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# NATIONAL HOUSEHOLD LOAD SURVEY REPORT 2015



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# **NATIONAL HOUSEHOLD LOAD SURVEY REPORT 2015**

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# Table of Contents

<b>ACRONYMS AND ABBREVIATIONS .....</b>	<b>IV</b>
<b>DEDICATION.....</b>	<b>V</b>
<b>EXECUTIVE SUMMARY.....</b>	<b>1</b>
GENERAL .....	1
METHODOLOGY .....	1
HOUSEHOLD DEMOGRAPHIC CHARACTERISTICS .....	2
HOUSEHOLD LIGHTING PATTERNS .....	2
HOUSEHOLD APPLIANCE HOLDINGS.....	2
SPACE HEATING AND COOLING PATTERNS.....	3
CONSUMER ELECTRICITY BILLS .....	3
CONSUMER AWARENESS OF ENERGY EFFICIENCY.....	3
RECOMMENDATIONS .....	4
<b>1 BACKGROUND AND STUDY METHODOLOGY.....</b>	<b>5</b>
1.1 Introduction.....	5
1.2 BACKGROUND .....	5
1.3 ENERGY POLICIES AND PROGRAMS .....	6
1.4 LOAD SURVEY OBJECTIVES .....	7
1.5 LOAD SURVEY METHODOLOGY AND ORGANIZATION .....	7
1.6 SAMPLE DESIGN .....	8
1.6.1 Survey Instrument.....	8
1.6.2 Staffing Recruitment .....	9
1.6.3 Training and Pre-Test .....	9
1.6.4 Field Work and Logistics.....	9
1.6.5 Data Processing.....	9
1.6.6 Field Work Results.....	10
<b>2 CUSTOMER CHARACTERISTICS .....</b>	<b>11</b>
2.1 NUMBER OF HOUSEHOLDS.....	11
2.2 HOUSEHOLD DEMOGRAPHICS .....	11
2.3 HOUSING UNIT CHARACTERISTICS .....	13
2.4 HOUSEHOLD INCOME .....	13
2.4 WEIGHTED AND UN-WEIGHTED CUSTOMER NUMBERS.....	14

<b>3</b>	<b>HOUSEHOLD LIGHTING PROFILES .....</b>	<b>15</b>
	3.1 INTRODUCTION.....	15
	3.2 INCANDESCENT LAMPS.....	15
	3.2 COMPACT FLUORESCENT LAMPS (CFLS).....	16
	3.3 FLUORESCENT TUBE LAMPS.....	16
	3.4    LED Lamps.....	17
	3.5    CFL and/or Fluorescent Tube Lamps.....	17
	3.6    Outdoor Lighting.....	17
	3.7    Estimated Total Number of Lamps.....	17
	3.8    Daily Lighting Hours .....	18
	3.9 POTENTIAL EFFICIENT LIGHTING DSM PROGRAMS.....	18
<b>4</b>	<b>APPLIANCE OWNERSHIP AND USAGE.....</b>	<b>20</b>
	4.1 TELEVISION SETS.....	20
	4.2 DISHWASHERS.....	21
	4.3 REFRIGERATORS.....	21
	4.4 FREEZERS .....	23
	4.5 WASHING MACHINES .....	23
	4.6 DRYERS.....	24
	4.7 OTHER ELECTRICAL APPLIANCES.....	25
	4.8 TOTAL ESTIMATED NUMBER OF APPLIANCES.....	25
	4.9    POTENTIAL APPLIANCE DSM PROGRAMS.....	26
	4.9.1 Refrigerators .....	26
	4.9.2    Washing Machines .....	26
<b>5</b>	<b>HOUSEHOLD WATER HEATERS.....</b>	<b>27</b>
	5.1 ELECTRICAL WATER HEATING .....	27
	5.2 GAS-FIRED WATER HEATERS.....	27
	5.3 SOLAR WATER HEATERS (SWHS).....	28
	5.4 OTHER WATER HEATING EQUIPMENT .....	29
	5.5 TOTAL ESTIMATED NUMBER OF WATER HEATING SYSTEMS IN JORDANIAN HOUSEHOLDS .....	29
	5.6 POTENTIAL WATER HEATER DSM PROGRAMS.....	29
<b>6</b>	<b>HOUSEHOLD HEATING AND COOLING.....</b>	<b>30</b>
	6.1 AIR CONDITIONERS.....	30
	6.2 ELECTRIC FANS .....	31
	6.3 ELECTRIC HEATERS.....	31
	6.4 OTHER SPACE HEATING EQUIPMENT .....	32

6.5 ESTIMATED ELECTRIC HEATING AND COOLING APPLIANCE NUMBERS .....	32
6.6 AVERAGE OPERATING HOURS OF HEATING AND COOLING APPLIANCES.....	34
6.6.1 Winter Heating Systems .....	34
6.6.2 Summer Cooling Systems .....	35
6.7 POTENTIAL DSM PROGRAMS FOR HEATING AND COOLING .....	36
6.7.1 Electric heater fuel substitution .....	36
6.7.2 Efficient AC program.....	37
<b>7 CONSUMER AWARENESS.....</b>	<b>38</b>
7.1 AVERAGE MONTHLY ELECTRICITY BILL VALUE.....	38
7.2 POTENTIAL FOR BILL REDUCTION.....	39
7.3 SOURCES OF INFORMATION ABOUT ENERGY EFFICIENCY .....	39
7.4 PREFERRED METHOD FOR RECEIVING ENERGY EFFICIENCY INFORMATION.....	40
7.5 ENERGY EFFICIENCY MEASURES UNDERTAKEN.....	41
<b>8 KEY FINDINGS AND RECOMMENDATIONS.....</b>	<b>42</b>
8.1 KEY FINDINGS - LIGHTING.....	42
8.2 KEY FINDINGS - ELECTRICAL APPLIANCES.....	42
8.3 Key Findings – Heating and Cooling Equipment .....	43
8.4 Key Findings - Energy efficiency awareness .....	43
8.5 RECOMMENDATIONS .....	43

## Acronyms and Abbreviations

CFL	Compact Fluorescent Lamp
DISCOs	Distribution Companies
EE	Energy Efficiency
EMRC	Energy and Mineral Regulatory Commission
EDCO	Electricity Distribution Company
ESCB	USAID Energy Sector Capacity Building project
ESCO	Energy Services Company
ESP	Energy Services Provider
GoJ	Government of Jordan
IDECO	Irbid District Electricity Company
JEPCO	Jordan Electric Power Company
JLGF	Jordan Loan Guarantee Facility
JD	Jordan Dinars
JREEEF	Jordanian Renewable Energy and Energy Efficiency Fund
LED	Light Emitting Diode
MEMR	Ministry of Energy and Mineral Resources
NEPCO	National Electric Power Company
NERC	National Energy Research Center
NGO	Non-Governmental Organization
OPIC	Overseas Private Investment Corporation
PPP	Public-Private Partnership
PV	Photovoltaic
SME	Small and Medium Enterprise
SWH	Solar Water Heating
TA	Technical Assistance
TSO	Transmission System Operator

## Dedication

This report is dedicated to the memory of Dr. Fathi Nsour, may his soul rest in peace. As ESCB's chief statistician Fathi was the engine that drove the successful completion of this first-ever national survey of household appliance holdings in Jordan. After retiring from a long and successful career with the Jordan Department of Statistics Dr. Fathi joined our team to lead our research into how Jordanian families use electricity. The survey results have been instrumental in helping Jordan's electricity distribution companies to choose the most-promising energy-saving measures for Jordan's households. Dr. Fathi's leadership, enthusiasm, technical skills, dedication, and good humor have been sorely missed since his passing. We dedicate this report to him in acknowledgement of his singular contributions to the household survey effort.



# Executive Summary

## *General*

The 2015 Jordan household electricity load survey, a first-of-its-kind effort, is an important initial step in developing Demand-Side Management (DSM) in Jordan. The survey included three separate studies, conducted by Jordan's electric distribution companies (DISCO) under the overall direction of the USAID-supported Jordan Energy Sector Capacity Building (ESCB) Activity. These studies provide critical information on how and when households use electricity, and thus are a key input to identifying and selecting electricity-saving policies and programs for Jordan's household consumers. This report combines information from the three individual DISCO reports to reflect the load survey information at the national level.

## *Methodology*

The national household load survey comprised a sample of 2,658 customers representing all residential consumer consumption categories.

The load survey project included four stages:

1. **Preparatory:** preparing, checking, and designing customer lists; designing and testing questionnaire forms; and preparing an instruction manual for interviewers and data processors.
2. **Field work:** mobilizing the interview teams; scheduling the surveys; collecting and quality-checking the survey; checking the completed questionnaires; data coding and entry; and trouble-shooting any problems with household access or data quality.
3. **Analysis:** performing statistical analysis; presenting and discussing results with DISCO management; preparing the report; and delivering the survey database to the DISCOs.
4. **Reporting:** compiling the national load survey report from the three individual DISCO reports.

A statistically-accurate sample of households served by each DISCO was drawn based on the DISCO-provided household data frame, using residential consumption values for 2014 and 2015. The survey excluded all non-residential consumers as well as households sharing the same electric meter or consumers with consumption of 33 kWh or less per month. The same questionnaire was used for all households throughout the three DISCOs.

Out of the 2,700 customers sampled, 2,658 completed the survey for an overall 98.4 percent response rate. Table ES-1 shows the distribution of the national sample according to consumption tier and DISCO.



Table ES-1: Distribution of national sample according to consumption tier and DISCO

		Tiers 1 & 2		Tiers 3 & 4		Tiers 5, 6, & 7		Total	
		No.	%	No.	%	No.	%	No.	%
Electricity company	JEPCO	821	56.0	688	67.6	141	81.1	1,651	62.1
	EDCO	203	13.8	94	9.2	15	8.3	311	11.7
	IDECO	442	30.1	235	23.1	18	10.6	696	26.2
Total		1,466	100.0	1,018	100.0	174	100.0	2,658	100.0

### ***Household Demographic Characteristics***

There are an estimated 1.366 million households in Jordan. Nearly one quarter (23%) of the interviewed households have three or fewer children. A majority of households (about 62%) contain four to seven people.

About 57% of households live in apartments, and two-fifths (40%) of the surveyed customers live in Dar housing.<sup>1</sup> Customers in Tiers 5, 6, and 7 have the highest villa ownership at nearly 9%. Nearly three quarters (75%) of those surveyed own their homes. More than half (56%) live in homes that are between 120 and 199 square meters and 85% live in homes smaller than 200 square meters. Most of the homes are older; slightly less than two-thirds (63%) were built prior to 2004, while only 24% of housing units have been built since 2005. About 69% of those surveyed reported a monthly average household income of 500 dinars or less.

### ***Household Lighting Patterns***

Most households use more than one type of lighting fixture. The majority (84%) use at least one compact fluorescent lamp (CFL); 76.2% use other types of fluorescent lamps; 40.1% still use incandescent lamps, and only 1.6% use LED lamps. (Note: because households have more than one type of lamp, the percentages do not add up to 100%).

The load survey results indicate there is an opportunity for households to replace incandescent, CFL, and fluorescent tube lamps (FTL) with LEDs. The total number of all CFLs, FTLs, and incandescent lamps in Jordanian homes is estimated to be 17.0 million.

### ***Household Appliance Holdings***

Customers in the national sample own a wide variety of household appliances. When the load survey data is extrapolated to the entire population, Jordanian households own an estimated 1.4 million refrigerators, 1.6 million TV sets, 1.4 million washing machines, and 205,100 freezers.

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<sup>1</sup> A "dar" is a rural separate house with fence and land around the house in the middle.

Three-quarters of those interviewed have one-door refrigerators ranging in size from five to 19 cubic feet. Nearly 36% of these refrigerators are more than ten years old, which means they are much less efficient than newer models. There is an opportunity to replace these older refrigerators with newer, more efficient models.

About half of households interviewed own top-loading washing machines; 35% of these washers are older than nine years. There is an opportunity to encourage these households to purchase more efficient front-loading washing machines, which also use much less water.

Sixty-one percent of surveyed households own electric water heaters. There is an opportunity to encourage households to invest in more efficient and less-costly solar water heating. So far only 13.7%<sup>2</sup> of households own solar water heaters, so a significant market potential remains for household solar water heating.

### ***Space Heating and Cooling Patterns***

Most Jordanians live in areas with higher elevation and cooler climates, and thus only one-quarter of households (27%) own AC units. Forty-two percent of these units are one ton or less in capacity, and 39% are older than five years. There are an estimated 573,400 AC units in Jordanian households. In contrast to AC, most households (69%) own electric fans, which they use for cooling. Households own an estimated 2.2 million fans. The ratio of fans to AC units is 7.4:1 for low-consumption households (Class 1), 3.4:1 for medium - consumption households (Class 2), and only 0.99:1 for high-consumption households. Overall, the fan to AC ratio is 3.8:1. These figures confirm that more affluent and higher-consuming customers are more likely to have AC systems than to use fans.

Not many households (13%) heat their homes with electric space heaters. There are an estimated 409,000 electric heaters in Jordanian homes. In contrast, 55% of households heat with bottled gas, 28% heat with kerosene/diesel stoves, and 11% heat with wood. Six percent of households have central heating systems (diesel-fueled boiler systems).

### ***Consumer Electricity Bills***

About 62% of surveyed households reported their average monthly electricity bill in summer to average between 15 and 49 dinars. Overall, those surveyed reported slightly lower bills in winter than in summer (59% vs. 62%).

### ***Consumer Awareness of Energy Efficiency***

Forty-four percent of households believe they can reduce their electricity bills, compared to 48% who believe they cannot reduce their bills. The overwhelming majority (90%) report turning off appliances not in use to save energy. About 38% reported purchasing energy efficient electric equipment. Thirty-two percent adjust thermostat levels. Only 23.4% reported performing regular maintenance to maintain efficiency levels.

Surveyed households tend to learn about energy efficiency from: television (77%); relatives/friends or radio (approximately 26% each); vendors (21.7%); newspapers and magazines (20.3%); internet (17.3%); and MEMR or their utility (9%). Forty-five percent prefer

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<sup>2</sup> MEMR Household Energy Survey 2013 estimated 13.5% penetration of solar water heaters.

to receive information about energy efficiency from TV, followed by SMS (35.9%), newspapers and magazines (5.7%) and internet (5.3%).

### ***Recommendations***

The load survey results suggest several DSM measures could yield significant energy savings for customers nationwide. Based on the data gathered from the survey, the DISCOs should consider the following DSM program concepts for application within their service territories.

- **Replace all incandescent, CFL, and FTL lighting with LEDs.** Survey data shows that 40.1% of households use energy-inefficient incandescent lighting and 76% use fluorescents. LED lighting penetration is very low, at 1.6%, presenting a major opportunity for a lighting replacement program. Because existing FTL fixtures cannot take LEDs without some sort of adaptor, offer consumers an incentive to install LED-dedicated fixtures.
- **Replace older one-door refrigerators with more efficient models.** Thirty-six percent of single-door refrigerators are more than ten years old and are less energy efficient than modern refrigerators.
- **Replace older one- and two-basin washing machines with more efficient automatic machines.** Thirty-five percent of top-loading washing machines are more than nine years old and are less energy and water efficient than more recent models, indicating that a washing machine replacement program could yield significant energy savings.
- **Replace electric and gas water heaters with solar water heaters.** Sixty-one percent of households own water heaters, but only 13% of households own solar water heaters, indicating there is significant opportunity to move households toward more energy efficient options.
- **Offer incentives for energy efficient AC units.** While only 27% of households own AC units, that percent represents 573,400 units in Jordanian households. Offering incentives to households for replacement would help bring the cost of energy efficient units on par with less efficient models. Since AC purchases have risen in recent years, DISCOs should encourage those customers purchasing AC for the first time to purchase energy efficient models.

# 1 Background and Study Methodology

## 1.1 Introduction

Load surveys are essential tools for planning and efficiently operating power systems. Load surveys identify appliance holdings and consumption patterns, thus ensuring that energy saving programs are targeted properly to maximize investment impact. Moreover, load survey results help utilities more accurately forecast load and the associated costs. Finally, load surveys provide insights into consumer energy consumption habits, and thus help utilities identify where they may be able to persuade consumers to change those habits.

The first-ever 2014 Jordan Household Load Survey is considered an important first step in developing distribution company (DISCO) led DSM programs in Jordan. The USAID-supported Energy Sector Capacity Building (ESCB) activity supported EDCO's, JEPCO's, and IDECO's load survey efforts. In addition to helping the DISCOs better target their energy efficiency efforts, the household load survey provides valuable inputs for decision makers developing national electricity sector policies and programs.

The National Load Survey included 2,700 households drawn from all residential consumption categories and the three DISCOs' service territories.

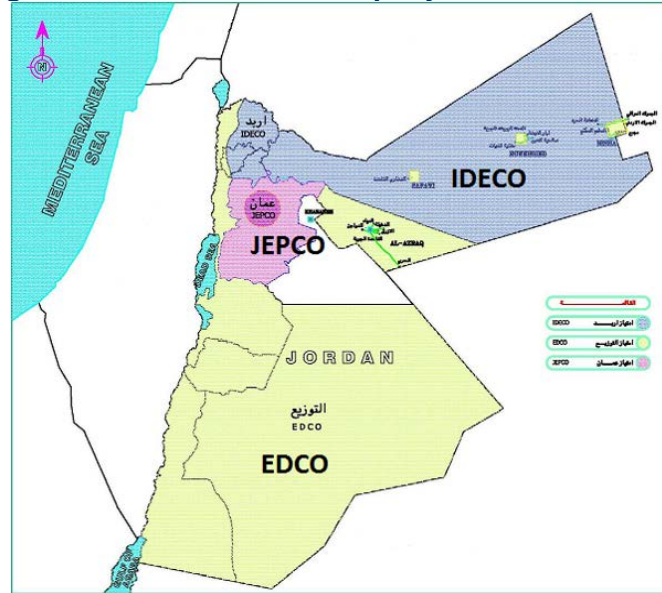
The National Load Survey collected extensive data on household characteristics and electricity consumption patterns, including demographics, housing types, lighting fixtures, electrical appliance ownership and vintage, space and water heating usage, and attitudes and propensities toward saving energy. This report analyzes results on a national level; ESCB already has provided each DISCO with a findings report specific to its customers and service territory.

## 1.2 Background

Jordan's electricity needs are served by three privatized and regulated distribution companies that together serve the entire country. The government, through the Ministry of Energy and Mineral Resources (MEMR) shares responsibility for overseeing the electricity sector with the Energy and Mineral Regulatory Commission (EMRC), and the National Electric Power Company (NEPCO). Figure 1.1 shows the three licensed distribution companies' service territories.

Virtually all (99%) of fixed housing units are connected to the public electricity network.

**Figure 1.1: Distribution Company Service Territories**



### 1.3 Energy Policies and Programs

Jordan imported 97% of its energy needs in 2013 at a total cost of 4 billion JD. Petroleum products supplied 85% of primary energy consumption, with natural gas providing 12%. While renewable energy provided just 0.5% of total energy needs, it represents a growing energy source for Jordan. Jordan's electricity sector currently suffers from increased production costs because natural gas supplies from Egypt have been interrupted. The higher costs have caused the National Electric Power Company (NEPCO) to accrue accumulated losses of 4 billion JD as of the end of 2014. In response, the Government has increased the electricity tariff for the period of 2013-2017; the increase averages 15% annually for all consumer categories except the lowest residential and agricultural consumption tiers.

The Government has also taken steps to diversify the electricity supply. MEMR's original Energy Strategy 2007-2020 anticipated that renewable energy would meet 10% of total electricity demand by 2020.<sup>3</sup>The Renewable and Energy Efficiency Law, enacted in 2012, established a fund to help develop renewable energy and energy efficiency, and created a process for private developers to construct large wind and photovoltaic (PV) power plants.<sup>4</sup>The National Energy Efficiency Action Plan, published in 2013, calls for energy efficiency and demand-side renewable energy to reduce Jordan's 2010 electricity consumption by 20% by 2020, which is equivalent to 2,000 GWh of energy savings over the next six years, or 7% of forecasted 2020 energy consumption.

In 2014 MEMR, in cooperation with EMRC and with the participation of Jordan's four electricity companies, recommended that the utilities implement a package of demand-side management (DSM) measures be implemented to help meet the 2020 savings goals. The recommendations provide the basis for Jordan's electric utilities to deliver energy-saving measures to their customers, and to receive an incentive for successfully meeting the 2020

<sup>3</sup> Updated Master Strategy of Energy Sector in Jordan for the period (2007-2020)

<sup>4</sup> Law No. 13 of 2012, Renewable Energy & Energy Efficiency Law

goals. The proposed DSM measures will help address Jordan's systemic energy challenges by reducing the country's rapid energy demand growth, which has averaged 6% annually for the past decade, and thus reducing oil and gas imports. These measures, several of which are targeted to subsidized residential customers, also will help reduce subsidy flows into and within the electricity sector.

The National Household Load Survey plays a small but important role in helping the country meet its targets. The survey establishes the DISCOs' capacity to collect and use customer end-use consumption information that will help them operate more efficiently and expand their networks to meet the expected future demand. It will also help each DISCO's DSM Unit more accurately forecast potential costs and savings from proposed DSM initiatives.

In addition to providing information about consumer energy use, the survey also helped identify technologies around which the DISCOs could potentially build DSM programs, thus curbing high electricity demand. The current survey targeted residential consumers, but DISCOs can use the same methodology to survey other customer classes in the future.

#### **1.4 Load Survey Objectives**

The load survey objectives were to:

- Provide detailed information about household electrical appliance ownership, including numbers, types, sizes/capacities, age, and manufacture;
- Identify appliance consumption patterns and their driving factors, as well as consumer awareness of energy efficiency measures and willingness to reduce consumption;
- Identify promising energy saving opportunities and target markets;
- Establish a database for use in demand forecasting and distribution planning; and,
- Build the capacity of distribution companies to plan and conduct load surveys and use the results.

#### **1.5 Load Survey Methodology and Organization**

The DISCOs and ESCB co-implemented the load survey. ESCB provided technical and field support, including survey instrument design, interview training, data entry and processing, and reporting. Engineers and meter readers from each DISCO together with female interviewers hired and trained by ESCB conducted the field work.

The load survey effort included four stages: (1) preparation, (2) field work, (3) analysis, and (4) reporting. During the **preparation stage**, DISCOs provided ESCB with customer lists, which ESCB staff then checked and used to select the sample. ESCB staff designed and tested the surveys as part of this stage, and then prepared an instruction manual for interviewers and data processors.

The **field work** stage included mobilizing the interview teams, obtaining the Department of Statistics official ID cards required for all authorized interviewers, and collecting the data. It also included quality-checking the completed questionnaires, coding and entering the data, and trouble-shooting any problems with household access or data quality.

The **analysis** stage included performing statistical analysis, and presenting and discussing results with each DISCO’s management.

Finally, the **reporting** effort involved preparing individual DISCO reports, delivering DISCO-specific load survey databases, and compiling the national load survey report.

### 1.6 Sample Design

ESCB designed the sample to yield statistically-accurate data on residential load characteristics across the three DISCO service territories. The sample was drawn based on the household data frame provided by each DISCO, using residential consumption values for 2014 and 2015. The sample excluded all non-residential consumers as well as households sharing the same electric meter or consumers with consumption less than 33 kWh per month.<sup>5</sup> DISCO-provided data included the consumer’s governorate, city/town, area, and average monthly consumption based on the previous twelve months. Each consumer was given a unique identifying number linked to DISCO consumer records.

ESCB stratified the sample based on consumption categories. The survey assigned customers to one of three classes that corresponded to the seven retail tariff tiers as follows:

- Class 1: tariff tiers 1 and 2 (consumption 300 kWh and less)
- Class 2: tariff tiers 3 and 4 (consumption from 301 to 600 kWh)
- Class 3: tariff tiers 5, 6 and 7 (consumption more than 601 kWh)

The sample size and distribution among the three classes were calculated to attain  $\pm 10\%$  relative precision at the 90% confidence level.<sup>6</sup> The total sample size was 2700 consumers, drawn randomly; table 1.1 shows their distribution.

**Table 1.1: Number of consumers in the national household load survey sample**

Class	Total number	Sample size
Class 1: tariff tiers 1 and 2	753,556	1,000
Class 2: tariff tiers 3 and 4	523,017	850
Class 3: tariff tiers 5, 6 and 7	89,639	850
<b>Total</b>	<b>1,366,212</b>	<b>2,700</b>

#### 1.6.1 Survey Instrument

All three DISCOs used the same survey instrument, which was prepared by the ESCB study team in collaboration with teams from JEPCO, EDCO, and IDECO. The survey instrument covered the following six sections.

1. **Housing unit characteristics:** including type, ownership, surface area, and year of construction.
2. **Lighting information:** including number and type of lighting fixtures, and hours of operation during summer and winter.

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<sup>5</sup> The sample also excluded the temporary dwellings used by Syrian refugees that house more than one family

<sup>6</sup> The sample frame selection was consistent with the so-called “90/10” rule as originally set by Federal legislation via the Public Utilities Regulatory Policy Act (PURPA) of 1978 and Code of Federal Requirements CFR 290.403 (b). The “90/10” minimum sample design criterion has become an industry-wide de facto standard recognized by most state utility commissions.

3. **Electrical appliances:** including number, size/capacity/wattage, manufacture, and vintage year.
4. **Space and water heating and cooling equipment characteristics:** including type of AC and heating unit, usage intensity of AC and heat units, and cost of cooling / heating expenditures.
5. **Questions on energy savings awareness and propensity to save:** including average electricity bill for the last twelve months, knowledge or awareness of energy efficiency, source of energy efficiency information, and experience in trying energy savings measures.
6. **Household income and expenditures:** monthly income for all household members from all sources and average monthly expenditures for all household members.

### ***1.6.2 Staffing Recruitment***

ESCB hired female engineers to conduct interviews, and each DISCO made meter readers available to establish three mixed-gender field teams. Each DISCO also allocated one engineer to be its survey's overall field supervisor and general supervisor. All of the teams cooperated well in conducting the survey.

### ***1.6.3 Training and Pre-Test***

The field personnel received training that included background information about household consumption, electrical appliance characteristics, energy efficient appliances, and conservation measures. The training also included instructions for conducting the interviews, including cultural and gender consideration; an explanation of the reason for each question; and mock interviewing sessions in which trainees took turns playing interviewer and respondent roles.

Survey teams conducted pretests to familiarize themselves with the survey instrument. Each team interviewed households in different parts of the service territory. Survey trainers held discussions before and after the pretest to capture interviewers' experiences with the survey instrument; ESCB staff then modified the survey instrument to reflect the pretest experience. Survey teams had additional training to address problem areas encountered during the pretest.

### ***1.6.4 Field Work and Logistics***

Each DISCO established field offices to coordinate and monitor survey execution. Field supervisors oversaw the survey teams to ensure the survey was conducted according to plan and addressed problems or logistical issues quickly.

Each survey team included a lead interviewer who conducted the interview and a second team member who completed the data collection form during the interview. The field supervisors checked completed questionnaires in the field and the field teams made repeat visits to those homes from which clarifications or corrections were needed. At the end of each day, the completed questionnaires were collected, checked, and prepared for data entry and processing.

### ***1.6.5 Data Processing***

Data processing started two weeks after the field work. Completed questionnaires were checked and verified prior to computer entry. System analysts conducted the office work in



Amman, where they registered and coded completed questionnaires, including open-ended questions. Analysts used CSPro software to check data entry; the software automatically checks and verifies data while it is being entered.

### 1.6.6 Field Work Results

Table 1.2 compares the number of customers from the original sample to the number of completed surveys. The survey teams successfully interviewed 2,657 of the 2,700 targeted customers for a 98.4% response rate.

**Table 1.2: Number of households, interviews, and response rates by class**

Class	Number of Sample Units		Response Rate %
	Intended	Completed	
Class 1: Tiers 1 and 2	1,000	994	99.4
Class 2: Tiers 3 and 4	850	848	99.8
Class 3: Tiers 5, 6, and 7	850	815	95.9
<b>Over all sample response</b>	<b>2,700</b>	<b>2,657</b>	<b>98.4</b>
Average response rate = (number of households completed/intended households) * 100			

## 2 Customer Characteristics

This chapter presents survey findings on residential consumers' social, economic and housing characteristics. The following sections address:

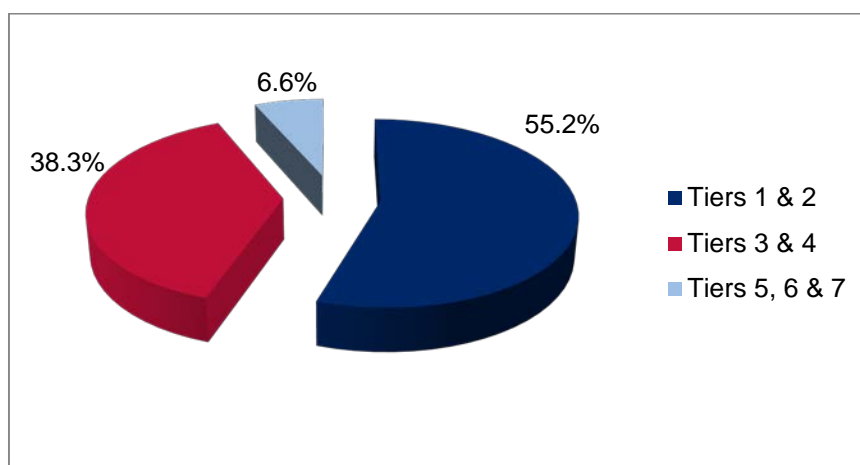
- Housing location
- Electricity consumption
- Household composition, including number and age of household members
- Housing characteristics, including type, size, ownership and vintage
- Monthly household income and expenditure.

To facilitate the analysis, ESCB grouped customers into three classes according to the electricity tariff: Class 1 (tariff tiers 1 and 2); Class 2 (tariff tiers 3 and 4); and Class 3 (tariff tiers 5, 6, and 7).

### 2.1 Number of households

The DISCOs serve an estimated 1.366 million households spread across the Kingdom. Figure 2.1 shows the distribution of consumption tiers for the national sample.

**Figure 2.1: Percentage distribution of consumption tiers (%)**



### 2.2 Household Demographics

Figure 2.2 explores the relationship between consumption class and family size. It shows that a majority of households have 4-7 members, this is true across all consumption classes with little variation. A greater proportion of low-consuming households are occupied by smaller families; however, very large families make up about the same proportion of households regardless of consumption levels.

Figure 2.2: Family size by consumption level

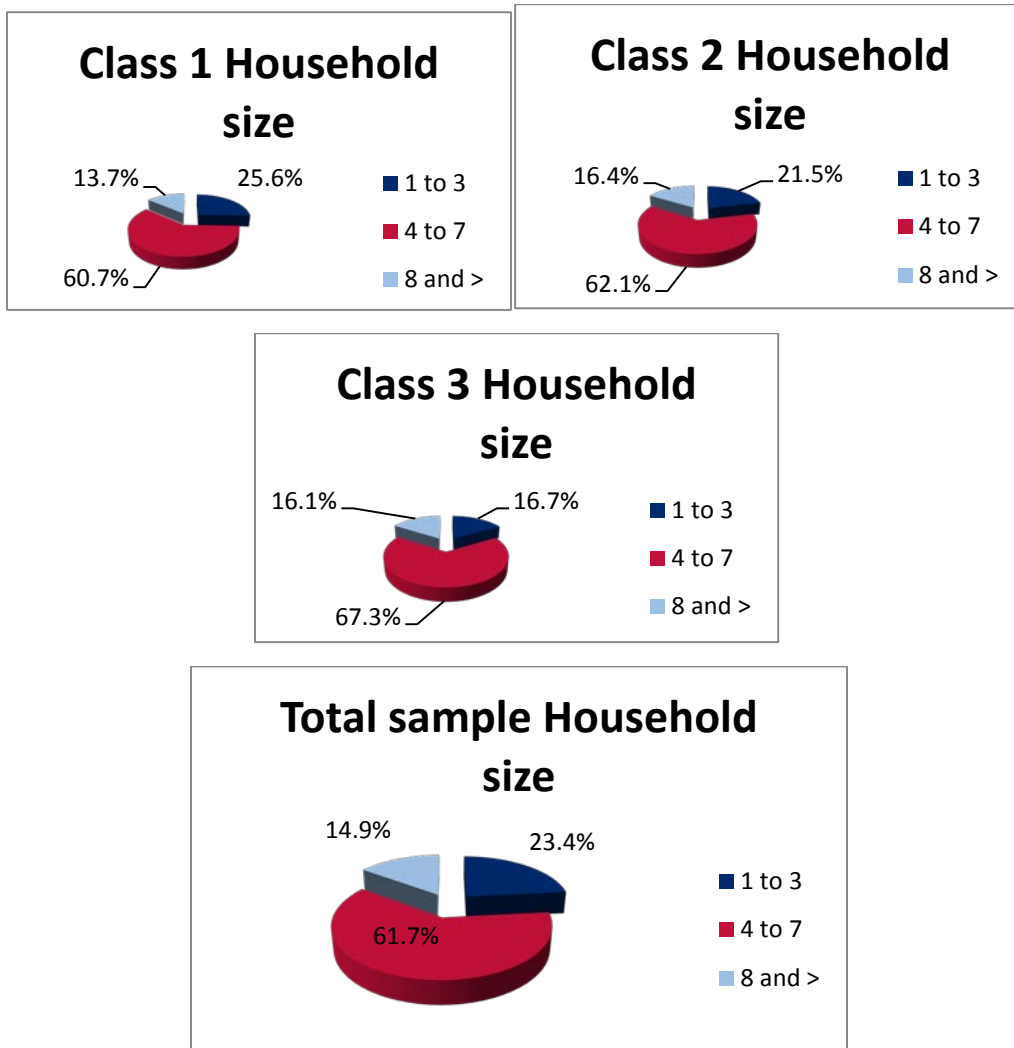


Table 2.2: Household distribution by class and size

		Class 1		Class 2		Class 3		Total	Total
		count	%	count	%	count	%	Count	%
Number of HH members	1-3	375	25.6	219	23.4	29	16.7	623	23.4
	4-7	890	60.7	632	61.7	117	67.3	1,639	61.7
	8 & above	200	13.7	167	14.9	28	16.1	396	14.9
Total		1466	100.0	1018	100.0	174	100.0	2,658	100.0

The survey also found a correlation between high-income families that own homes larger than 200 square meters, constructed prior to 2004, and large family size (8 or more members).

### **2.3 Housing Unit Characteristics**

Approximately 57% of the housing units in Jordan are of the apartment type, while nearly 40% are the "Dar" type. Nearly three-quarters of those surveyed (75.4%) own their home or apartment. The proportion of high-consuming households owning their own home is even higher (84%).. Most homes (56%) have a surface area between 120 and 199 square meters. Very few homes (12%) are larger than 200 square meters.

The survey shows that consumption correlates strongly with housing size; 39% of the highest-consuming households live in housing units larger than 200 square meters compared with 17% and 10% for classes 2 and 3 respectively. Approximately 24% of housing units have been built since 2005. Consumption correlates weakly with housing age; older homes tend to consume more electricity than do newer homes.

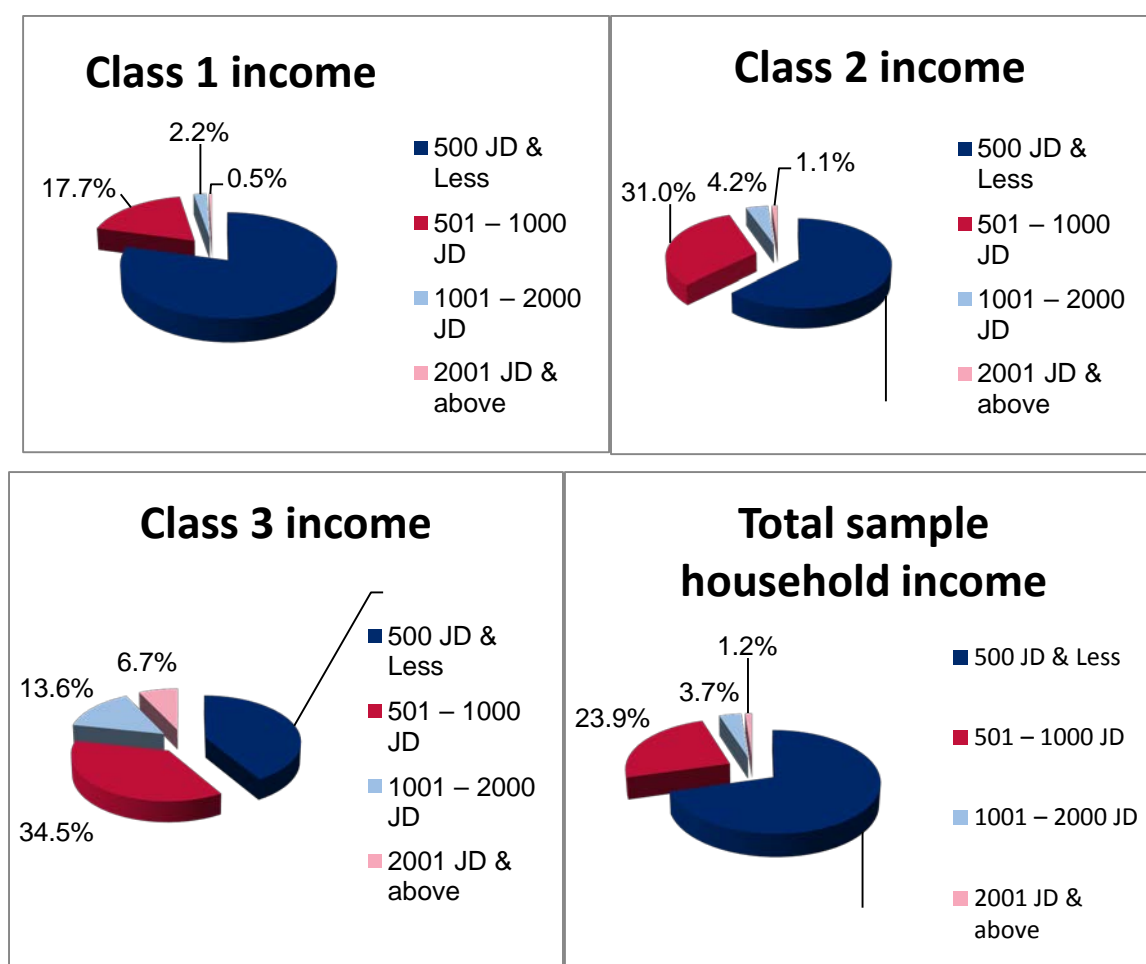
**Table 2.1: Household distribution by class and housing unit characteristics**

Housing Unit Characteristics	Class			
	Class 1	Class 2	Class 3	Total
	%	%	%	%
<b>Housing Unit Type</b>				
Villa	1.0	1.6	8.7	<b>1.7</b>
Dar	43.7	37.3	30.6	<b>40.4</b>
Apartment	54.7	60.4	60.6	<b>57.3</b>
<b>Ownership</b>				
Owned	73.1	77.1	84.3	<b>75.4</b>
Rented	26.9	22.9	15.7	<b>24.6</b>
<b>Housing Surface Area (in m<sup>2</sup>)</b>				
25-119	34.5	22.6	11.8	<b>28.5</b>
120-199	54.5	60.5	48.3	<b>56.4</b>
200+	10.3	16.7	39.1	<b>14.6</b>
<b>Year Home was Constructed</b>				
Before 1990	32.4	31.1	28.6	<b>31.7</b>
1990-2004	28.3	33.3	36.1	<b>30.8</b>
2005 & above	26.2	21.3	25.7	<b>24.3</b>

### **2.4 Household Income**

Nearly 69% of the households surveyed reportedly earn less than 500 dinars per month (Figure 2.3). Income is correlated with electricity consumption; 55% of the households that fall into the highest consumption tiers have incomes that exceed 500 dinars compared to only 36.4% and 20.4% for classes 2 and 1 respectively.

**Figure 2.3: Household distribution by income (JD)**



#### **2.4 Weighted and Un-Weighted Customer Numbers**

Table 2.2 presents the weighted and unweighted numbers of interviewed households in the sample. The unweighted numbers reflect the total sample share allocated to each consumption strata. The weighted numbers reflect each stratum's weight relative to the entire household population. ESCB calculated the weighted figures to obtain a more accurate representation of how the three classes are distributed across the actual population. While Class 3 represents the smallest population percentage, the ESCB sample for this class is almost as large as the samples for the other two classes because there is greater variation around the average consumption in this class. As a result, we needed to survey a larger sample size relative to the population to ensure an accurate representation. The ultimate statistical weight reflected each class's true weight in the population.

**Table 2.2: Percentage distribution of weighted and un-weighted cases**

Class	Un-weighted cases		Weighted cases	
	Number	%	Number	%
Class 1	995	37.4	1568	58.9

Class 2	848	31.9	944	35.5
Class 3	815	30.7	145	5.5
<b>Total</b>	<b>2658</b>	<b>100.0</b>	<b>2657</b>	<b>100.0</b>

### 3 Household Lighting Profiles

The load survey asked respondents about use of household lighting, including the number and type of lighting fixtures, and summer and winter lighting hours. The following sections present the survey's household lighting findings according to household characteristics and electricity consumption.

#### 3.1 Introduction

The survey instrument included detailed questions about the type, number and capacity of lighting fixtures in the home. This information can be used to identify not only the type of lighting currently in use, but also to pinpoint opportunities for lighting efficiency improvements.

There are four types of lighting commonly found in Jordanian households: incandescent lamps, fluorescent tube lamps, compact fluorescent lamps (CFLs), and LED lamps. Other types such as halogen or High Intensity Discharge (HID) are not commonly used for household lighting; the survey did not find these lights in residential customer homes.

The efficiency with which lamps use energy and the lamp lifetime vary according to the lamp type. Incandescent lamps are the most inefficient and have the shortest lifetime. CFLs and FTLs have longer lives and are much more efficient. LED lamps, the newest to enter the market, have the highest efficiency levels and longest lifetimes. The average LED lamp lifetime is 40,000 hours compared to 10,000 hours for a CFL and only 1,000 hours for an incandescent lamp. Table 3.1 shows the numerical comparisons.

**Table 3.1: Efficiency and Lifetime Comparisons for 60W and Equivalent Lamps**

Lamp fixture type	Average efficiency (Lumen <sup>7</sup> /W)	Average Lifetime (hours)
<b>Incandescent</b>	5-15	800-1,200
<b>CFL</b>	40-70	6,000-15,000
<b>FTL</b>	55-90	20,000-30,000
<b>LED</b>	90-120	30,000-50,000

#### 3.2 Incandescent Lamps

Table 3.2 shows that 60% of households neither have nor use incandescent lamps. Of the remaining 40%, about half (18%) have one or two incandescent lamps, while the other half (19%) still use three or more of these low-efficiency lamps. Incandescent lamps have the lowest penetration in Classes 1 and 2 households (40 and 39% respectively) and a slightly higher penetration (46%) in Class 3 households. Since some Jordanian consumers still use incandescent lamps, and the energy savings from switching to LED lamps are very high, any efficient lighting should include an incandescent replacement initiative.

<sup>7</sup> A lumen is a measure of the total amount of visible light, or illumination, emitted by a light source

Families that live in villas or “Dar” housing seem to use fewer incandescent lamps than do other households. Newer households (i.e., those built after 2005) also seem to have fewer incandescent lamps; the reasons for this are not clear.

**Table 3.2: Incandescent lamp usage by class**

Class	Number of Incandescent Lamps			
	Not using	1-2	3 & above	Total= 100
	%	%	%	
Class 1	59.9	20.9	19.1	1466
Class 2	61.0	15.6	23.2	1018
Class 3	53.6	11.7	34.7	174
<b>Total</b>	<b>59.9</b>	<b>18.3</b>	<b>21.8</b>	<b>2658</b>

### 3.2 Compact Fluorescent Lamps (CFLs)

Table 3.3 shows that CFL lamps are the most commonly found form of lighting in Jordanian households. Approximately 83% of households use CFL lamps, with higher use by higher consumption class (86.5% for Class 3 compared to 84.6% and 81.5% for Classes 2 and 1 respectively). Moreover, within Class 3 the percentage of households using more CFLs is higher (20% of Class 3 households use 20 and more CFLs compared to only 7.2% and 4% for Classes 2 and 1 respectively).

**Table 3.3: CFL lamp usage by class**

Class	Number of CFLs					Total = 100
	Not using	1-4	5-9	10-19	20 & above	
	%	%	%	%	%	
Class 1	18.5	30.3	29.9	17.3	4.0	1466
Class 2	15.4	23.0	28.4	25.9	7.2	1018
Class 3	13.5	14.9	19.3	32.0	20.0	174
<b>Total</b>	<b>16.4</b>	<b>32.4</b>	<b>30.0</b>	<b>15.6</b>	<b>5.6</b>	<b>2658</b>

### 3.3 Fluorescent Tube Lamps

Table 3.4 shows that 76.2% of Jordanian households use fluorescent tube lamps (FTLs). There seems to be no difference in FTL use by electricity consumption level; all households use this type of lighting. About 30% of households have between one and three FTLs, while 42.6% use between four and ten FTLs.

**Table 3.4: Percentage distribution of households by number of FTLs used, and class**

Class	Number of Fluorescent Lamps				Total=100 No.
	Not using	1-3	4-10	11& above	
	%	%	%	%	
Class 1	22.7	31.8	42.7	2.8	1466
Class 2	24.9	27.3	42.9	4.8	1018
Class 3	25.6	24.4	40.1	9.9	174
<b>Total</b>	<b>23.8</b>	<b>29.6</b>	<b>42.6</b>	<b>4.0</b>	<b>2658</b>

### 3.4 LED Lamps

Only 1.6% of households surveyed reported having any LED lamps. LEDs are much more expensive on a unit basis than other lamp types with prices ranging from 4 to 6 JD in 2014, and consumers are less aware of the lamps' benefits overall. Consumers need an additional connector to replace FTLs with LEDs, which presents an additional barrier to LED adoption.

### 3.5 CFL and/or Fluorescent Tube Lamps

The survey results indicate that almost all DISCO households (97.7%) use some fluorescent lighting, either CFL or FTL. Table 3.5 shows that 61.5% of households use both types of lamps.

**Table 3.5: Household distribution of CFL and/or FTL by class**

Class	Using CFL and/or FTL				Total = 100
	None	CFL Only	FTL Only	Both	
	%	%	%	%	
<b>Class 1</b>	2.2	20.7	16.3	60.8	1466
<b>Class 2</b>	2.4	22.5	13.0	62.0	1018
<b>Class 3</b>	3.0	22.4	10.5	64.1	174
<b>Total</b>	<b>2.3</b>	<b>21.5</b>	<b>14.7</b>	<b>61.5</b>	<b>2658</b>

### 3.6 Outdoor Lighting

An insignificant number of survey respondents (0.8%) use outdoor lighting. The response level is too small to provide a sufficient basis for meaningful analysis.

### 3.7 Estimated Total Number of Lamps

Almost all households use multiple lamp types. Table 3.6 indicates the proportion of households that own each type of lamp, by class.

**Table 3.6: Percentage of lamps in each class, by type**

Class	Type of lamp			
	Incandescent	CFL	LED	Fluorescent
<b>Class 1</b>	46.2	46.9	57.8	51.8
<b>Class 2</b>	37.1	41.9	17.9	40.2
<b>Class 3</b>	16.7	11.2	24.2	8.0
<b>Total</b>	<b>14.7</b>	<b>54.7</b>	<b>1.9</b>	<b>28.6</b>

Table 3.7 presents an estimate of the total number of lamps based on the proportion between the sample and the total number of households. The survey found a total of 18 million lamps of all types, of which almost half (9.8 million) are CFLs, five million (29%) are fluorescent tubes, 2.6 million (14.7%) are incandescent, and 341 thousand (1.9%) are LED.



**Table 3.7: Lamp distribution throughout Jordanian households (in 000)**

Class	Type of Lamp					Total	%
	Incandescent	CFL	LED	Fluorescent			
Class 1	1,227	4,630.9	197.2	2,678.1	8,733.2	48.4	
Class 2	987.5	4,137.6	61.1	2,077.7	7,263.9	40.3	
Class 3	443.9	1,105.6	82.6	411.8	2,043.9	11.3	
<b>Total</b>	<b>2,658.4</b>	<b>9,874.1</b>	<b>340.9</b>	<b>5,167.6</b>	<b>18,041</b>	<b>100.0</b>	
<b>%</b>	<b>14.7</b>	<b>54.7</b>	<b>1.9</b>	<b>28.6</b>	<b>100.0</b>		

### 3.8 Daily Lighting Hours

Daily lighting hours differ by season because natural light is more available in the summer than in the winter. The survey instrument asked respondents about their seasonal lighting usage in the common living areas. Table 3.8 indicates that all consumption classes leave the lights on for longer hours in winter more than summer.

**Table 3.8: Distribution of living room daily lighting hours in summer and winter, by class**

Class	Month			
	1-6		7-12	
	Summer	Winter	Summer	Winter
	%	%	%	%
Class 1	73.9	31.6	23.8	66.1
Class 2	62.8	25.1	34.2	71.8
Class 3	54.7	26.9	43.8	71.6

Table 3.8 shows there is not a strong correlation between lighting hours and consumption class. It is reasonable to expect that Class 1 consumers would use less lighting than consumers in Classes 2 or 3, but this is not the case. It may be the case that consumers understand that lighting costs less to use than other appliances, but increasing lighting use certainly increases consumer electricity bills.

### 3.9 Potential Efficient Lighting DSM Programs

The survey of lighting usage in Jordanian households suggests several possible DSM programs:

- **LED replacement program for incandescent and compact fluorescent lamps:** A surprising number of high-usage households (14.7%) are still using incandescent lamps. Many households have replaced some of their incandescent lamps with CFLs over the past few years. Consumers have had mixed success with the performance and lifetime of CFLs, especially those purchased without any product quality guarantees. Consumers may respond well to a lighting program that offers LEDs to replace both remaining incandescent lamps and CFL lamps. Such a program promises to be both cost-effective and easy to implement.

- **LED replacement program for FTLs:** FTL usage is somewhat high (28.6%). An LED-for-FTL replacement program would have definite advantages for households, providing more efficient lighting that also will last longer. This program might be targeted to low-income households because many more Class 1 households use FTLs (52% compared with 40% and 8% for Classes 2 and 3 respectively).

## 4 Appliance Ownership and Usage

This chapter presents survey results regarding the appliances most commonly found in the Jordanian households. Note that Chapter 5 discusses hot water heaters, and Chapter 6 presents findings on heating and cooling systems. In addition to counting the number of appliances owned by each household, this chapter also presents information on appliance size, age, and manufacture (i.e., imported or local). The results are presented by consumption class, and in some cases according to other independent variables such as income, expenditure, number of family members, type of housing unit, year of construction, and surface area of household. Some results are noted without the accompanying data for the sake of brevity.

### 4.1 Television Sets

There are two kinds of televisions (TVs) in Jordan: older cathode ray tube (CRT) televisions and newer liquid crystal display (LCD) televisions. Approximately 54% of households have CRT TVs. These TVs are most common in Class 1 households (59%) and less common in Class 2 households (50%) and Class 3 households (39.3%). Forty percent of the CRT TVs are ten years old or older. CRT TVs are considerably less energy efficient than are LCD TVs.

**Table 4.1: CRT TV distribution by class**

Class	No. of CRT TV			Total = 100
	Not using	1	2+	
	%	%	%	
Class 1	41.1	56.4	2.6	1466
Class 2	50.0	45.5	4.5	1018
Class 3	60.7	33.4	5.9	174
<b>Total</b>	<b>45.8</b>	<b>50.7</b>	<b>3.5</b>	<b>2658</b>

Table 4.2 shows that LCD TVs are making inroads with Jordanian customers: about 54% of households own one or more LCD TV sets and 76% of Class 3 households own at least one LCD TV. Overall, only 6% of households own two or more LCD TV sets. The most common TV screen size is 32 inch (56.4%). About 79% of all LCD TVs are less than 4 years old.

**Table 4.2: LCD TV distribution by class**

Class	No. of LCD TVs			Total = 100
	Not using	1	2+	
	%	%	%	
Class 1	53.6	43.3	3.0	1466
Class 2	38.8	54.2	7.1	1018
Class 3	23.7	53.9	22.4	174
<b>Total</b>	<b>46.0</b>	<b>48.2</b>	<b>5.9</b>	<b>2658</b>

Virtually every household (99%) owns one or more CRT and/or LCD TVs (Table 4.3).

**Table 4.3: Television ownership by class**

Class	Type of TV				Total = 100
	None	CRT TV Only	LCD TV Only	Both	
	%	%	%	%	
Class 1	1.6	52.1	39.5	6.9	1466
Class 2	1.1	37.7	49.0	12.3	1018
Class 3	0.5	23.3	60.2	16.1	174
<b>Total</b>	<b>1.3</b>	<b>44.7</b>	<b>44.5</b>	<b>9.5</b>	<b>2658</b>

#### 4.2 Dishwashers

Very few households (2%) own dishwashers. Class 3 households have the highest dishwasher ownership at 9.1%. Most dishwashers (65%) are less than four years old.

**Table 4.4: Dishwasher ownership by class**

Class	Owned	Total = 100
	%	
Class 1	1.3	1466
Class 2	1.7	1018
Class 3	9.1	174
<b>Total</b>	<b>2.0</b>	<b>2,658</b>

#### 4.3 Refrigerators

Jordanian households typically possess either a one-door or two-door refrigerator. Almost all households sampled (97%) own at least one one-door refrigerator. A few households (3%) own more than one one-door refrigerator.

**Table 4.5: One-door refrigerator distribution by class**

Class	No. of one door refrigerator			Total = 100
	Not using	1	2+	
	%	%	%	
Class 1	2.7	95.0	2.3	1466
Class 2	3.0	93.7	3.4	1018
Class 3	7.6	86.1	6.2	174
<b>Total</b>	<b>3.1</b>	<b>93.9</b>	<b>2.9</b>	<b>2,658</b>

The most common size of one-door refrigerator is 15-19 cubic feet (60%) (Table 4.6).

**Table 4.6: One-door refrigerator distribution, by number and size**

Size in feet	No. of one-door refrigerators		
	1	2+	Total
	%	%	%
5-14	18.0	12.5	17.8
15-19	59.7	65.6	59.9
20-42	22.3	21.9	22.3
<b>Total = 100</b>	799	32	831

Nearly 30% of the one-door refrigerators in Jordanian households are more than ten years old. Because refrigerator efficiency has increased rapidly over the past decade, there is an opportunity to save energy by encouraging customers to replace these older models with energy efficient newer models. Almost two-thirds (64.3%) of one-door refrigerators are more than five years old, while 31.6% are four years old or less (Table 4.7).

**Table 4.7: One-door refrigerator distribution, by number and age**

Age in years	No. of one-door refrigerators			
	1	2	3-5	Total
	%	%	%	%
0-4	31.8	25.1	17.8	31.6
5-9	28.0	32.7	28.1	28.2
10-14	17.7	20.5	51.7	17.9
15-32	18.3	14.9	2.4	18.2
Unknown	4.1	6.8	0.0	4.2
<b>Total = 100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

As is the case with TV sets, refrigerator ownership among Jordanian households is nearly universal. Table 4.8 shows that 98.8% of households own either one door or two door refrigerators.

**Table 4.8: One- and/or two-door refrigerator distribution by class**

Class	Type of refrigerator				Total = 100
	None	One door only	2 doors only	Both	
	%	%	%	%	
Class 1	1.6	97.1	1.1	0.2	1466
Class 2	0.7	96.6	2.3	0.5	1018
Class 3	0.3	90.7	7.3	1.7	174
<b>Total</b>	<b>1.2</b>	<b>96.5</b>	<b>2.0</b>	<b>.4</b>	<b>2658</b>

#### **4.4 Freezers**

Table 4.9 shows that just 13.4% of residential households own vertical freezers, and horizontal freezers are virtually nonexistent (1.3%). Vertical freezer ownership varies according to consumption class; 34% of Class 3 households own freezers. Results show that 78% of freezers are 19 cubic feet or less, almost 44% less than four years, and almost all (87%) are imported.

**Table 4.9: Vertical freezer distribution by class**

Class	No. of Vertical Freezers			Total = 100
	Not using	1	2-5	
	%	%	%	
Class 1	93.4	6.6	-	1466
Class 2	80.3	18.9	0.8	1018
Class 3	66.4	32.3	1.4	174
<b>Total</b>	<b>86.6</b>	<b>13.0</b>	<b>0.4</b>	<b>2658</b>

#### **4.5 Washing Machines**

Jordanian market has two kinds of washing machines: basin (one or two basin) and automatic. Generally speaking, basin-type washing machines tend to be older, less expensive, and manufactured locally, while automatic washing machines are newer, energy efficient, more expensive, and imported. Both types of washers are in common use.

Nearly half of Jordanian households own at least one one- or two-basin washing machine. Households living in villas, housing units of 200 square meters or more, housing units built in 2005 and later, households of higher income and expenditure are less likely to own basin washing machines.

**Table 4.10: Household e basin washing machines distribution by class**

Class	Number of One- or Two-Basin Washing Machines			Total = 100
	Not using	1	2-4	
	%	%	%	
Class 1	44.4	55.3	0.3	1466
Class 2	53.8	45.1	1.1	1018
Class 3	67.8	30.1	2.1	174
<b>Total</b>	<b>49.6</b>	<b>49.7</b>	<b>0.7</b>	<b>2658</b>

Thirty percent of basin washing machines are ten years or older, and another 35% are between five and nine years old (Table 4.11). This suggests there may be opportunities for a program to replace older, inefficient one- and two-basin washing machines with newer more-efficient automatic washing machines.

**Table 4.11: Household of basin washing machines distribution by number and age**

Age in years	Number of One- or Two-Basin Washing Machines		
	1	2-4	Total
	%	%	%
0-4	30.0	29.7	30.0
5-9	35.0	39.0	35.0
10- 14	16.9	18.8	17.0
15-35	13.6	0.8	13.4

The load survey also shows that about half (49.7%) of Jordanian households own one or more automatic washing machines (Table 4.12). Not surprisingly, more Class 3 households (71.4%) own automatic washing machines than do Class 2 (55.3%) or Class 1 (42.4%) households.

**Table 4.12: Automatic washing machines by class**

Class	No. of Automatic Washing Machines			Total = 100
	Not using	1	2+	
	%	%	%	
Class 1	57.6	42.2	0.2	1466
Class 2	44.7	54.8	0.5	1018
Class 3	28.7	69.3	2.1	174
<b>Total</b>	<b>50.3</b>	<b>48.8</b>	<b>0.4</b>	<b>2658</b>

Most automatic washing machines are fairly new; 61% are less than four years old. As with TVs and refrigerators, washing machine ownership is virtually universal. Nearly all (97%) households own some type of washing machine, and 2% have both automatic and basin washing machines.

#### **4.6 Dryers**

Survey results indicate that only 1% of households in DISCO service territories owns a dryer separate from the washing machine.

#### 4.7 Other Electrical Appliances

The load survey asked respondents what other types of electrical appliances they own. Table 4.13 lists the responses provided. The most common appliance, other than those listed above, is a microwave oven. Other common appliances include irons and coolers.

**Table 4.13: Other household electric appliances by class (%)**

Appliance	Class 1	Class 2	Class 3
	%	%	%
Cooler	22.9	29.9	32.5
Microwave	27.0	31.2	32.6
Iron	29.2	24.1	19.8
Vacuum Cleaner	3.3	4.1	4.4
Hair Dryer	3.5	3.7	3.0
Computer	1.2	0.7	1.2
Grill	0.7	1.3	0.7
Speed heat	1.1	1.3	1.5
Blender	2.0	1.1	0.6
Heater	0.5	0.5	0.3
Receiver	7.5	2.3	0.8

#### 4.8 Total Estimated Number of Appliances

The load survey data can be used to estimate the number of each type of appliance in DISCO households. Figure 4.1 shows total numbers for each appliance in DISCOs service territories.

**Figure 4.1: Total estimated appliances by type (in thousands)**

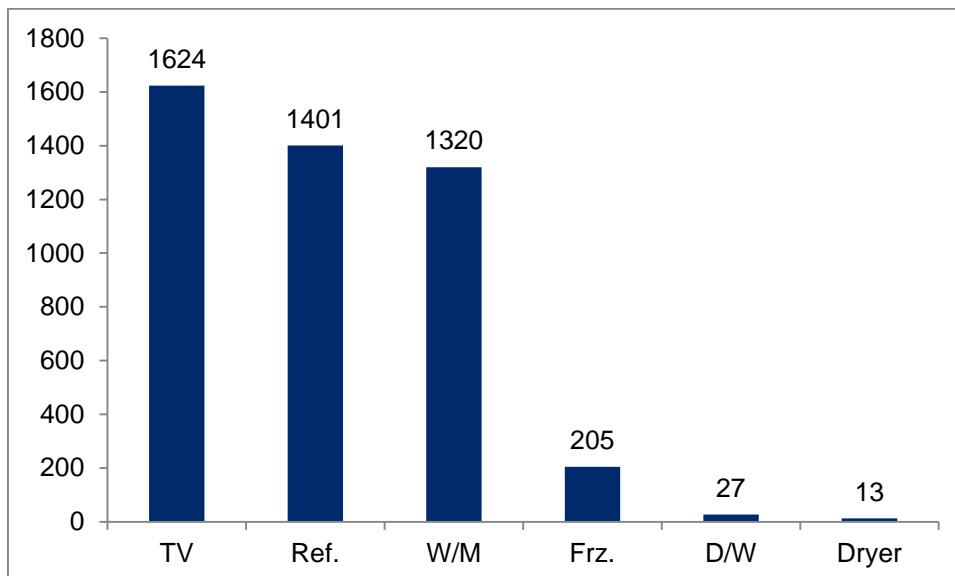




Table 4.14 shows appliance ownership by type. The information was calculated based on the proportion between the sample and the total number of households

**Table 4.14: Estimated appliance ownership by tier (in thousands)**

Type of Appliance	Tiers 1 & 2	Tiers 3 & 4	Tiers 5, 6, 7	Total
CRT TV	464.5	287.3	42.5	794.3
LCD TV	364.6	368.2	96.9	829.7
Dish Washer	10.1	8.7	8.3	27.1
One-door Refrigerator	751.7	525.7	90.0	1367.4
Two-door Refrigerator	9.9	14.2	9.7	33.8
Vertical Freezer	49	106.8	31.4	187.2
Horizontal Freezer	5.8	7.9	4.2	17.9
One- or two-basin Washing Machine	420.9	188.1	31.9	640.9
Full Automatic Washing Machine	321.1	291.6	66.7	679.4
Dryer	1.4	7.3	4.5	13.2

#### **4.9 Potential Appliance DSM Programs**

##### **4.9.1 Refrigerators**

The load survey results suggest that a refrigerator replacement program may be appropriate for residential customers. Ninety-seven percent of households own one-door refrigerators, and 36% of those are more than ten years old. The figures from Table 4.14 suggest the potential universe of participants for a refrigerator replacement program would be approximately 492,264 households. Because refrigerator efficiency has increased so rapidly over the past decade, motivating customers to replace these older models might yield significant aggregate energy savings. Such a program would likely appeal to customers who would value the capacity and amenities of the newer refrigerator models.

##### **4.9.2 Washing Machines**

Households that own one- or two-basin washing machines constitute 50% of the total population, and 30% of basin washing machines are ten years old or more. An effective energy-saving program might include offering an incentive to persuade households with older basin-type washing machines to upgrade to more efficient automatic models.

## 5 Household Water Heaters

This chapter presents the load survey results regarding residential water heating systems. The survey collected information on the type, number, size, capacity, and age of water heaters found in Jordanian homes. Results are presented according to consumption class, income, expenditure, and number of family members. Some results are noted without the accompanying data for the sake of brevity.

Water heating equipment in Jordan includes:

- 1) Electric water heaters;
- 2) Gas-fired water heaters;
- 3) Solar water heaters; ,
- 4) Other water heaters such as limited use heaters for one installation only (e.g., bathroom);and,
- 5) Central heating systems that provide hot water.

Most housing units have a combination of more than one type of water heating system.

### 5.1 Electrical Water Heating

Sixty percent of Jordanian households own one or more electric water heaters (Table 5.1). This figure is very close to the 56% water heater saturation figure from a recent MEMR survey.<sup>8</sup> Class 2 has the highest penetration of electric water heaters (70%) compared to 67% for Class 3 and only 53% for Class 1 households. Nearly two-thirds (62.3%) of residential electric water heaters have a capacity of 50-80 liters, and about half of them are less than four years old.

**Table 5.1: Household distribution by number of electric water heaters used and class**

Class	Number of Electric Water Heaters			
	Not using	1	2+	Total = 100
	%	%	%	
Class 1	47.1	51.2	1.8	1466
Class 2	29.6	65.4	5.0	1018
Class 3	33.0	60.6	6.4	174
<b>Total</b>	39.5	57.2	3.3	2658

### 5.2 Gas-Fired Water Heaters

Very few households (9%) own gas water heaters (Table 5.2). Thirty-four percent of residential gas water heaters are less than four years old, while 61% are five years old or more.

<sup>8</sup> MEMR Household Energy Survey (2013)

**Table 5.2: Household by number of gas water heaters used and class**

Class	No. of gas water heaters			Total = 100
	Not using	1	2-3	
	%	%	%	
<b>Class 1</b>	90.6	9.4	0	1466
<b>Class 2</b>	91.0	9.0	0.1	1018
<b>Class 3</b>	93.9	5.2	0.9	174
<b>Total</b>	90.9	9.0	0.1	2658

### 5.3 Solar Water Heaters (SWHs)

Nearly fourteen percent of Jordanian households own a solar water heater<sup>9</sup> (Table 5.3). Higher consumption households are most likely to own solar water heaters (25.2%). Approximately half of those households with solar water heaters do not know the heaters' size in liters, and 60% of solar water heaters are five years or older. Seventy six percent of the solar water heaters are of the flat-plate type and 18% are vacuum type.

**Table 5.3: Household solar water heater distribution by class**

Class	No. of Solar Water Heaters		
	Not using	1	Total = 100
	%	%	
<b>Class 1</b>	89.1	10.9	1466
<b>Class 2</b>	84.3	15.7	1018
<b>Class 3</b>	74.8	25.2	174
<b>Total</b>	86.3	13.7	2658

Sixty-nine percent of households have either an electric water heater or solar water heater or both (Table 5.4). Ownership of either solar, electric or both water heaters varies across consumption class; Class 3 households have the highest water heater penetration (82%) compared to Class 2 (78%) and Class 1 (61%). Only 5% of households own both electric and solar water heaters.

**Table 5.4: Household distribution for electric and/or solar water heaters by class**

Class	Type of Water Heater				Total = 100
	None	Electric Only	Solar Only	Both	
	%	%	%	%	
<b>Class 1</b>	38.8	50.2	8.2	2.7	1466
<b>Class 2</b>	21.6	62.7	8.0	7.7	1018
<b>Class 3</b>	18.1	56.7	14.9	10.2	174

<sup>9</sup> MEMR Household Energy Survey 2013 estimated 13.5% penetration of solar water heaters.

<b>Total</b>	30.9	55.4	8.6	5.1	2658
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#### 5.4 Other Water Heating Equipment

A very small number of households (0.4%) use “flash” or “spot” water heaters, which usually are found in bathrooms and are intended for bathing and washing purposes. More households (25%) have water coolers, which are used to heat water for cooking or drinking (Table 5.5).

**Table 5.5: Proportion of households with other electric water heating appliances by type and class**

Class	Cooler	Speed Heat
	%	%
Class 1	42.5	44.6
Class 2	47.9	45.4
Class 3	9.6	10.1
Total	100	100

#### 5.5 Total Estimated Number of Water Heating Systems in Jordanian Households

The load survey data can be used to estimate the total number of water-heating appliances in Jordanian households. Table 5.6 shows that estimate to be 1,192,200 water heaters, of which electric water heaters account for about 74%.

**Table 5.6: Estimated total number of water heaters, by type, and class**

Class	Type of Appliance (000s)			
	Electric Water Heater	Gas Water Heater	Solar Water Heater	Total
	No.	No.	No.	No.
Class 1	415.2	71.2	82.5	568.9
Class 2	397.8	47.7	82.4	527.9
Class 3	66.3	6.6	22.6	95.5
Total	879.3	125.5	187.5	1192.2

#### 5.6 Potential Water Heater DSM Programs

Nearly three fourths (74%) of Jordanian households own electric water heaters. Recent studies, including ESCB’s study for the Jordan River Foundation<sup>10</sup>, have shown that solar water heaters are an effective way to save electricity, and that these appliances have a relatively short payback period. An energy saving program that provides financial assistance, such as a low- or no-interest loan, to encourage households to switch from electric water heating to solar water heating might be very effective. Such a program would have the

<sup>10</sup>JORDAN RIVER FOUNDATION SOLAR HOT WATER SURVEY REPORT 2015

secondary benefit of contributing to the GoJ's target of promoting installation of 30,000 household solar water heaters by 2017.

## 6 Household Heating and Cooling

This chapter presents information about Jordanian household ownership of space heating and cooling appliances, including air conditioners (AC), electric and gas space heaters, and fans. Results are presented by level of consumption, including information on capacity, age, and country of manufacture. The report also discusses correlations between heating and cooling equipment ownership and other variables such as household income and family size. The survey asked customers to estimate the number of hours each day they use electric space conditioning equipment during the peak heating and cooling months (i.e., January and August). While self-reported data always has some margin of error, it still is useful in estimating the extent to which space heating and cooling equipment contributes to peak demand.

### 6.1 Air Conditioners

Almost 27% of Jordanian households own one or more AC units (Table 6.1).<sup>11</sup> That number is likely to increase over the next year or two as the recent heat wave has prompted many consumers across the country to purchase AC units for the first time. The data show a strong correlation between AC unit ownership and consumption; many more medium- and high-consuming than low-consuming households (36% for Class 2 and 69% for Class 3) own AC units. It is worth noting that 75% of AC units are imported.

**Table 6.1: Household distribution for AC units, by number and class**

Class	Number of Air Conditioning Units				Total = 100
	0 %	1 %	2-4 %	5+ %	
Class 1	85.2	11.6	3.2	0.0	1,466
Class 2	63.7	26.1	9.3	1.0	1,018
Class 3	30.9	25.1	37.4	6.7	174
<b>Total</b>	<b>73.4</b>	<b>18.0</b>	<b>7.8</b>	<b>0.8</b>	<b>2,658</b>

Seventy-six percent of AC units are fairly small (e.g., 1.5 tons or less). Low- and high-usage households vary significantly in terms of the total AC tonnage they own; almost half of low-usage households have 0.5-1.0 tons of AC capacity, while 58% of high-usage households have 1.6 or more tons of AC capacity.

Table 6.2 shows that 61% of air conditioners are less than five years old. Higher-consuming households tend to have slightly older units than do households in Classes 2 and 1. This differential suggests that higher consumption households purchased AC units earlier than the other classes.

<sup>11</sup> This compares to 22% of all households as reported in the 2013 MEMR Energy Survey Study.

**Table 6.2: Household AC distribution by age, and class**

Class				Total = 100
	0 – 2	3 – 4	5+	
	%	%	%	
Class 1	32.0	31.6	33.6	1,466
Class 2	25.0	37.0	33.4	1,018
Class 3	21.3	33.7	36.6	174
<b>Total</b>	<b>26.3</b>	<b>34.8</b>	<b>34.1</b>	<b>2,658</b>

### 6.2 Electric Fans

Most (82%) households own one or more electric fans. Homes in hotter areas tend to own multiple fans. Higher income households are less likely to own electric fans, but these households also are more likely to own AC units, as discussed above. Class 2 households have the highest fan ownership rates (86%) followed by Class 1 (79%).

**Table 6.3: Household electric fan distribution by number and class**

Class	Number of Electric Fans			
	0	1-2	3+	Total =100
	%	%	%	No.
Class 1	21.0	62.7	16.2	1,466
Class 2	13.9	60.0	25.9	1,018
Class 3	24.6	51.5	23.2	174
<b>Total</b>	<b>18.5</b>	<b>61.0</b>	<b>20.5</b>	<b>2,658</b>

### 6.3 Electric Heaters

Table 6.4 shows that about one in four households owns one or more electric heaters. Class 3 households have higher ownership rates than do the other two classes (36% compared to 20% and 28% for classes 1 and 2 respectively).

**Table 6.4: Household electric heater distribution by class**

Class	Number of electric heaters			Total = 100
	None	1	2 & above	
	%	%	%	
Class 1	80.4	16.8	2.8	1,466
Class 2	71.6	23.1	5.3	1,018
Class 3	64.4	21.2	14.4	174
<b>Total</b>	<b>76.0</b>	<b>19.5</b>	<b>4.5</b>	<b>2,658</b>

Most electric heaters (69%) are 2000 watts or less. Class 1 and 2 households tend to own more small wattage heaters (400-2000) than larger ones, while Class 3 households own both sizes almost equally (Table 6.5).

**Table 6.5: Electric heater distribution by size and class**

Class	Electric Heater Size in Watts		
	400 – 2000	2001 and above	Total = 100
	%	%	
Class 1	70.0	23.7	1466
Class 2	72.5	22.7	1018
Class 3	49.2	45.9	174
<b>Total</b>	<b>69.1</b>	<b>25.4</b>	<b>2658</b>

#### **6.4 Other Space Heating Equipment**

Electric heating is not the only type of space heating equipment available. About half of Jordan's households use gas heaters (55%), and almost 6% have a central heating system. About 28% of the households surveyed use kerosene/diesel heaters, and 11% heat with wood. Heating type varies across consumption classes. Class 3 households own central heating systems at rates as much as seven and five times the rates of Classes 1 and 2, respectively. On the other hand, Class 1 households own wood heaters at rates as much as two and three times the rates of Classes 2 and 3, respectively (Table 6.6).

**Table 6.6: Non-electric heating and cooling, by type and class**

Class	Heating Types			
	Central	Gas	Kerosene/ Diesel	Wood
	%	%	%	%
Class 1	3.8	54.7	26.9	14.6
Class 2	6.3	56.4	29.9	7.4
Class 3	28.1	45.3	20.4	4.8
<b>Total</b>	<b>6.3</b>	<b>54.8</b>	<b>27.6</b>	<b>11.2</b>

#### **6.5 Estimated Electric Heating and Cooling Appliance Numbers**

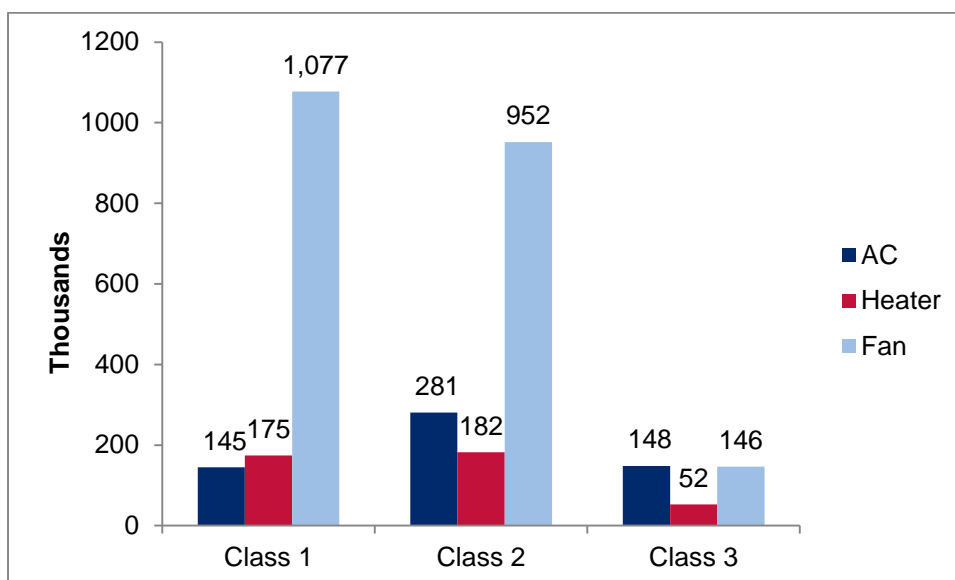
Table 6.7 presents estimates for the total electric heating and cooling appliances found in Jordanian households. The estimate, reached by extrapolating survey data to the total population, is that there are 3.15 million such appliances. This total breaks down to an estimated 573,400 AC units (18.2%), 409,000 electric heaters (12.9%), and 2.17 million fans (68.9%).

**Table 6.7: Estimated numbers of electric heating and cooling appliances owned, by type and class**

Class	Number of Appliances Owned (000s)		
	AC	Electric Heater	Fan
Class 1	144.9	174.6	1,077.1
Class 2	280.8	181.9	951.6
Class 3	147.7	52.5	146.1
<b>Total = 100</b>	<b>573.4</b>	<b>409.0</b>	<b>2,174.8</b>

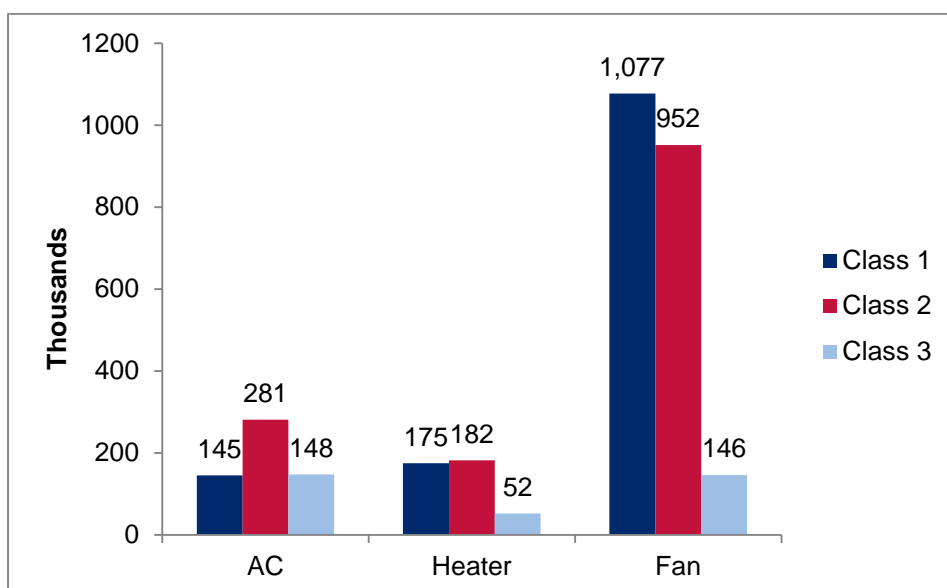
Figures 6.1 and 6.2 show the breakdown of heating and cooling equipment owned across tiers. The ratio of fans to AC units is 7.4:1 for low-consumption households (Class 1), 3.4:1 for medium-consumption households (Class 2), and only 0.99:1 for high-consumption households. Overall, the fan to AC ratio is 3.8:1. These figures indicate that higher consumption households are more likely to own AC systems than lower consumption households.

**Figure 6.1: Estimated appliance numbers by class and type (in thousands)**





**Figure 6.2: Estimated appliance numbers by type and class (in thousands)**



### 6.6 Average operating hours of heating and cooling appliances

Households use their heating and cooling equipment differently according to the local weather, which varies considerably across location<sup>12</sup> and consumption class.

#### 6.6.1 Winter Heating Systems

Respondents were asked how frequently they used their electric heating system during January, the coldest month of the year (Table 6.8). Nearly 64% of customers avoid using electric heat at all, although this number varies by consumption level. Higher consumption households (55%) use their electric heating systems more frequently compared to 44% for Class 2 and only 28% for Class 1.

**Table 6.8: January electric heating days by class**

Class	Numbers of Days			
	0	1-20	21-31	Total= 100
	%	%	%	
Class 1	71.6	14.0	14.4	1,466
Class 2	55.6	18.0	26.5	1,018
Class 3	44.8	19.0	36.2	174
<b>Total</b>	<b>63.7</b>	<b>15.8</b>	<b>20.4</b>	<b>2,658</b>

Respondents were asked to estimate the number of hours during which they operate their heating system on an average January day. Table 6.9 shows daily electric heater usage

<sup>12</sup> According to a study presented in the "International Refrigeration Conference", which was held in Jordan, March, 2015, the author Prof. Ali Badran indicated that for all locations in Jordan, except Aqaba and Ghore areas the heating degree days (HDD) is higher than the cooling degree days (CDD) meaning that the need for heating is much more than the need for cooling

patterns across household consumption levels. Nearly 16% of households operate their heating system for 1-4 hours per day, and 16.2% of households operate their heating systems for 5-9 hours. Not surprisingly, high consumption households (Class 3) operate their heating systems longer; 38% operate for 5 hours or more compared to 25% for Class 2 and only 16% for Class 1.

**Table 6.9: Daily heating hours during January by class**

Class	Daily Hours of Operation			Total = 100
	1-4	5-9	10 and above	
	%	%	%	
Class 1	12.9	12.6	2.9	1466
Class 2	19.6	19.2	5.6	1018
Class 3	17.5	28.8	8.9	174
<b>Total</b>	<b>15.8</b>	<b>16.2</b>	<b>4.3</b>	<b>2658</b>

Average monthly heating operation hours can be calculated by multiplying the number of days in a month by the daily operating hours. Table 6.10 shows that about 18% of Jordanian households report using their electric heaters for less than 100 hours in an average January.

As expected, higher consumption households operate electric heaters for more hours each month; 35% of Class 3 households operate their heating systems for 100 hours or more compared to 23% and 13% for Classes 2 and 1 respectively.

**Table 6.10: Monthly heating hours during January by class**

Class	Monthly Hours of Operation			Total = 100
	1-100	101-200	201-744	
	%	%	%	
Class 1	15.0	9.6	3.7	1466
Class 2	21.0	15.9	7.5	1018
Class 3	20.0	22.6	12.6	174
<b>Total</b>	<b>17.7</b>	<b>12.9</b>	<b>5.7</b>	<b>2658</b>

### **6.6.2 Summer Cooling Systems**

Respondents were asked to estimate how often they use electric space cooling (air conditioning or fans) to cool their homes during August, which is generally the hottest month of the year. Table 6.11 presents survey responses by consumption class. Including fans, 84% of households use cooling equipment during August, and almost half (49%) reported using cooling equipment for more than 20 days. Class 3 and 2 use cooling more than Class 1. It is interesting to note that while some respondents indicated that they use their cooling system close to 84% of the time in August, the same respondents indicated that they use their electric heating systems in January for 36% of the time. This result reinforces that many Jordanians use non-electric heating systems more commonly than electric heat, while they rely on electricity for space cooling.

**Table 6.11: August electric cooling days by class**

Class	Days Operating Cooling Appliances in August			Total = 100
	0	1-20	21-31	
	%	%	%	
Class 1	20.6	34.0	45.3	1466
Class 2	9.5	37.3	53.1	1018
Class 3	8.8	34.3	57.0	174
<b>Total</b>	<b>15.6</b>	<b>35.3</b>	<b>49.0</b>	<b>2658</b>

The survey also asked respondents to estimate the number of hours during which they operated their cooling equipment on the August days when it was used. Overall, most households (67%) operate their cooling systems for between one and nine hours per day.

**Table 6.12: Daily cooling hours during August by class**

Class	Daily hours of operation in August			Total = 100
	1-4	5-9	10+	
	%	%	%	
Class 1	39.7	25.2	14.4	1,466
Class 2	35.2	34.1	21.1	1,018
Class 3	37.1	36.8	17.3	174
<b>Total</b>	<b>37.8</b>	<b>29.4</b>	<b>17.2</b>	<b>2,658</b>

Monthly cooling operation hours can be calculated by multiplying the number of days in a month by the daily operating hours. Table 6.13 shows little less than half of all households (40%) use their cooling equipment for less than 100 hours during August.

**Table 6.13: Monthly cooling hours during August by class**

Class	Monthly Hours of Operation			Total = 100
	1-99	100-299	300-744	
	%	%	%	
Class 1	40.2	21.3	17.9	1,466
Class 2	38.7	24.8	27.0	1,018
Class 3	40.0	26.1	25.1	174
<b>Total</b>	<b>39.6</b>	<b>22.9</b>	<b>21.8</b>	<b>2,658</b>

## **6.7 Potential DSM Programs for Heating and Cooling**

The use of AC units during summer is one of the most significant drivers of household electricity use in Jordan, and is one that promises to increase as more households adopt AC systems over fans. Electric space heating is much less significant. The following sections discuss options for increasing the efficiency of both end uses over time.

### **6.7.1 Electric heater fuel substitution**

Many households consider space heaters to be very convenient because they heat the immediate surroundings and can be moved around in the home. A DSM program could be developed to substitute gas or other fuels for electric heaters. However, challenges to

developing such fuel-substitution programs include the relative price of electricity and fuels and the costs of new heating equipment.

### ***6.7.2 Efficient AC program***

There are more than 500,000 AC units in Jordan. At least one third of such units are five years and older. This indicates that a DSM program to replace older units with newer and more efficient units could be a good choice if it can address the issue of sunk costs. Another energy saving program could encourage those residential customers in the market for new AC systems to purchase more efficient units, perhaps through awareness-building or even financial incentives.

## 7 Consumer Awareness

In addition to asking consumers about their household energy use and appliances, the load survey also asked them to describe their perceptions regarding their electricity consumption and electricity bill, awareness of and prospects for saving energy, and preferences for receiving information and advice about energy efficiency.<sup>13</sup>

Table 7.1 provides a reminder of how monthly bill amounts relate to the different consumption classes.

**Table 7.1: Monthly bill minima and maxima for each class**

Consumption Class	Retail tariff tiers	Monthly bill ranges (JD)	
		Lowest	Highest
1	Tiers 1 & 2	1.0	15.4
2	Tiers 3 & 4	15.4	44
3	Tiers 5, 6 & 7	44	N/A

### 7.1 Average Monthly Electricity Bill Value

Respondents were asked about their average electricity bills over the twelve months prior to the survey. Table 7.2 shows their responses for the summer months (May-October), sorted by consumption class. Reported values vary significantly across consumption classes. About 62% of DISCO households reported an average monthly electricity bill during the summer of between 15-49 JD. Some of the self-reported values are inaccurate, since 12.5% of Class 2 households receive electricity bills greater than 50 JD. In general the reported values are in line with the tariff tiers.

**Table 7.2: Household summer electricity bill distribution by class**

Class	Average Monthly Electricity Bill in Summer (JD)			Total= 100
	3-14	15-49	50+	
	%	%	%	
Class 1	42.0	53.7	2.0	1466
Class 2	6.5	79.1	12.5	1018
Class 3	1.4	29.8	62.6	174
<b>Total</b>	<b>25.6</b>	<b>61.8</b>	<b>10.0</b>	<b>2658</b>

The load survey also asked customers to report their winter (November-April) bills and, as Table 7.3 shows, the self-report pattern is very similar to that found for the summer. Overall, households reported slightly lower bills in winter than in summer. For example, 27% of households reported bills less than 15 dinars during winter, compared to 26% in summer.

<sup>13</sup> Self-reported information regarding electricity bills may not be accurate, either because the respondent may not be the one who pays the bill or may not remember accurately the amounts paid.

**Table 7.3: Household winter electricity bill distribution by class**

Class	Average Monthly Electricity Bill in Winter			Total = 100
	3-14	15-49	50+	
	%	%	%	
Class 1	43.7	51.3	2.5	1466
Class 2	6.9	76.5	14.3	1018
Class 3	1.7	29.8	62.3	174
<b>Total</b>	<b>26.9</b>	<b>59.4</b>	<b>10.9</b>	<b>2658</b>

### **7.2 Potential for Bill Reduction**

Respondents were asked whether they are aware of any steps they can take to reduce their household electricity consumption. Surveyed households mentioned several measures, including: 1) turning off the lights in unoccupied rooms; 2) ironing in large batches rather than one piece at a time; 3) turning off appliances not in use; and 4) purchasing energy-efficient appliances.

Table 7.4 indicates that Jordanian households are almost evenly distributed regarding their belief that they can reduce their bills; only about 7.6% do not know whether they can reduce their bills or not. Variation across consumption classes is not significant – 48% of Class 3 households compared to 44% of Class 1 households believe they can reduce energy consumption.

**Table 7.4: Household perceptions on electricity bill reduction by class**

Class	Possibility of reducing the amount of electricity bill			Total = 100
	Yes	No	Don't Know	
	%	%	%	
Class 1	44.0	48.9	7.2	1,466
Class 2	44.4	47.4	8.1	1,018
Class 3	47.9	44.5	7.5	174
<b>Total</b>	<b>44.4</b>	<b>48.0</b>	<b>7.6</b>	<b>2,658</b>

### **7.3 Sources of Information about Energy Efficiency**

The load survey asked respondents to identify whether they had heard information regarding energy savings opportunities or not; the question was designed to measure the impact of energy efficiency awareness programs offered by MEMR, EMRC, and others. The survey asked respondents whether they had heard, seen, or been told about energy efficiency or energy savings measures during the past twelve months.

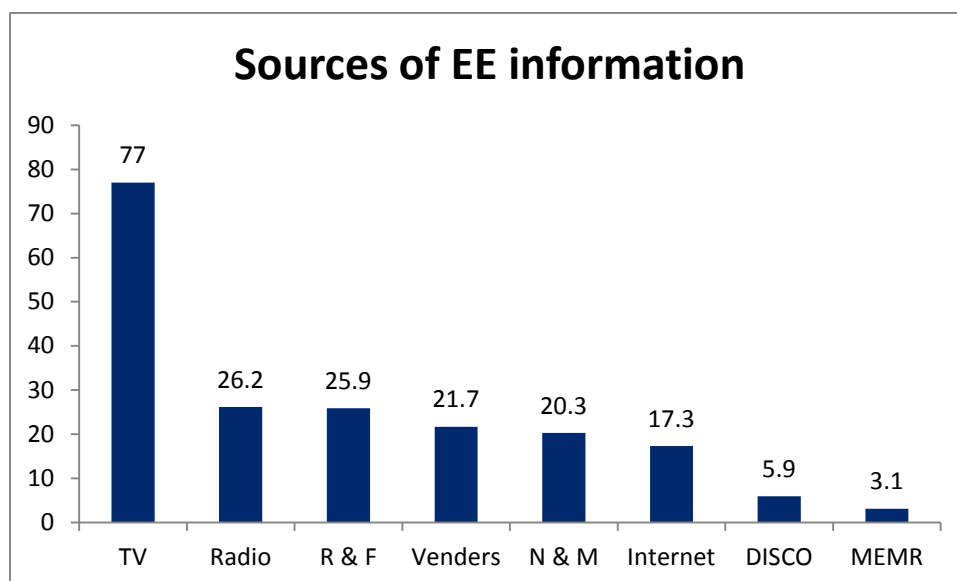
Respondent households reported that their most common sources for energy efficiency information are: TV (77%); relatives and friends (26%); radio (26%); internet (17%); vendors (22%); newspapers, magazines, and brochures (20%); and electric company (6%). Only 3% of households identified MEMR as a source of information about energy efficiency, but it is likely that most consumers would not necessarily match an information campaign to the

organization sponsoring it (Table 7.5 and Figure 7.1). These figures indicate the available sources of information used to gain information regarding energy efficiency as a concept, which help in designing DSM programs or awareness campaigns in the future.

**Table 7.5: Household energy efficiency information sources by class**

Class	Sources of Energy Efficiency Information							
	TV	Radio	Newspaper, Magazine	Internet	Relative/Friends	MEMR	Vend.	Electric Company
	%	%	%	%	%	%	%	%
<b>Class 1</b>	79.2	26.1	19.3	15.2	26.0	3.3	20.1	6.4
<b>Class 2</b>	74.6	25.2	20.4	19.0	26.1	2.7	23.8	5.1
<b>Class 3</b>	72.9	33.4	29.2	24.4	23.8	4.3	23.8	7.3
<b>Total</b>	<b>77.0</b>	<b>26.2</b>	<b>20.3</b>	<b>17.3</b>	<b>25.9</b>	<b>3.1</b>	<b>21.7</b>	<b>5.9</b>

**Figure 7.1: Sources of household energy efficiency information**



#### **7.4 Preferred Method for Receiving Energy Efficiency Information**

Consumers tend to respond better to information received through their preferred channels. The load survey asked respondents how they would prefer to receive information about saving energy in their homes. Most survey respondents (45%) prefer to get information through television, followed by SMS (36%), newspapers and magazines (6%), and internet and emails (5%). Few customers mentioned any other media. High-consuming households are most likely to prefer receiving information via SMS (42%), while low-consuming households prefer to receive information through television (48%). Such differences suggest that DISCOs should use more than one method to provide their customers with energy efficiency information.

**Table 7.6: Household preferences for receiving energy efficiency information by class**

Class	Energy Efficiency Information Type			
	TV	SMS	Newspaper & Magazine	Internet & Emails
	%	%	%	%
<b>Class 1</b>	48.3	33.3	5.8	4.3
<b>Class 2</b>	42.7	38.6	5.3	6.4
<b>Class 3</b>	34.1	42.4	6.9	7.6
<b>Total</b>	<b>45.2</b>	<b>35.9</b>	<b>5.7</b>	<b>5.3</b>

### **7.5 Energy Efficiency Measures Undertaken**

The survey asked respondents to describe any energy saving measures they had already undertaken. The overwhelming majority of respondents (90%) said they turn off appliances when not in use; 38% said they had purchased energy efficient appliances; 32% adjust thermostats of HVAC equipment; and about 23% perform regular maintenance. It is important to note that, when asked about a behavior they perceive as being desirable, such as saving energy, numerous studies have shown that consumers will report the behavior that they believe the questioner would like to hear. The implication for this study is that consumers may be saying they take more energy saving actions than they actually do.

**Table 7.7: Self-reported energy saving actions by class**

Class	Energy Saving Actions			
	Use energy saving appliances	Turn off appliances or lighting when not in need	Adjust temperature to reduce electricity consumption of HVAC equipment	Perform periodical maintenance for all electrical appliances
	%	%	%	%
<b>Class 1</b>	36.9	90.1	30.9	23.6
<b>Class 2</b>	38.1	90.1	31.8	23.6
<b>Class 3</b>	43.1	88.8	42.3	20.7
<b>Total</b>	<b>37.8</b>	<b>90.0</b>	<b>32.0</b>	<b>23.4</b>



## 8 Key Findings and Recommendations

The load survey provided an extensive dataset that DISCOs can use to develop demand-side management and energy efficiency programs. The following sections summarize the most important findings.

### **8.1 Key Findings - Lighting**

CFL lighting is the dominant lighting type in Jordanian households; 84% of all households have at least one CFL light. FTLs are almost as prevalent (76%); only 40% of households still use incandescent lamps. LEDs have very low (2%) market penetration. Nearly all households (98%) use either CFL or FTL lamps.

Jordan's household lighting market is significant:

- Eighteen million total lamps
- Nearly ten million CFLs
- Five million FTLs
- 2.6 million incandescent lamps
- Three hundred forty thousand LED lamps (just 2% of the total)

### **8.2 Key Findings - Electrical appliances**

Virtually all households (99%) own TVs, washing machines and refrigerators. Sixty-nine percent of households have some form of water heating (electric, solar, or gas), while relatively few own freezers (13%) and virtually none own dishwashers (2%).

TVs are of two types – CRTs and LCDs. Household TV ownership is equally split between CRT and LCD TV types (45% each) with an additional 9.5% of households owning both types. There are 1.6 million TVs in Jordanian households.

Virtually all DISCO households (97%) own one-door type refrigerators. About 60% of these are between 15-19 cubic feet in capacity. Nearly 36% of the refrigerators are ten years or older; 32% are less than four years old. There are 1.4 million refrigerators in Jordan's households.

Washing machine ownership is virtually universal. Half of households own the older one/two-basin type washing machine and the other half own automatic washing machine. There are 1.4 million washing machines in Jordan's households.

Residential customers heat water using electricity, gas and solar energy in addition to other non-commercial water heating means. Nearly 60% of households use electric water heaters. Sixty-two percent of these electric water heaters are between 50 and 80 liters size, and 46% are more than 5 years old. There are 879,000 electric water heaters in DISCO service territories out of the total of 1.195 million heaters.

Few customers (11%) heat water using gas; there are only 125,500 gas water heaters in residential households. Sixty-one percent of these water heaters are older than five years.

Nearly one seventh (14%) of households heat with solar water heaters, which tend to be fairly large (100-600 liter) (36%), and older (60% are more than 3 years old). There are 190,000 solar water heaters throughout the country. Rising electricity prices suggest there may be strong market potential for solar water heaters to replace electric water heaters.

### **8.3 Key Findings – Heating and Cooling Equipment**

Jordan's climate varies considerably and includes some areas with higher elevation and cooler climates. Only one fourth of households (27%) own AC units. Forty-two percent of these units are one ton or less in capacity, and 39% are older than five years. There are an estimated 573,400 AC units in Jordanian households.

In contrast to AC, most households (69%) own electric fans, which they use for cooling. There are 2.2 million fans in residential homes. The ratio of fans to AC units is 7.4:1 for low-consumption households (Class 1), 3.4:1 for medium -consumption households (Class 2), and only 0.99:1 for high-consumption households. Overall, the fan to AC ratio is 3.8:1. This ratio indicates that cooling type ties closely to consumption level.

Not many households (13%) heat their homes with electric space heaters. Most of these electric heaters (69%) are less than 2000 watt capacity. There are 409,000 electric heaters in Jordanian households. In contrast, 55% households heat with gas, 28% heat with kerosene/diesel stoves, and 11% heat with wood. Only 6% of households have central heating systems, and all of those households fall into Class 2 or 3.

### **8.4 Key Findings - Energy efficiency awareness**

The survey asked respondents several questions about the potential to save energy. Slightly less than half believe they can take steps to reduce their electricity bills through such means as turning off the lights in unoccupied rooms, ironing in large batches rather than one piece at a time, turning appliances off when not in use, and purchasing energy-efficient appliances. However, 48% did not think they could achieve such reductions, and the remaining 8% do not know.

Most households had heard about the concept of energy efficiency, most frequently from TV (77%), friends and relatives (26%), radio (26%), vendors (22%), the internet (17%), and newspapers, magazines and brochures (20%). Only 6% remembered receiving information about energy efficiency from their DISCO and only 3% from MEMR.

Forty-five percent of households prefer to receive information about energy efficiency through TV. An additional 36% would prefer to receive SMS messages with energy efficiency information.

### **8.5 Recommendations**

The load survey results suggest several energy-saving measures for households, including:

- Efficient lighting replacement programs targeting incandescent, CFL, and FTL lighting with LED equivalents;
- Replace older one-door refrigerators with more efficient one-door or two-door models;
- Replace older one- and two-basin washing machines with more efficient automatic machines;
- Replace electric and gas water heaters with solar water heaters; and,
- Offer incentives and awareness-building to encourage households purchasing new refrigerators, washing machines or air conditioners to select energy efficient models.

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