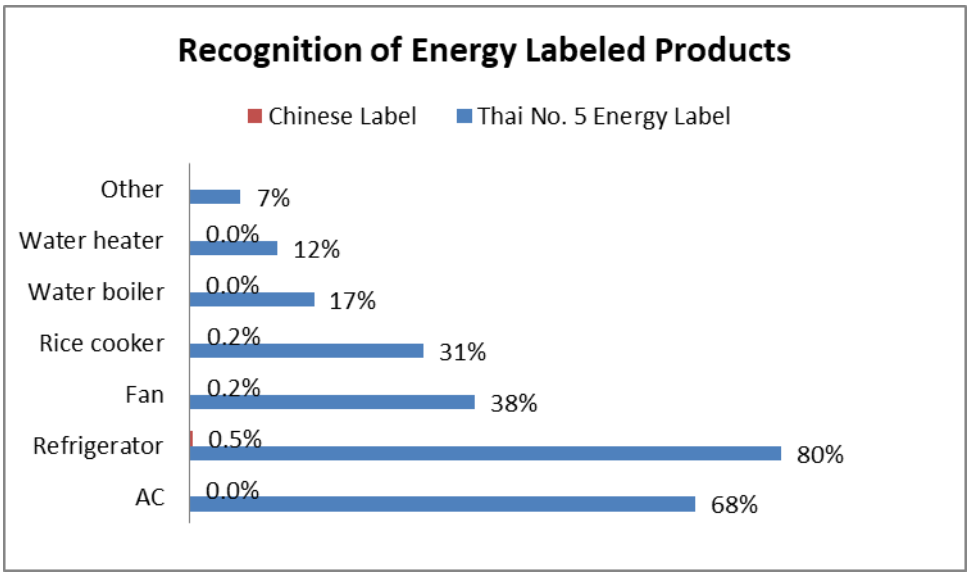
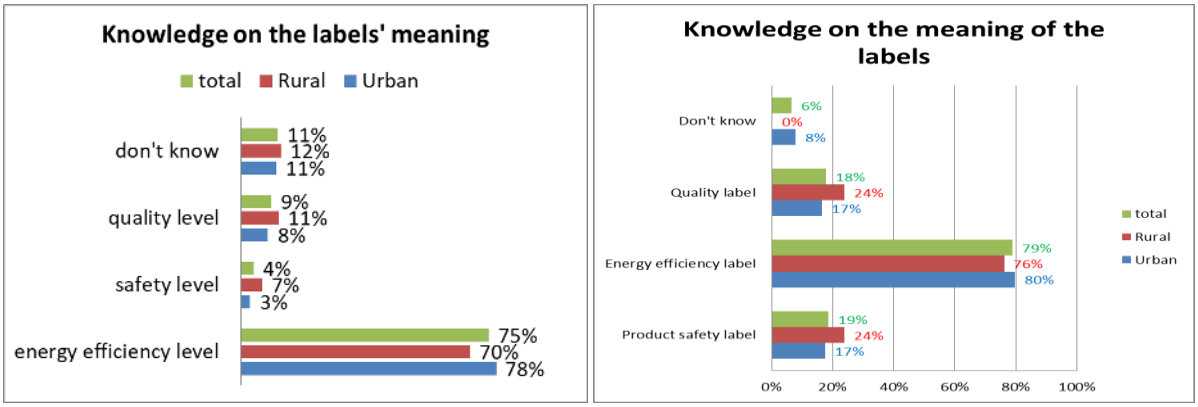


Figure 68: Recognition of Energy Labeled Products

More than 70% of household respondents and shop surveyed (except low electricity consumption households) were able to associate energy labels with appliance energy efficiency. Approximately 10% of the household respondents do not understand meaning of energy labels (see Figure 69).



(a) (b)

Figure 69: Understanding of Energy Labels by Household (a) and Shop (b) Respondents

2.6 SECONDHAND APPLIANCES

Secondhand appliances are available in Lao PDR through very small shops that repair electrical appliances and sell some of the repaired products. The survey team identified three shops in Vientiane capital selling secondhand appliances in large volumes, and these secondhand appliances in Lao PDR mainly include washing machines, refrigerators, freezers, electric fans and ACs. Two of these three shops repair and sell secondhand appliances sought domestically, while the third shop imports secondhand appliances from Thailand per customers' orders. These secondhand appliances are purchased for both residential and small commercial premises, such as apartments, restaurants, and Karaoke bars. These secondhand shops usually give 3-6 months warranty for secondhand appliances.

3 ESTIMATION OF ENERGY CONSUMPTION

During the field household surveys, the lighting and appliance market study and assessment collected data on estimated operating hours of different household appliances. These appliance usage behaviors and unit power consumption obtained from different secondary resources are used for estimation of annual unit energy consumption (UEC), profiles of household energy consumption, and baseline energy consumptions at the national level for key household appliances.

3.1 ANNUAL UNIT ENERGY CONSUMPTION

Estimation of annual UEC was based on daily operating hours reported by respondent households, and typical unit power/energy consumption data obtained from various secondary resources (see Annex II). Average annual UEC values for key household appliance in Lao PDR are summarized in Table 13.

Table 13: Summary of Operating Hours and UEC of Key Household Appliances in Lao PDR

Appliance	Operating Hours (hour/day)	Unit Energy Consumption (kWh/year))
Air conditioners	5.35	1,780
Lighting		
Incandescent	5.61	55
Fluorescent	5.44	57
CFL	5.57	23
LED	5.38	15
Electric Fan		
Ceiling Fan	4.06	102
Ventilation/Exhaust Fan	2.94	25
Wall/Ceiling Mounted Fan	3.82	70
Table Fan	5.05	99
Water Steam Fan	5.31	302
Floor Standing Fan	4.23	195
Refrigerator & Freezer		
Refrigerator/Freezer	N/A	254
Freezer	N/A	866
TV		
Box TV	4.54	217
Flat screen	4.39	181
Electric rice cooker	1.04	245
Washing machine	1.39	126

3.2 HOUSEHOLD ELECTRICITY CONSUMPTION PROFILE

Analysis of energy end-use based on appliance saturation and UEC data found that the major energy end-uses in Lao households include cooling (ACs and fans), refrigeration (refrigerators/freezers) and lighting. On average, cooling and refrigeration appliances (ACs, fans and refrigerators/freezers) contribute about 64% of the annual electricity consumption in Lao households, and lighting end-uses account for about 12%. These findings are in line with the home energy audits conducted in four provinces in Thailand in 2019[10].

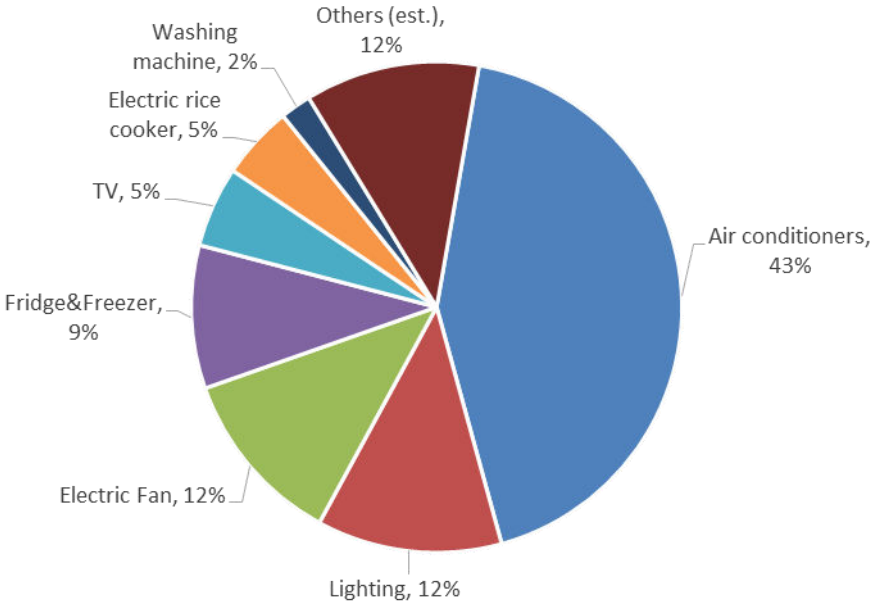


Figure 70: Profile of Lao Household Electricity Consumption by Appliance

3.3 BASELINE ENERGY CONSUMPTION

According to EdL, nationwide annual electricity consumption in the residential sector in Lao PDR stood at 2.15 TWh. Analysis of energy consumption by key appliances listed in Table 13 using a bottom up approach reveals that the following types of appliances would constitute up to 80%-90% of annual electricity consumption by the residential sector, and these include:

- Air conditioners with cooling capacity up to 24,000 BTU/hr
- Fluorescent lamps (tube and circular)
- Table and floor standing electric fans
- Refrigerator/freezers
- Rice cookers

[10] Promoting Household Energy Conservation through Feedback Services and Home Energy Audit on Residential Sustainable Lifestyle Programs, Final Report, 2019

From the energy consumption perspective, the above mentioned appliances should be regarded as high priority products for the MEPS and labelling programmes in Lao PDR. Estimated annual baseline energy consumptions in 2020 at the national level of these priority appliances are summarized in the table below.

Table 14: Estimated Annual Baseline Energy Consumption of Priority Appliances

Appliance	Estimated Annual Energy Consumption (GWh)
Air conditioners	763.67
Fluorescent Lamps	345.07
Table/Floor Standing Fan	287.62
Refrigerator/Freezer	282.66
Rice Cookers	243.73

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 LIMITATION OF THE MARKET STUDY AND ASSESSMENT

Household and shop survey activities were carried out in the third quarter of 2020 during which partial lock down and travel restriction were imposed in Lao PDR. This posed significant challenges to the survey team to carry out field data collection activities in accordance with the sampling framework. In some provinces where strict lock down was implemented, such as the Northwestern provinces of Bokeo and Luangnamtha, the survey team requested the Department of Energy and Mines (DEM) to visit households and shops, and conduct interviews on behalf of the survey team. Due to these limitations, the households visited were mostly confined to urban and sub-urban areas, and the surveyed households were not proportionally distributed across low to high electricity consumption household groups as planned.

With regard to the appliance shop interviews, number and popularity of Chinese operated/owned appliance shops in Lao PDR have rapidly increased over the last two decades, however, these Chinese appliance shops were not included in the survey plan due to the language barrier preventing meaningful interviews with the shop owners. As a result, availability and popularity of Chinese products reported by this market study and assessment could be lower than the actual situation.

4.2 IMPORTANT FINDINGS

- **High household ownership and saturation appliances:** Findings on ownership and saturation of household appliances and electrical equipment in Lao households are summarized in Table 13. Due to a small sample size of this survey, and difficulty to reach target households during the COVID-19 pandemic in 2020, the figures shown in the table are normalized by number of EdL's customers in each tariff category. Based on the study results, the three most popular household appliances in Lao PDR are refrigerators/freezers, TVs, and rice cookers. It should be noted that combined ownership rates of all lighting technologies, and all types of electric fans are close to 100%, however the study has opted for presentation of ownership and saturation by type of lighting technologies and electric fans.

Table 15: Summary of Ownership and Saturation of Household Appliances and Electrical Equipment in Lao PDR

No	Appliance/ Electrical Equipment	Household Ownership (%)	Saturation (Unit/HH)
1	Fluorescent Lamp (Tube & Circular)	70%	4.33
2	CFL	16%	0.98
3	LED (Bulb, Tube & Downlight)	34%	2.55
4	Incandescent Lamp	18%	0.58
5	Air Conditioner	19.7%	0.33
6	Refrigerator/ Freezer	**73.1%**	0.79

No	Appliance/ Electrical Equipment	Household Ownership (%)	Saturation (Unit/HH)
7	Ventilation/Exhaust Fan	27%	0.88
7	Ceiling Fan	21%	0.40
8	Wall/Ceiling Mounted Oscillating Fan	26%	0.81
9	Table Fan	42%	0.93
10	Floor Standing Fan	25%	0.58
11	Washing machine	45.4%	0.47
12	TV	**71.0%**	0.91
13	Rice cooker	**65.5%**	0.71
14	Electric Frying Pan	57%	0.62
15	Iron	47%	0.53
16	Electric Kettle	47%	0.52
17	Electric Water Pump	35%	0.36
18	Electric Shower Heater	19%	0.19
19	Electric Water Boiler	9%	0.09
20	Microwave	5%	0.05
21	Vacuum Cleaner	3%	0.03

- **Transition to LED lighting technologies:** The market study and assessment found that although fluorescent tube lamps are still the most popular lamp types among Lao households, LED lighting technologies have gained more popularity, and their saturation rates have already surpassed CFL technologies. In fact, LED bulbs have the highest saturation rate among high electricity consumption households.

- **Direct import of appliances by Lao households:** Although majority of household appliances are sourced locally and small appliance shops usually get their supplies from large wholesalers located in Vientiane Capital and other major cities, up to 30% of appliance shops reported that they directly imported appliances from China and Thailand. These direct imports can pose challenges in implementation of product registration requirements for MEPS and labeling programmes.

- **High recognition of the Thai No. 5 Energy Label:** More than 95% of surveyed households and appliance shops recognize the Thai No. 5 energy labels, and more than 70% of the respondents were able to associate energy labels with energy efficiency. 80% of household respondents also recall the Thai No. 5 energy labels on refrigerators, ACs and electric fans. It is perceived that awareness and knowledge on energy efficiency in Lao PDR are partly driven by Thai TV commercial as well as perception and recognition of the Thai No. 5 energy label.

4.3 RECOMMENDATIONS

Recommendations on priority products and possible approaches to develop and implement MEPS and energy labelling in Lao PDR are as follows:

- **Priority products for immediate and short-term implementation:** With high ownership and saturation rates among Lao households, and high energy savings potential, ACs, fluorescent lamps, electric fans, refrigerators/freezers, and rice cookers are recommended as priority products for MEPS and labelling programmes in Lao PDR. It should be noted that a draft Ministerial regulation on energy standards and labelling for room air conditioners prepared by MEM is under the final stage of review by the Government of Lao PDR, and it is expected that this Ministerial regulation will be approved by 2021. In addition, MEM has actively participated in the regional initiative on harmonization of MEPS and testing standards for lighting products (fluorescent and LED lamps) with other ASEAN member countries, and a draft document, entitled "National Roadmap - Lao PDR Energy Performance Standards for Lighting Products", has been prepared to facilitate implementation of MEPS and labelling activities for energy efficient lighting in Lao PDR. In view of these ongoing developments, the immediate and short-term focus of MEPS and labelling in Lao PDR shall be on ACs and lighting products.

- **Collaboration with neighboring countries:** Considering that household appliances and electrical equipment in Lao PDR are imported mainly from China and Thailand, and most of Lao households and appliance shops are well aware of No. 5 energy labels issued by the Electricity Generating Authority of Thailand (EGAT), it is recommended for MEM to explore collaboration opportunity with EGAT to maximize benefits from the existing high awareness on energy labels among Lao households and appliance shops. The collaboration could be further expanded to include recognition of energy performance test results for products certified under the No. 5 energy labelling programme.

5 ANNEXES

Annex I	Household and Appliance Shop Survey Questionnaires
Annex II	Unit Power/Energy Consumption
Annex III	References

5.1 ANNEX I: HOUSEHOLD AND APPLIANCE SHOP SURVEY QUESTIONNAIRES

5.1.1 Household Survey Questionnaire

ພະລັງງານແລະບໍ່ແຮ່
ENERGY AND MINES

Interview Number:

Enumerator ID:

Date: _____/ _____ / 2020

Ward/ commune:

Province:_____

Good [morning/ afternoon], my name is [interviewer's name] and I am conducting a survey for the [name of university. The purpose of this study is to find out how your household appliances, and what you might like to consume in the future. This survey is being carried out in 10 provincial centres and 9 districts of Vientiane capital as well.

I anticipate that this survey will take about 30 minutes to complete. The information you give me will be kept confidential. You and your household will not be identifiable in any outputs from this study. If there are any questions you prefer not to answer, or if for any reason you want to withdraw from this study, you may do so at any time without giving a reason. Finally, if you have any questions or comments on this study, please ask now.

Thank you in advance for your participation.

A. INFORMATION ABOUT THE HOUSEHOLD

INTERVIEWER: ***To begin with, I would like to ask you for some information about you and your household.***

Firstly, what is your name?			
A01	Gender	□ Male □ Female	
A02	How old are you?	□ 18 – 29 □ 30 – 39 □ 40 – 49 □ 50 – 59 □ 60+	
A03	Are you the chief wage earner in your household?	□ Yes □ No	→ Skip to A05 → A04
A04	If no, what is your relationship to the chief wage earner?	□ Husband/ wife □ Son/ daughter □ Father/ mother □ Other (please specify)_____	
A05	What is the principal occupation of the chief wage earner?	□ Agriculture □ Construction □ Retail/ street vendor □ Government, teacher or other professional □ Self-employed	

		□ Unemployed □ Retired □ Other (please specify)_____
A06	What is the highest level of schooling completed by the chief wage earner?	□ No formal education □ Primary □ Secondary □ College/ University □ No answer
A07	Who in your household makes decisions about electricity?	□ I do □ My husband/ wife □ My son/ daughter □ Jointly with others □ Other (please specify)
A08	How many members of your household are there?	
A09	And how many are under 16?	
A10	How many in your household are earning an income?	
A11	How many rooms are there in your property? [This includes bathrooms]	
A12	Thinking about a typical month, what is your average household income?	□ <1.0 mln kip □ 1.0-2.5 □ 2.5-4.5 mln kip □ >4.5 mln kip □ No answer

B. HOUSEHOLD ENERGY CONSUMPTION

INTERVIEWER: ***I would now like to ask you some questions about your household electricity consumption...***

B01	When do you pay for your electricity?					□ In advance □ Once I receive a bill
B02	How much your average monthly electricity bill (ask to see bills of one year or 6 months, take photos)					
B03	How often do you pay for the electricity you use?					□ Monthly □ 2 months once □ When I have the money □ I don't pay for electricity
B04	From your household perspective, do you think that what you spend on electricity as a proportion of your total household income is acceptable?	Not at all acceptable	Slightly acceptable	Moderately acceptable	Very acceptable	Completely acceptable
		□	□	□	□	□

INTERVIEWER: ***For lighting, does your household use any of the following-***

B05	Incandescent light bulbs	□ Yes □ No, skip to B06		
	If yes, can you give some more details (or interviewer to check)	Wattage	Number	Usage (hours)
		100		
		60		
		40		
B06	Fluorescent lamps	□ Yes □ No, skip to B07		
	If yes, can you give some more details (or interviewer to check)	Wattage(/length in ft)	Number	Usage (hours)
		40 W		
		20 W		
		Circular (…… W)		
B07	Compact fluorescent lamps	□ Yes □ No, skip to B08		
	If yes, can you give some more details (or interviewer to check)	Wattage	Number	Usage (hours)
B08	Light Emitting Diode lamps	□ Yes □ No, skip to B09		
	If yes, can you give some more details (or interviewer to check)	Wattage	Number	Usage (hours)

INTERVIEWER: ***Does your household own or rent any of the following…***

B09	Box TV	□ Yes □ No, skip to B10			
	If yes, please give some more details or interviewer to check	Screen size (inch)	Number	Usage (hours)	
B10	Flat screen TV	□ Yes □ No, skip to B11			
	If yes, please give some more details or interviewer to check	Screen size (inch)	Number	Usage (hours)	
B11	Mobile phone	□ Yes □ No, skip to B12			
	If yes, please give some more details or interviewer to check	Type	Number		
		Smart phone			
		Ordinary			
B12	Tablet	□ Yes □ No, skip to B13			
	If yes, please give some more details or interviewer to check	Screen size	Number	Usage or recharge	
B13	Refrigerator	□ Yes □ No, skip to B14			

	If yes, please give some more details or interviewer to check	Type	Volume (cub. ft)	Number	
		Ordinary			
		Inverter			
B14	Freezer (commercial)	❑ Yes ❑ No, skip to B15			
	If yes, please give some more details or interviewer to check	Type (Ordinary/Inverter)	Volume (cub. ft)		Number
B15	Electric ceiling fan	❑ Yes ❑ No, skip to B16			
	If yes, please give some more details or interviewer to check	Blade diameter /wattage	Number of units		Usage (hours)
B16	Electric exhaust fan	❑ Yes ❑ No, skip to B17			
	If yes, please give some more details or interviewer to check	Blade diameter /wattage	Number of units		Usage (hours)
B17	Electric table fan	❑ Yes ❑ No, skip to B18			
	If yes, please give some more details or interviewer to check	Blade diameter /wattage	Number of units		Usage (hours)
B18	Electric pedestal fan	❑ Yes ❑ No, skip to B19			
	If yes, please give some more details or interviewer to check	Blade diameter /wattage/width x height[1]		Number of units	Usage (hours)
B19	Electric wall mount fan	❑ Yes ❑ No, skip to B20			
	If yes, please give some more details or interviewer to check	Blade diameter /wattage	Number of units		Usage (hours)
B20	Air conditioner	❑ Yes ❑ No, skip to B21			
	If yes, please give some more details or interviewer to check	Type (Ordinary/Inverter)	Cooling capacity (BTU)	Number	Usage
B21	Electric rice cooker	❑ Yes ❑ No, skip to B22			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	

[1] This is square water steam fan

B22	Hot pot	□ Yes □ No, skip to 23			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B23	Infrared Electric cooker	□ Yes □ No, skip to B24			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B24	Induction cooker	□ Yes □ No, skip to B25			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B25	Hair dryer	□ Yes □ No, skip to B26			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B26	Notebook Computer	□ Yes □ No, skip to B27			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B27	Desktop computer	□ Yes □ No, skip to B28			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B28	Hi Fi/sound system	□ Yes □ No, skip to B29			
	If yes, please give some more details or interviewer to check	Number	Usage		
B29	Video/ DVD player	□ Yes □ No, skip to 30			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B30	Electric kettle/water boiler	□ Yes □ No, skip to 31			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B31	Electric iron/steam iron	□ Yes □ No, skip to 32			
	If yes, please give some more details or interviewer to check	Type (ordinary/steam)	Wattage	Number	Usage
B32	Electric water heater/shower	□ Yes □ No, skip to B33			
	If yes, please give some more details or	Type (ordinary/steam)	Wattage	Number	Usage

	interviewer to check				
B33	Washing machine	□ Yes □ No, skip to B34			
	If yes, please give some more details or interviewer to check	Type (ordinary/inverter)	Wattage	Washing Capacity (kg)	Usage
B34	Electric water pump	□ Yes □ No, skip to B35			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B35	High pressure water pump	□ Yes □ No, skip to B36			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B36	Roaster	□ Yes □ No, skip to B37			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B37	Microwave oven	□ Yes □ No, skip to B38			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B38	Vacuum cleaner	□ Yes □ No, skip to B39			
	If yes, please give some more details or interviewer to check	Wattage	Number	Usage	
B39	Other (please specify)	□ Yes, please specify details □ No, skip to C			
	If yes, please give some more details or interviewer to check	Number	Usage		

C. ENERGY EFFICIENCY

INTERVIEWER: ***Now I'm going to show you some labels...*** **[Interviewer shows the respondent energy efficiency labels]**

C1	Do you have any of your appliances with these labels in your house? If no, skip to End	 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

C2	If yes, what appliances with what labels (please put number 1 - 5 for respective labels)	☐ Refrigerator (.....) ☐ Air conditioner (.....) ☐ Fan (.....) ☐ Rice cooker (.....) ☐ Water boiler/heater (.....) ☐ Other (please specify ....)					
C3	Do you understand what it is used to demonstrate?	☐ Yes, it is to demonstrate energy efficiency of appliance ☐ No, I don't know skip to the End					
C4	Do you agree with the following points	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know
	Energy efficient appliances consume less energy?						
	Energy efficient appliances have longer lifetime span?						
	Energy efficient appliances tend to cost more expensive?						
	Energy efficient appliances have more benefits in long run?						

And finally, is there anything we have not covered in this interview that you would like to tell me about your use of electricity?

Thank you for taking the time to complete this questionnaire!

5.1.3 Appliance Shop Survey Questionnaire

Questionnaire for Electric Appliances Retailer

ພະລັງງານແລະບໍ່ແຮ່
ENERGY AND MINES

Interview Number:

Enumerator ID:

Date: _____/ _____ / 2020

Ward/ commune:

Province: _____

Comprehensive knowledge on current market status of electric appliances in Lao market is essential to estimate energy saving potential in Lao PDR. The survey is aiming at gathering necessary information about electric appliances distribution/sales as well as consumers behavior by interviewing the shop owners/managers about their business/products/service.

The survey results will be used by Ministry of Energy and Mines in developing action plans for National Energy Efficiency policy implementation. Therefore, best quality of your answers will be very much helpful and appreciated.

May we reassure you that ***all the information you provide will be treated as confidential and your company will not be identifiable in any publications***.

A. Section I: General Information

(We would like to know a little bit about your shop and yourself)

A1	Basic information about your shop	Shop name: …… …….....
		Address:…… ……
		Fax:
		Tel:
		Website:
A2	Short description about your shop profile (*products/ services*):	…… ……
A3	Contact information of the respondent:	Name:
		Position:
		Email:
		Fax:
		Tel:
A4	First year of operation	
A5	Type of business	☐ Family business ☐ Privately owned ☐ Government owned ☐ Part of international corporation ☐ Other, specify:……
A6	Number of employees	☐ Less than 2 ☐ 2 – 5

		☐ 5 – 8 ☐ 8 – 10 ☐ More than 10
A7	Can you please reveal your shop annual sales turnover? (approximately)	

B. Electric appliances

	Questions	Answers			
B1	Lighting products				
B1.1	What types of lighting devices are sold in your shop?	☐ Incandescent bulbs(IB) ☐ Fluorescent Lamps (FL) ☐ Compact Fluorescent Lamp (CFL) ☐ Light Emitting Diode (LED) ☐ Other			
B1.2	What is the percentage of each type of lighting product type sold in your shop? (say in the last year)	Inc. Bulb:_____%, FL:_____%, CFL_____% LED:_____%, Other _____%			
B1.3	What share of lighting products sales in your total annual turnover?	_____ % (approximately)			
B1.4	What Brands of lighting products in sales in your shop (Sales Proportion, %)	☐ Panasonic (_____%) ☐ Philips (_____%) ☐ Sylvania (_____%) ☐ Lamptan (_____%) ☐ FSL (_____%) ☐ Chinese (_____%) ☐ Racer (_____%) ☐ L&E (_____%) ☐ Other (_____%)			
B1.5	Where do you usually get your products?	☐ Panasonic (_____) ☐ Philips (_____) ☐ Sylvania (_____) ☐ Lamptan (_____) ☐ FSL (_____) ☐ Chinese (_____) ☐ Other (_____)			
B1.6	Most selling lamps' capacity (W)?	Incandescent bulb	☐ 40 W	☐ 60 W	..... W
		FL	☐ 20 W	☐ 40 W	..... W

		CFL	☐ 8 W	☐ 12 W	……. W
		LED	☐ 7 W	☐ 10 W	……. W
		Others	☐ ….. W	☐ ……. W	……. W
B2	Air Conditioner unit (AC)				
B2.1	What brands of AC are in your shop sales?	☐ Mitsubishi ☐ Gree ☐ Samsung ☐ LG ☐ …… ☐ …… ☐ …… ☐ ……			
B2.2	Most selling capacity (BTU)	☐ 9,000 ☐ 12,000 ☐ 18,000 ☐ 24,000 ☐ > 24 ☐ others: ……..			
B2.3	Do you have inverter type (or variable speed) of AC sold in your shop sales? If no skip to B3	☐ Yes, we have ☐ No, we have not			
B2.3	What is proportion between ordinary/inverter types of AC sold in your shop?	……/…… (for example, 60/40)			
B2.3	What is proportion of AC sold will be used in residential vs commercial/industrial sector?	(R/C&I)……/…… (for example, 60/40)			
B2.4	In case if ACs are selling in mix with other appliances, what is roughly proportion of AC sales in total annual turnover of your shop?	_____%			
B3	Refrigerator(Ref)				
B3.1	What brands of Ref are in your shop sales?	☐ Toshiba ☐ Hitachi ☐ Panasonic ☐ Mitsubishi			

		☐ Samsung ☐ _____
B3.2	Most selling Ref. capacity	☐ <5 Cubic ft ☐ 5-7 Cubic ft ☐ 7-9 Cubic ft ☐ 9-11 Cubic ft ☐ >11
B3.3	Import/distribution sources	☐ Thailand ☐ China ☐ Vietnam ☐ Somewhere else (_____)
B3.2	Do you have inverter type of Ref. in your shop sales?	☐ Yes, ☐ No,
B3.3	If yes, what proportion between ordinary / inverter Ref.?	_____/ _____
B3.4	Can you estimate proportion of Ref. sales in your shop annual turnover?	_____% (approx.)
B4	Ventilating appliances	
B4.1	What ventilating appliances do you sell in your shop?	☐ Floor Standing Ventilation ☐ Ceiling ventilation ☐ Wall mounted ventilation ☐ Exhaust ventilation ☐ Other (_____)
B4.2	Please indicate the Import/ distribution sources of these appliances	☐ Floor Standing Ventilation_____ ☐ Ceiling ventilation _____ ☐ Wall ventilation _____ ☐ Exhaust ventilation _____ ☐ Other (_____)
B4.3	Can you approximately rank your sales by types of these ventilation appliances?	☐ Floor Standing Ventilation ☐ Ceiling mounted ventilation ☐ Wall mounted ventilation ☐ Exhaust ventilation ☐ Other (_____)
B4.4	Can you reveal sales share of these appliances in total annual	_____ %

	turnover of your shop?	
B5.	Electric cooking devices	
B5.1	What electric cooking appliance do you sell in your shop?	☐ Rice cooker ☐ Frying pan ☐ Hot plate stove ☐ Microwave stove ☐ Toaster ☐ other
B5.2	Import/dealer sources of these products?	☐ Rice cooker:_____ ☐ Frying pan_____ ☐ Hot plate stove _____ ☐ Microwave stove _____ ☐ Toaster _____ ☐ Other _____ _____
B5.3	Can you rank customers' preference based on your shop sales of these products?	☐ Rice cooker ☐ Frying pan ☐ Hot plate stove ☐ Microwave stove ☐ Toaster ☐ Other _____
B5.4	Percent share of these products sales in total turnover of your shop?	_____ %
B6	Water Heating appliances	
B6.1	What electric water heating appliances do you have in sales of your shop?	☐ Insulated Electric Kettle ☐ Ordinary Electric Kettle ☐ Shower Water heating ☐ other (_____)
B6.2	Import/distribution sources of these products or where from do you get these products?	☐ Insulated Electric Kettle _____ ☐ Ordinary Electric Kettle _____ ☐ Shower Water heating _____ ☐ other (_____)
B7	Entertainment appliances	
B7.1	What Entertainment appliances do you have in sales of your shop?	☐ Box TV ☐ Flat screen TV

		☐ Home theatre ☐ Stereo/Hi fi sound system ☐ Other (_____)
B7.2	Brands of the Entertainment products?	☐ Box TV(_____) ☐ Flat screen TV (_____) ☐ Home theatre (_____) ☐ Stereo/Hi-fi sound system (_____) ☐ Other (_____)
B7.3	Customer preference ranking for these products?	☐ Box TV ☐ Flat screen TV ☐ Home theatre ☐ Stereo/Hi-fi sound system ☐ Other
B7.4	Percent share of these products sale in your shop annual turnover?	_____ %

C. Energy Efficiency Products

(We would like to know about energy efficient products at your shop)

	QUESTION	ANSWER
C1	Energy efficiency labels	
C1.1	Have you ever seen these labels attached to your products in your shop? If No, skip to C2	 ☐ ☐ ☐ ☐ ☐
C1.2	If yes, do you understand what does it mean?	☐ Safety label of product ☐ Energy efficient product label ☐ No, I don't know its meaning
C1.3	If yes, what products do have these labels attached? (you may tick multiple boxes)	☐ Air Conditioners ☐ Refrigerators ☐ Fans ☐ Electric kettles ☐ Electric stoves ☐ Other products (please specify…… …… …… ……
C1.4	If possible, can you reveal, how much the cost of energy efficient products (with truly labels) is higher than	☐ < 10% ☐ 10-20%

	QUESTION	ANSWER
	ordinary products (without labels)?	☐ >20% ☐ No difference (almost the same) ☐ Not sure
C1.5	Have you ever told the customers about the true meanings of the labels? If no, skip to C2	☐ Yes, always ☐ Yes, but sometimes ☐ No, never
C1.6	If yes, how did the customers react?	☐ Purchased the products with labels ☐ Preferred the products without labels ☐ Had no reaction
C1.7	If customers don't want to buy products with labels, what the reasons would be?	☐ More expensive ☐ Not trust the labels ☐ Just a preference to buy a cheaper ☐ Just Can afford for cheaper only
C2	What is your perception about customers' awareness on the energy efficiency	

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	Don't know
When customers want to buy an appliance, they look for the cheapest one?						
Customers are not familiar with energy efficiency labels						
Customers do not purchase energy efficient appliances because of its higher price?						
Customers do not care about the long term benefits of EE products, but they care about the cheaper price						
Customers lack of awareness on energy efficiency of appliances						

Thank you for taking the time to fill in this questionnaire!

5.2 ANNEX II: UNIT POWER/ENERGY CONSUMPTION

Table 16: Estimated Unit Annual Energy Consumption of ACs

Air Conditioners		
Cooling Capacity (BTU)	**Energy Consumption per hour (kWh)**	
	Fixed Speed	**Inverter**
9000	0.6877	0.4985
12000	0.9011	0.6545
15000	0.9932	0.7264
18000	1.3838	0.9784
24000	1.6114	1.1836
>24000	2.5859	1.8901

Source: http://labelno5.egat.co.th/new58/, accessed April 2021

Table 17: Estimated Unit Annual Energy Consumption of Refrigerators and Freezers

Refrigerator		Freezer	
Storage Volume (cu.ft)	**kWh per day**	**Storage Volume (cu.ft)**	**kWh per day**
3.0	0.6237	4.0	1.91
4.0	0.4973	5.0	1.98
5.0	0.4735	6.0	2.05
5.2	0.4496	6.7	2.10
5.3	0.7146	7.0	2.17
5.6	0.4778	7.1	1.79
5.8	0.5968	7.2	1.79
5.9	0.7157	7.3	1.79
6.0	0.5022	7.5	1.79
6.3	0.4873	8.0	2.24
6.4	0.5883	8.5	2.03
6.5	0.6445	8.6	2.03
6.6	0.5583	9.0	2.70
6.8	0.5362	9.6	2.42
7.0	0.8299	10.0	2.67
7.4	0.7106	10.4	2.57
7.6	0.6871	11.0	2.37

Refrigerator		Freezer	
Storage Volume (cu.ft)	kWh per day	Storage Volume (cu.ft)	kWh per day
8.0	0.6501	11.5	2.25
8.5	0.7546	12.0	2.10
8.8	0.7783	13.0	2.32
9.0	0.7210	16.0	3.42
10.0	0.7897	17.0	3.66
11.0	0.8387	25.0	4.45
12.0	0.8654	35.0	3.96
13.0	0.9970	54.0	3.05
14.0	0.9511		
14.4	0.8330		
15.0	0.8515		
16.0	1.2753		
17.0	0.9927		
18.0	0.9866		
22.0	1.3069		
27.0	1.4252		
28.0	1.4621		
32.0	1.6099		
35.0	1.7207		
55.0	2.4597		

Source: http://labelno5.egat.co.th/new58/, accessed April 2021

Table 18: Estimated Unit Power Consumption of Electric Fans

Electric Ceiling Fan		Electric Ventilation/Exhaust Fan		Electric Wall/Ceiling Mounted Oscillating Fan		Electric Table Fan		Electric Water Steam Fan		Electric Floor Stand Fan	
Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W
25	70	5	15	14	40	5	20	10	125	14	45
30	70	6	20	15	45	6	20	11	125	15	45
33	70	8	20	16	50	12	35	12	125	16	45
36	70	9	25	18	65	14	45	13	150	18	60
39	70	10	25	19	85	15	45	15	150	19	140
40	70	11	30	20	110	16	45	16	150	20	140
43	70	12	35			17	55	17	250	22	200

Electric Ceiling Fan		Electric Ventilation/Exhaust Fan		Electric Wall/Ceiling Mounted Oscillating Fan		Electric Table Fan		Electric Water Steam Fan		Electric Floor Stand Fan	
Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W	Blade Dia. (inch)	W
45	70	14	40			18	60	18	250	25	215
47	75	15	45			20	125	20	250	31	250
48	75	16	45					22	300	40	750
52	75	35	120					24	300		
53	75							26	350		
55	75										
56	75										

Source: http://labelno5.egat.co.th/new58/, accessed April 2021

Table 19: Estimated Unit Power Consumption of TVs

Box TV		Flat TV	
Screen Size (Inch)	Wattage:	Screen Size (Inch)	Wattage:
10	60	16	20
12	60	20	25
14	60	21	30
15	65	22	35
16	80	24	45
18	80	25	70
20	90	28	70
21	100	29	70
22	110	30	85
23	115	31	90
24	120	32	95
25	125	34	100
26	130	35	100
27	140	36	100
29	150	38	125
32	170	40	125
35	190	41	125
38	210	42	140
40	220	43	160
45	250	45	160

Box TV		Flat TV	
Screen Size (Inch)	**Wattage:**	**Screen Size (Inch)**	**Wattage:**
50	285	46	160
		48	160
		49	160
		50	185
		51	185
		52	190
		54	200
		55	205
		56	210
		60	230
		62	240
		63	245
		64	250
		65	255

Source: https://line.17qq.com/articles/qwmsmfhgsy.html, accessed April 2021

Table 20: Estimated Unit Power Consumption of Washing Machines

Washing Machine	
Capacity (kg)	**Wh**
5	76
6	76
7	712
7.5	736
8	496
8.5	416
9	471
9.5	273
10	304
10.5	419
11	306
11.5	281
12	255
12.5	153
13	111
14	124
15	119

Washing Machine	
Capacity (kg)	**Wh**
16	113
18	110
19	107
20	138
22	124
24	106
25	122

Source: http://labelno5.egat.co.th/new58/, accessed April 2021

Table 21: Estimated Unit Power Consumption of Rice Cookers

Rice Cooker	
Capacity (Liters)	**Wattage**
1	435
1.1	520
1.3	600
1.5	580
1.6	580
1.8	645
2	650
2.1	650
2.2	835
2.3	850
2.4	850
2.5	850
2.8	1000
3	1000
3.2	1025
3.3	1025
3.4	1200
3.5	1350
4	1350
4.2	1400
5	1550
6	1550
7	2000
10	2750

Source: http://labelno5.egat.co.th/new58/, accessed April 2021

5.3 ANNEX III: REFERENCES

1. *Report on electricity energy demand and supply forecast for 2016-2030.* Jointly Developed by Ministry of energy and Mines, and Electricite du Laos. Available at www.edl.com.la, www.laoenergy.com.la
2. *Electricity statistics 2019*. Electricite du Laos 2020. Available at www.edl.com.la
3. *Achievement of Electricite du Laos under 40th anniversary of Lao PDR, 1975-2015*. EDL 2016.
4. Kythavone S., Suyavong S. *Household energy efficiency: a socio-economic perspective*. MECON, 2014.
5. Vongchanh K., Nanthavong K. *Technological Perspective Survey*. MECON, 2014.
6. *Results of Population and Housing census 2015.* Lao Statistics Bureau, 2016. Available at www.laosis.lsb.gov.la
7. Nanthavong K., Vilayda X. *Laos Market Research 2016 (lighting products)*. Survey report. 2016
8. Lao Social Indicators Surveys II (LSIS II, 2017). *Survey Findings report.* June, 2018. Available at www.laosis.lsb.gov.la
9. *Electricity statistics 2018*. Department Energy policy and planning, Ministry of Energy and Mines 2018.
10. Yamane, Taro. (1967). *Statistics: An Introductory Analysis*, 2nd Edition, New York: Harper and Row.
11. (EDL, 2020). *Summary of study on new electricity tariff structure for 2021-2025.* EDL, 2020. Available for download at www.edl.com.la