Study on
Requirements of Prospective Electricity Consumers
and
Fuel (electricity) Poverty & Affordability

Conducted by
SPARC, University of Colombo
for
Public Utilities Commission of Sri Lanka

Final Report

April 2011

Social Policy Analysis & Research Centre (SPARC)
University Of Colombo, Sri Lanka

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Abbreviations

PUCSL	Public Utilities Commission of Sri Lanka
SPARC	Social Policy Analysis & Research Centre
BNE	Basic Needs Electricity
RMA	Resource Management Associates
GN	Grama Niladhari
CEB	Ceylon Electricity Board
CDMA	Code Division Multiple Access
kWhs	Kilo Watt Hours
CEPA	Center for Poverty Analysis

1. Background

The National Energy Policy and Strategies of Sri Lanka[1] (Policy) states that energy requirements to fulfill the basic needs of the people and to enhance their living standards and opportunities for gainful economic activity will be adequately and continually satisfied at the lowest possible cost to the economy. In this regard:

 a. Priority will be given to improving access by rural areas to commercial energy forms such as electricity and petroleum-based fuels;
 b. Current modalities of providing basic electricity requirements of the entire population either through grid-extension or off-grid systems will be expanded and a systematic action-plan will be implemented to meet those requirements;
 c. A transparent mechanism will be established to provide subsidies to the deserving groups to ensure that such groups have access to their basic energy needs at affordable prices. This includes providing low cost standardized electricity connections to consumers on lifeline tariffs both in urban and rural areas; and
 d. An appropriate pricing policy for the energy sector will be adopted considering important factors such as cost reflectivity, need for targeted subsidies, and competitiveness of locally produced goods and services in the regional and world markets.

In order to ensure that the deserving groups have access to basic energy needs at affordable prices through a transparent subsidy mechanism (item 'c' above), the Policy states that household consumers consuming less than 30kWh per month should be permanently subsidized 50% of their consumption. Further, as per the Budget Speech 2011, the tariffs applicable for consumers consuming less than 120kWh per month were kept constant, at the recent revision of electricity tariffs (for the period January to June 2011). However, none of such estimations of basic energy needs are based on any empirical study and therefore are based on various assumptions.

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[1] http://power.lk/downloads/ministry_sri_lanka_energy_policy.pdf

2.   Objectives

The Public Utilities Commission of Sri Lanka (PUCSL), with the enactment of the Sri Lanka Electricity Act No. 20 of 2009, commenced economic, safety and technical regulation of the electricity industry. The functions of the PUCSL include:

a. Advising the Government on all matters concerning the generation, transmission, distribution and supply of electricity;
b. Regulating tariffs and other charges levied by licensees and other electrical undertakings in order to ensure that the most economical and efficient service possible is provided to consumers (consumer means a consumer of electricity and includes a prospective electricity consumer)

The PUCSL is currently in the process of formulating policy advice on energy requirements to fulfill the basic needs of the people and the provision of subsidies to deserving households. In order to aid the formulation of such advice, the PUCSL engaged the Social Policy Analysis & Research Centre (SPARC) of the University of Colombo to conduct a study (based on an island-wide survey) on 'fuel (electricity) poverty and affordability' and 'electricity requirements of prospective electricity consumers'.

The objectives of the assignment are to:

a. Estimate the fuel (electricity) poverty & affordability, including:
    i.   Basic electricity needs;
    ii. How much is presently spent on electricity;
    iii. Number of households consuming electricity below the basic electricity needs; and what they need to be able to consume basic electricity needs; and
    iv. Location and characteristics of the households
b. Identify the electricity requirements of prospective electricity consumers, including:
    i.   Whether households that do not have electricity want electricity, and if so;
    ii. What they want to use electricity for and how much of electricity they are likely to consume;
    iii. Constraints they face in obtaining electricity;
    iv. How they manage without electricity at present and the amount of money spent for same;
    v.   How much they can afford to pay for electricity and their willingness to pay;
    vi. What is required by them to obtain electricity; and
    vii. Location and characteristics of the households
c. Formulate policy recommendations to meet the basic electricity needs of all at affordable prices

In order to arrive at the electricity poverty and affordability, the basic electricity needs of a typical Sri Lankan household need to be properly estimated. Identification of such basic need

would facilitate the policy makers in determining the lifeline (subsidized) block of electricity tariffs.

Once the basic electricity needs are established, the electricity poverty and the electricity poverty line could be measured for Sri Lanka. Incident of electricity poverty (Percentage of households below the poverty line) can then be estimated based on the electricity poverty line. This would be a better estimation of electricity consumption compared with the percentage of households with access to electricity. This study will also focus on: measuring the relative electricity poverty (examination of the disparity of electricity consumption); and examining the variation of the disparity of electricity usage over different socio-economic characteristics. Considering the above analyses and examination, the affordability of electricity by households would be measured.

The study would also project potential demand for electricity by prospective electricity consumers who are not connected to the grid at present. The electricity consumption would also be explored in the context of energy consumption by households.

3.   Methodology
3.1   Definitions

This study is based on three key concepts. Basic Needs Electricity (BNE), Affordability and Electricity Poverty are the three key concepts covered by this study. In addition to that the study also focuses on predicting the demand for electricity. The three key concepts and demand for electricity are defined here.

Basic Need Electricity: Literature on basic needs defines basic needs as the requirements to have a minimum life standard. This does not have an absolute sense because minimum life standard itself does not have an absolute sense. Minimum for one person may not be agreeable to another person. In this regard, food basic need is relatively easy to justify. Food basic need is defined as the food requirements to obtain minimum nutritional requirements to maintain health conditions and to sustain physical and mental strength to perform activities of a person. When it comes to non-food basic needs such an absolute definition is not possible. Therefore, the practice is to consider the amount of consumption of non-food items by the households consuming basic need foods as non-food basic need [For details on this see, Department of Census and Statistics (2004), p. 4].

With regard to basic need electricity two approaches are used; a *top down* approach and a *bottom-up* approach. The top-down approach suggests to identify "most essential electrical appliances" and then to estimate the electricity requirements to use those appliances for a reasonable duration of time.

There are several alternative definitions of basic need electricity.

Energy Forum (2003) has identified having electricity for domestic lighting within 7 – 10pm and to watch TV as basic need electricity. The same report further argues that electricity should be considered as a basic need because of the convenience that household members enjoy with electricity. Exploring the peoples' perception on electricity, Energy Forum (2003) identifies that

> Electricity is a basic need, even if there is no direction connection with income generation….electricity is like living in heaven- easy to handle, less accidents, work time is extended, education goes up, ability to access new kinds of technological equipment…[Energy Forum (2003), p. 28,29].

Practical Actions (2008) defines 120 kWhs for lighting and 35kg LPG equivalent for lighting as the basic need volume of electricity. This is estimated on per-person per year basis.

However, findings of Lighting Hambantota Baseline study conducted by the Resource Management Associates (Pvt.) (RMA) Ltd, in December 2008 shows that households' perception on the Basic Needs of electricity is more comprehensive than any of the top-down definitions of it.

According to RMA (2008) electrified households have classified electricity as a prime-need of a household mainly because it (electricity) improves the quality of household life in terms of ability to use electric appliances, reduction of cost on energy, enabling children to study long hours in the night and thereby achieving improved school performance and convenience of getting their work done.

This suggests that peoples' perception of basic need of electricity cannot simply be defined as having electricity for lighting and to watch TV. Electricity means much more for households than what is defined by top-down approach of basic need electricity.

Therefore, this study also uses bottom-up approach to define basic need electricity. In that context, definition of basic need electricity is the volume of electricity consumed by the households on the poverty threshold. Assuming that those households can attain just minimum amount of all life requirements, the volume of electricity consumed by the

households on the poverty threshold can be justified as minimum requirement (basic need) of electricity for daily life[2].

In this study poverty threshold is defined in terms of national official poverty line. The national official poverty line for year 2010 (September) is Rs. 3,141 per person per month [Department of Census and Statistics, Sri Lanka, Web page]. Considering the average family size of 4 in the sample the above figure suggests that families earning Rs. 12,564 or below per month are poor. According to this definition 26 percent of the responding families in the sample are poor. This is closely consistent with the national estimate of 23 percent [Department of Census and Statistics, Web page].

For the purpose of this study poverty threshold is defined in terms of a range (Rs. 500 above and below the official poverty line) Rs. 2,641 and 3,641. This is the standard practice of most of the studies on basic needs.

The electricity consumption pattern of this group is used to define basic need electricity. The average volume of electricity consumption is defined as the basic need volume and the type of electrical appliances used by majority of respondents in this group (over 75 percent) is identified as basic need electrical appliances.

Similar information drawn from the non-electrified households is the percentage of expenditure on non-electricity energy. This includes all the sources of energy used by non-electrified households.

Affordability: Affordability to electricity is the second concept explored in this study. There are two popular methods of defining electricity affordability. First it is the percentage of income spends on electricity. In this regard, the popular norm is that if a household spends more than 10 percent of the income on electricity it is defined as unaffordable level. This is only a rule of thumb and it changes depending on whether the country concerns is a tropical country or other where the electricity requirement for heating is required.

The present study adopts the same definition as an alternative method. However, the analysis is extended to compare the expenditure share for other essentials.

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[2] This is a crucial assumption. There are empirical as well as theoretical criticisms against that. However, in the absence of alternative method this has become the standard method in poverty literature. See for details Department of Census and Statistics (2004).

The second definition of affordability is the affordability for basic need electricity. Again, percentage of income requires to attain basic need volume of electricity as defined above is considered here.

From the non-electrified households, affordability is measured in terms of other sources of energy.

Electricity Poverty: Following the conventional wisdom the electricity poverty is defined in both relative and absolute sense. The relative poverty explores the disparity of electricity consumption. In this regard the standard measure of relative poverty is *Lorenze curve* and *Gini ratio*.

The *Lorenze curve* measures the percentage of electricity consumption by each expenditure decile. If the distribution is fair each decile should consume 10 percent of total electricity consumption. Present study compares the income disparity with the disparity in electricity consumption.

The absolute poverty is defined in terms of the percentage of households consuming below basic need electricity.

For non-electrified households energy poverty is defined using the same steps given above[3].

3.2   Measures and Indices

Measurements of the above three concepts are summarized in this section.

Basic Need Electricity: As described in previous section this study uses both approaches in defining basic need electricity. The top-down approach defines various levels of electricity consumption as basic need and examines electricity consumption pattern and appliances used by responding households consuming same volume per-month.

The bottom-up approach measures the electricity basic need as the average volume of electricity consumed by households with per-capita income Rs. 2,641 and 3,641 range. Then, the type of appliances used by more than 75 percent of households fall into the above income bracket is also explored.

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[3] This study covers only one aspect of poverty-electricity nexus. Namely the under-consumption of electricity by poor and its implications on the wellbeing of the poor people. There is a separate literature on electricity as a poverty reduction strategy. This argues that by providing access to electricity, rural micro finance investments can be expanded and make more profitable. In this regard, CEPA (2002) and (2008) provide empirical evidence supporting the causality from provision of electricity to poverty reduction.

Affordability: Percentage of income spends on electricity, comparison of that with the expenditure share of other essentials and percentage of income required to obtain basic need electricity defined above are the three measure used to measure affordability.

Electricity Poverty: *Lorenz curve* and poverty incident are used to measure electricity poverty[4]. The poverty incident is measured in terms of head count ratio where the head count ratio is the ratio of number of households consuming below the basic need volume to the total number of households in the sample.

Predicting Electricity Demand: Demand for electricity is expected to be a function of income, electricity pricing, prices of alternative energy sources and the demand is also subject to a lifecycle effect. Consumers add various consumer electric appliances to their households after the housing unit is electrified. Therefore, it is expected that demand for electricity increases once the electricity is provided. Taking this into account, present study examines the consumption pattern and volume of electricity consumption of the households within one year period. In this context, assessment will be done on volume of electricity consumed against family income (expenditure), electricity pricing, size of the housing unit (square feet) and various other socio-demographic conditions of the household including family size.

Demand for Electricity: In order to predict the demand for electricity following regression model is used.

$$Q_i = \alpha_o + \alpha_1 N_i + \alpha_2 R_i + \alpha_3 S + \alpha_4 Y_i + \alpha_5 T_1 + \alpha_6 T_5 + \alpha_7 T_{20} + \varepsilon_i$$

Where, Q is the demand for electricity in kWhs, N is the household size (Number of family members), R is the number of rooms in the residence, S represents the level of schooling of the household head. This is a proxy for the education background of the household. Y is the family income and T_1, T_5 and T_{20} are categorical variables representing time when the electricity connection is given (1 to 5 years, 5 to 20 years and more than 20 years) and ε is the random error term representing the unpredictable variations of electricity demand. This model is estimated using electrified sample and the measures of the independent variables (N, S and Y) are available for non-electrified households and the T can be arranged at lowest level for them.

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[4] These are only two indicative measures covering relative and absolute poverty. In modern literature poverty is considered as a multi-dimensional phenomenon. For a conceptual note on this See, Cader and Melis (2006)

3.3 Data and Sources of Data

3.3.1 Data

This study is entirely based on primary data collected by the research team. In order to collect required information, two sample surveys were conducted. A sample of electrified households covering 22 districts (all provinces) and a sample of non-electrified households from two districts with highest rate of non-electrification provide data for this analysis. In this section of the study, required data under each objective is summarized and then the survey methods are described. Questionnaire is attached as an appendix.

Table 1 summarizes the data required under each objective.

Table 1: Data Required under each Research Objective

Basic Need Electricity/Energy:	Electricity Poverty
- Volume of electricity/ other energy consumed by the household on the poverty threshold. - Type of electric appliances used by the HHs on the poverty threshold. - Income of the household. (All inclusive monthly average income). - Type of needs satisfied by electricity/ other energy	**Absolute Poverty:** This can be done with the information collected under objective one. **Relative Poverty:** In order to understand disparity of electricity consumption Lorenz curves of electricity consumption will be constructed and that will be compared with income (expenditure) disparities. This will also provide required information on "over and under" consumption of electricity by responding families. Analysis in this section can be done using the field survey data.
Affordability:	**Demand by Prospective Electricity Consumers:**
- Total spend on electricity during the last month. - Total spend on other forms of energy during the same reference period. - Total family expenditure during the same reference period. - Whether electrified household or not.	- Volume of electricity consumed by electrified households in last month. - Type of electric appliances used by the household. - Total household income in last month. - Number of individuals living in the household. - Number of rooms available in the house. - When the household was electrified (year).

In addition to these basic socio-economic and demographic information will also be gathered as controlling variables.

3.3.2 Sample Survey

Two thousand five hundred electrified households were selected from all provinces covering 22 districts. Three districts from North and Eastern provinces under post-war reconstruction were excluded (Kilinochchi, Mulativu and Mannar) because the rapid changes in those areas can distort the picture.

Five hundred non-electrified households were selected from Rathnapura and Monaragala districts which are reported to be the districts with lowest electrification rates.

3.3.2.1 Distribution of the sample

Sample selection process is further elaborated in this section. The electrified household survey was designed to cover all the provinces of the country. Selection of housing units for the electrified household survey was determined by multi-stage probability proportionate to the size mechanism. In principle all the districts are required to be in the sample. However, three districts from North and Eastern provinces were excluded. Excluded districts are given in previous section. Main reason for this exclusion is that those districts are rapidly developing under post-war construction. Therefore, inclusion of these three districts may distort the actual situation.

In the third stage, number of households from each district was determined proportional to the number of households in each district. This mechanism selects more households from districts with higher population density.

Once the number of households for each district is determined number of households allocated for a given district was equally allocated among the GN divisions selected from that district.

Sample of electrified households is further stratified by the year of electrification and volume consumed. As there are no any ground statistics about the year of electrification we use an arbitrary allocation of 10 percent households with electrification in last year and the rest 90 percent with any year beyond one year. Regarding the level of electrify consumption the CEB has classified all households into 5 categories as less than 30 units (28 percent), 31 to 90 units (49 percent), 91 to 120 units (11 percent), 121 to 180 units (8 percent) and over 180 units (4 percent). With all these stratifications, probability of selecting a given household will be determined by the product of all the probabilities given above.

Sample of non-electrified households was selected using multi-stage purposive and snowball sampling procedure. First, the two districts with lowest rate of electrification were selected. The two districts are Rathnapura and Monaragala. This selection was purposive. According to statistics available at CEB the electrification rate in the two districts were significantly lower than the national average electrification rate.

In the second stage 04 GN divisions from each district was selected after consulting the GN officer of the division. The sample size of non-electrified households was decided as 500 and it was equally allocated to the two districts selected.

Finally considering the possible non-responses 50 additional households were added to the sample of electrified households and the non-electrified households were visited and interviewed until 500 households were completed[5].

3.3.3 Focus Group Discussions and Key Informant Interviews

In addition to the two surveys described above several Focus Group Discussions (FGD, Key Informant Interviews (KII) and a review of local and international literature on related issues were used to gather required information for this study.

Several KIIs and FGDs were conducted before and after the surveys. First the concept notes of the study was presented at a FGD where the participants were representatives from CEB, PUCSL and NGOs and research groups interested in electricity related issues. Individual meetings with experts, policy makers etc. were also held during the designing of the study. Sample selection and questionnaires were prepared based on this consultative process.

Once the data is collected and analysed preliminary findings of the surveys were presented at a public seminar and the report was circulated among the experts, policy makers, consumer societies and various other stakeholders.

List of Key Informants and participants at FGDs are attached to this report as appendices.

3.3.4 Literature Review

Literature review was used to conceptualise the research issue and for interpretations and policy implications. Although the review of literature is not reported as a separate section of this study due references are given to the literature reviewed throughout the report. All the literature reviewed is listed in the list of references.

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[5] As there is no any list of non-electrified households investigators visited non-electrified household s in the districts until required number is completed. This method can be considered as a variant of snowball sampling method.

4.   Survey Findings

4.1   Sample Characteristics

Sampling mechanism of the two surveys are described in Section 2 of this report. Due to various practical obstacles actual sample sizes were different from the expected size. None responses, incomplete responses and falls responses etc. limited the size of electrified household survey[6] to 2,541 and 500 non-electrified households.

Trained enumerators visited all the selected households and interviewed the head of the households. In the absence of head of the household another adult member (housewife or another elderly member) was interviewed to record information.

Gender, Age and Education compositions of respondents of both surveys show that the majority of respondents are middle aged and fairly educated.

In percentage terms, there are more male respondents in non-electrified survey than the electrified survey.

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[6] Initial plan was to interview 2,500 electrified households. Considering non-responses another 50 cases were added to the sample.

Table 2 below reports the district-wise distribution of sample of electrified households.

Table 2: Stratification of Electrified Households

Districts	Electrification: Less than one year				Electrification: More than one year				
	30<	31-90	91-180	180+	30<	31-90	91-180	180+	Total
Colombo	6	13	5	1	60	119	48	12	264
Gampaha	7	13	5	1	60	119	48	12	265
Kalutara	3	6	3	1	29	57	24	6	129
Kandy	4	8	3	1	34	68	27	7	152
Mathale	2	3	1	0	13	23	10	3	55
Nuwara Eliya	2	4	2	0	19	42	15	4	88
Galle	6	8	2	1	26	56	21	5	125
Matara	2	7	2	0	20	44	16	4	95
Hambantota	2	3	1	0	14	27	11	3	61
Jaffna	4	8	3	1	38	75	33	8	170
Vavunia	4	8	3	1	38	75	30	8	167
Batticaloa	1	2	0	0	8	17	8	2	38
Ampara	1	3	1	0	13	26	10	3	57
Trincomalee	4	8	3	1	38	77	31	8	170
Kurunagala	4	8	3	1	37	74	29	5	161
Puttalam	2	4	2	0	18	35	14	4	79
Anuradhapura	2	4	2	0	20	40	16	4	88
Polonnaruwa	1	2	1	0	10	20	8	2	44
Baddulla	3	5	2	0	20	40	16	4	90
Monaragala	1	2	1	0	9	19	8	2	42
Rathnapura	3	5	2	1	23	47	19	5	105
Kagalla	2	5	2	0	22	44	17	4	96
Total	66	129	49	10	569	1,144	459	115	2,541

Selected basic characteristics of electrified and non-electrified households are summarized in Table 3.

Table 3: Characteristics of Electrified and Non-electrified Samples

	Electrified	Non-electrified
Sample Size	2,541	500
Monthly Income	22,430	18,089
Family Size	4.04	3.59
Number of Rooms	4.06	4.05
Incident of Poverty	25.80	33.20
Disparity of Income	77.30	92.42

Table 3 shows that the electrified households are richer than non-electrified households. Average income of electrified households is 1.2 times the average income of non-electrified

households. The last row reports the Coefficient of Variation (CV) of income distribution[7]. This measures the degree of income disparity in two samples. Estimates reported in the table show that the income disparity in non-electrified sample is greater than that of the electrified sample[8]. In all other respects the two samples are comparable.

4.2   Pattern of Energy Consumption

In this section of the study, main features of the electricity consumption pattern in the electrified households and consumption pattern of alternative energy (including non-grid electrified households) is examined. Level of energy consumption, type of appliances and needs satisfied through electricity and alternative energy uses to satisfy the same needs are elaborated in this section.

Table 4: Sample Distribution by Level of Electricity Utilizations

	Number	%	Average	
			Units	Cost (Rs.)
Less than 30	635	24.99	22.60	97.79
31-90	1,273	50.10	63.16	347.61
91-180	508	19.99	120.16	1,399.91
More than 180	125	4.92	227.04	4,255.64
Total	2,541		72.48	687.81

Table 4 shows the distribution of the sample by level of utilization of electricity. First part of the table is an outcome of the sampling procedure. The sample was stratified by the level of utilization. Percentages reported in the third column represent the sample stratification. Average units of electricity consumption and the average electricity bills of each consumer categories are reported in fourth and fifth columns respectively. On average a household in the sample of 2,541 households interviewed, uses 73 units of electricity and Rs. 688 spends on electricity. Variation between different consumer groups is very high. For example, average electricity consumption of second consumer group (31 to 90 units) is three times greater than the average consumption by the lowest group. In general, the difference between all other groups is twice the previous group. The average of electricity consumed by highest class is 10 times greater than that of the lowest class.

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[7] Coefficient of variation (CV) is the ratio of variance to average expressed in percentage form.

[8] Income disparity cannot be interpreted in relation to availability of electricity. Perhaps, this may represent the district-wise variation of income disparity. As it is already stated electrified sample is collected from all provinces whereas the non-electrified sample was drawn from two districts where the poverty ratios are highest.

In terms of electricity bill, the gap is much wider than the gap in terms of units of electricity consumed per month. Highest consumer group spends 43 times the average electricity bill of lowest class.

Relationship between electricity consumption and years of electricity utilization was reported in Table 5 below.

Table 5: Electricity Consumption and Years of Electricity Connection

Years of Electricity Connection	Number	Bill	Number of Unit
Less than 1 Year	254	581	63
1 to 5 Years	434	531	59
5 to 20 Years	1,362	669	73
Over 20 Years	491	933	88
Total	2,541	688	72

Majority of respondents in the survey have been using electricity for 5 to 20 years period. Both the average electricity bill and units consumed show a positive relationship between average electricity consumption and years of connection. Neglecting the slight drop of average consumption from most recent connections to the second category, one may conclude that the average electricity consumption remains unchanged in first five years time and then starts increasing.
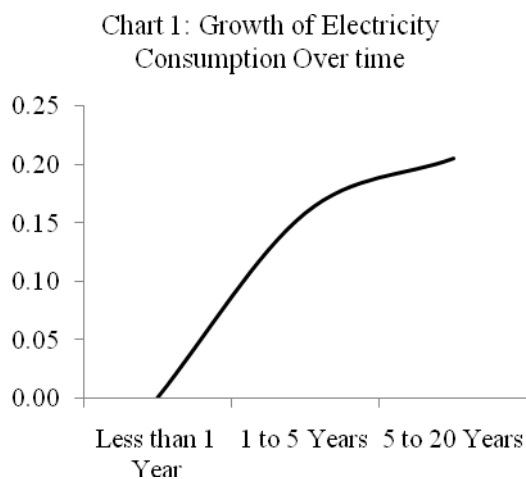
Chart 1 below reports the growth of average electricity consumption over time. The rate of growth of electricity consumption over time is gradually decreasing.

In this regard the general expectation is that the consumers increase electricity consumption with number of years having access to electricity because over time they gradually add more electric appliances and utilities and therefore average consumption of electricity increases over time. However, electricity consumption would increase at a decreasing rate because over time they also learn to economize electricity consumption. Therefore, it is expected that all the consumers reach a saturation level over time. The data shown in the Table 5 and Chart 1 show that the electricity consumption pattern revealed by this study is consistent with intuitive expectations.

Relationship between electricity demand and monthly average income is another interesting aspect. This is depicted in Table 6 below.

Table 6: Per-capita Income and Electricity Consumption

| Per-capita Income Class | Number of Cases | Average Per capita Electricity Consumption | | Average Per capita Income of Class (Rs.) |
		Units (KWh.s)	Bill (Rs.)	
Less than Rs. 1,000	47	12	64	729
Rs. 1,001 to Rs. 2,000	220	16	113	1,727
Rs. 2,001 to Rs. 3,000	385	18	135	2,696
Rs. 3,001 to Ts. 4,000	394	19	142	3,,658
Rs. 4,001 to Rs. 5,000	435	20	174	4,827
Rs. 5,001 to Rs. 6,000	160	26	262	5,797
Rs. 6,001 to Rs. 7,000	193	23	209	6,544
Rs. 7,001 to Rs. 8,000	158	23	241	7,589
Rs. 8,001 to Rs. 9,000	105	28	374	8,586
Rs. 9,001 to Rs. 10,000	132	25	268	9,923
Rs. 10,001 to Rs. 11,000	29	21	184	10,749
Rs. 11,001 to Rs. 12,000	42	32	431	11,619
Rs. 12,001 to Rs. 13,000	49	23	249	12,567
Over Rs. 13,000	192	28	331	20,625
Total	2,541	21	199	6,285

Second column of Table 6 shows number of households in each income bracket. Income brackets are defined specifically to highlight the differences between poorest and richest groups in the sample.

Average units of electricity consumed by each income group is reported next. Poorest group consumes 12kWhs per person per month. The average electricity consumption by richest group is 28kWhs, per person per month. This is two times greater than the poorest group.

Demand for electricity increases with the per capita income. On average consumers in higher income brackets consume more units and spends more on electricity than the households in lower income brackets. However, they increase electricity consumption at a decreasing rate.

Average electricity bill and average income on per capita basis of each income bracket is reported next.

Chart 2 reports the relationship between per-capita electricity consumption in kWhs and family per-capita income. Relationship observed is positive indicating that the demand for

electricity increases with family income. However, the increase of demand for electricity takes place at a decreasing rate. In economic terms, this is an evident that electricity is an essential commodity[9].

Chart 2: Demand for Electricity by Income Class
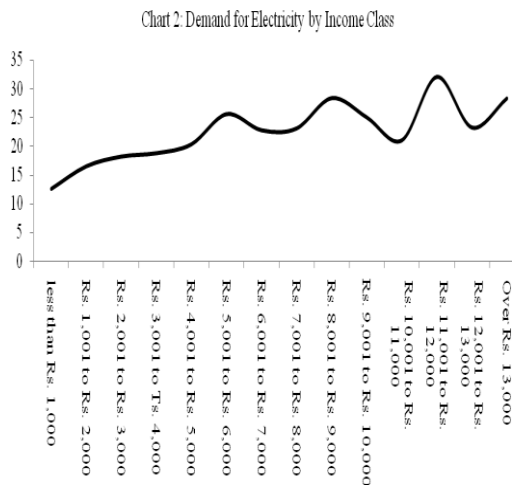
Table 7 summarizes the electrical appliances available at electrified and non-electrified households in percentage form. For non-electrified households most prominent electrical appliances are radio, TV and cassette recorders. Nearly 50 percent of households without electricity have communication facilities (46.2 percent hand phones+ 4.6 CDMA phones). For electrified households, after lighting the most prominently used electric appliance at homes is Television. Nearly 90 percent of households interviewed have a TV. In all the cases percentage of families with those appliances increases with the increase of number of years of electrification. They start with most essential appliances and gradually add more and more appliances over time[10].

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[9] This will be further elaborated in Section 3.6 where the demand for electricity function is estimated.

[10] Over time, households also learn to economize the use of electricity. Therefore, possession of more electric appliances does not necessarily mean that they use them. The intensity of using some appliances gradually lowers. This is already described under Chart 1 of this report

Table 7: Electric Equipments by Years of Connection

	Electrified Households					Non-electrified
	Less than 1 Year	1 to 5 Years	5 to 20 Years	Over 20 Years	Total	
Television	81.89	85.48	91.34	91.24	89.37	41.20
Electricity Iron	70.08	66.82	76.87	79.84	75.05	2.60
Hand Phones	59.06	57.37	64.17	65.17	62.69	46.20
Radio	46.46	46.08	52.94	47.66	50.10	66.80
Refrigerator	33.86	33.41	48.02	62.12	46.83	0.60
Cassette	37.40	39.63	45.52	47.86	44.16	19.80
Fan	33.86	35.94	42.80	48.27	41.79	1.00
CDMA Phone	28.35	31.34	40.53	42.77	38.17	4.60
Rice Cooker	24.80	24.65	31.64	39.92	31.37	
Grinders/Blender	24.80	23.50	31.28	37.07	30.42	0.20
Water Pump	17.72	18.89	28.41	37.88	27.55	0.20
Water Heater	22.83	19.59	29.52	26.27	26.52	
DVD Player	20.08	18.20	26.95	25.05	24.40	0.20
Computer	8.66	7.14	13.58	19.55	13.14	
Washing Machine	6.69	5.07	9.40	14.87	9.45	
Toaster	4.33	4.84	8.52	13.44	8.42	
Electric Kettle	5.12	4.84	7.86	10.39	7.56	
Oven	3.15	1.61	6.61	8.96	5.86	
Electric Cooker	2.36	1.61	4.04	4.89	3.62	
Emergency lamp	2.76	2.07	2.94	3.05	2.79	
Sewing Machine	1.18	1.15	3.08	3.46	2.64	2.40
Hot water Heater	1.18	0.46	1.84	2.65	1.69	
Floor Polisher	1.18	1.61	1.25	2.44	1.53	
Bakery Oven	0.79	0.92	1.25	1.63	1.22	
Air Condition	0.79	0.92	1.32	0.61	1.06	
Hot Plate	0.79	0.23	0.88	2.24	1.02	0.20
Home Theatre	1.18	0.46	0.95	1.43	0.98	
Hair Drier	0.39	0.00	0.59	1.22	0.59	
Pans	0.00	0.00	0.00	0.41	0.08	

Chart 3 plots proportion of income spends monthly on energy by currently electrified households and non-electrified households. For electrified households energy demand includes only electricity bill. For non-electrified households all energy sources used for

lighting and other domestic purposes other than fuel for vehicles are included. Fuel for vehicles is excluded from both groups.

Continues line represents the electrified households. Non-electrified households are represented by dashed line. Findings of this survey is complicated than the conventional wisdom that electrification reduces the cost of living.

Chart 3 clearly shows that the conventional wisdom is true only for low income groups. Up to Rs. 4,000 per-capita income the share of income spent on electricity by electrified households is smaller than that of the non-electrified households. For the rest, the reverse is true. Still the electrification can be considered as pro-poor strategy because it reduces the cost of living of poor segments of the society.

Chart 3: Expenditure Share on Energy
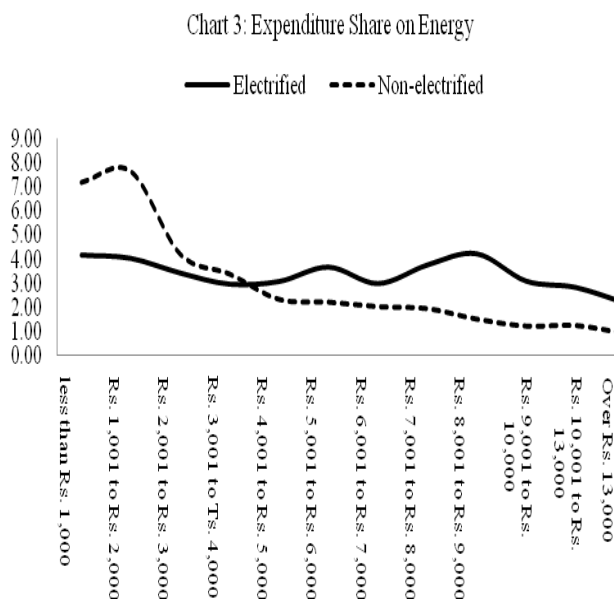
Regarding the alternative energy uses, respondents in both surveys were asked about the alternative energy used for lighting and cooking. Out of the 2,534 electrified households 2,524 (99 percent) respondents has reported that they use electricity for lighting purposes. Little less than 70 percent of non-electrified households use kerosene for lighting another 29 percent use solar systems and the rest use generators for lighting. However, when it comes to cooking respondents have different answers. Table 8 summarizes the responses.

Table 8: Alternative Energy uses for cooking by electrified and non-electrified households

	Electrified					Non-electrified
	Less than 1 Year	1 to 5 Years	5 to 20 Years	Over 20 Years	Total	
Electricity	4.37	3.98	6.49	7.77	6.10	0.00
Kerosene oil	5.56	6.79	1.77	7.57	4.12	0.20
Wood	79.76	78.22	80.38	64.83	76.94	99.40
LP Gas	10.32	11.01	11.36	19.22	12.72	0.40

Large majority of non-electrified households use wood for cooking. This may be because both districts selected for non-electrified household survey are rural.

Situation in electrified households is summarized in first five columns of the table. Out of all the respondents only 6 percent uses electricity as the main source of energy for cooking. Main source of energy for cooking is wood. Percentage of respondents using electricity for cooking shows a gradual increase with the years of connection. Only 4 percent of respondents with less than one year electricity connection use electricity for cooking whereas the same percentage for the respondents with more than 20 years of electricity connection is 8 percent.

Chart 4: Demand for alternative energy for Cooking
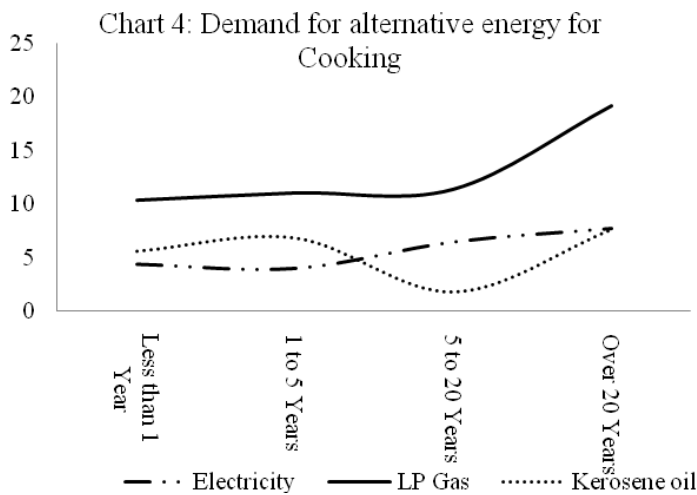
For the electrified households use of LP Gas for cooking shows an interesting pattern. For all sub-groups percentage of LP Gas users for cooking is greater than the percentage of electricity users. For example, households received electricity connection within one year period from the survey date the percentage of LPG users is 2.4 times greater than that of electricity users. The same is 2.5 times greater for the households obtained electricity connection 20 years or more before the survey date.

Chart 5: Use of Electricty for Cooking by Income
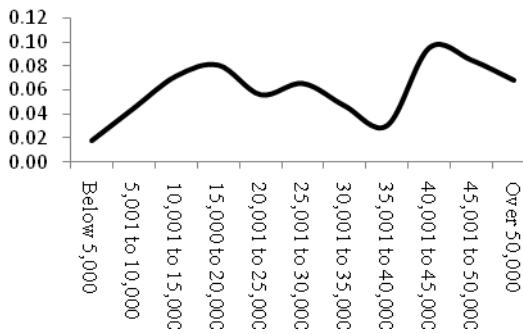
Chart 6: Use of Gas for Cooking and Income
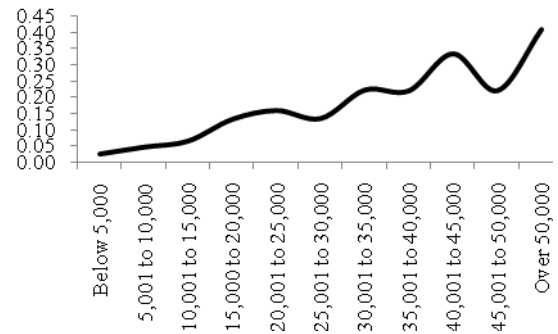
Table 8 and Chart 4 show that over time electrified households have moved away from kerosene and shifted to LP gas and electricity. However, intensity to use LP gas is faster than that to the electricity. Movement away from kerosene is obvious. Kerosene is an inferior substitute for other types of energies.

Chart 7: Use of Kerosene for Cooking by Income
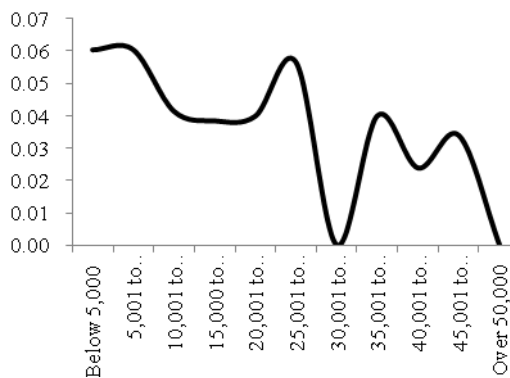
Chart 8: Use of Wood for Cooking by Income
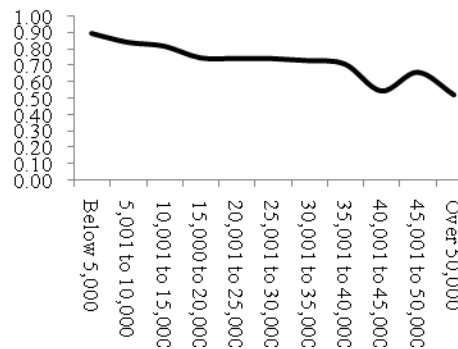
Use of electricity and alternative energy sources change with the economic status of the responding households. In general, use of Kerosene and Wood decreases with income and demand for Electricity and Gas increases with income. Charts 5 to 8 depict the relationship between various energy sources and income.

The four sources of cooking energies are substitutes for each other. Charts 5 and 6 show that the number of users of electricity and gas increases with income. However, demand for other two sources of energy is negatively related with income. Percentage of families using for Wood and Kerosene declines with income increase.

As far as the economic implications of this pattern are concerned it is obvious that wood and electricity are the most environmentally undesirable sources of energy. Kerosene and LP gas have implications on foreign exchange.

4.3   Electricity Basic Needs

This section examines the basic need electricity of electrified households and the basic need alternative energy for non-electrified households. As far as the basic needs of electricity are concerned, some argue that electricity cannot be a basic need. One can live without it. However, in the modern day human needs are closely related with the electricity because many services affecting the quality of modern life use electricity as energy. Therefore, one cannot think about a decent living standard in the modern world without referring to electricity[11]. Electricity itself cannot be a basic need. However, many basic needs of modern life cannot be met without electricity. This leads the researchers on basic need electricity to define it in two broad approaches: a top down approach and a bottom up approach.

Table 7 above shows that more than quarter of households interviewed has various types of electrical appliances. In addition to lighting and TV/Radio this list includes Fridges, Electric Irons, Fans, Rice Cookers and Water Heaters as well. Table 7 also shows that over 10 percent of respondents also have Computers at home.

This makes the problem of identifying electrical appliances satisfying basic needs more complicated. Can we exclude iron, fridge and rice cookers from the list? There is no generally acceptable answer to this question.

Electric appliances used by domestic users are also reported in SLSEA (2009). Findings of the present study in this regard are quite consistent with SLSEA (2009) findings. SLSEA (2009) has also examines the relationship between availability of various types of electric appliances and monthly electric bill. The list of appliances in SLSEA (2009) ranges from various types of lighting bulbs to many other types of appliances including refrigerators, rice cookers, washing machines, computers and many other appliances. SLSEA (2009) also identifies a positive relationship between availability of such appliances and electricity bill. Province and sector-wise comparisons show that the urban sector and western province shows a relatively high correlation between availability of appliances and electricity bill

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[11] Essentiality of electricity increases with urbanization and modernization which make busy lifestyles of all parties.

indicating that the usage of such appliances in western province and urban sector are much intensive than that of the rest of the country.

All these appliances cannot be defined as basic need appliances. Therefore, this study examines the electricity consumption pattern of families on the poverty threshold. By definition, income of those families is barely adequate to live on basic needs of foods, clothing etc. Therefore, assuming that they also live on basic need electricity as well we can define the electricity consumption pattern of families on poverty threshold. In this regard, we proposed two measures in the inception report. Namely, the volume of electricity consumed by households at the poverty threshold and type of electric appliances used by the same group.

This requires definition of poverty threshold. For this study we consider three alternative definitions and choose one for the analysis.

According to the estimates of national poverty lines by the Department of Census and Statistics for year 2010 (September) is Rs. 3,141 per person per month [Department of Census and Statistics, Sri Lanka]. Considering the average family size of 4 in the sample the above figure suggests that families earning Rs. 12,564 or below per month are poor. According to this definition 25 percent of the responding families in the sample are poor. This is closely consistent with the national estimate of 23 percent [Department of Census and Statistics, 2010].

Therefore, families with per capita income of Rs. Rs. 3,141 are considered as the reference group of this analysis. However, number of households satisfying this strict condition (per-capita income equal to Rs. 3,141) is very low. Therefore, we use a range of income instead of one level. Namely, families earning between Rs. 2,641 and 3,641 (Rs. 500 from poverty line to both sides) per capita incomes are selected for the analysis. Following section of the report examine the electricity consumption pattern of families in that per capita income range.

The bottom-up approach is the best strategy to understand the electricity consumption pattern of the families in poverty thresholds. However, one criticism against this method is that it may under-estimate the "basic need electricity" because they (families within poverty threshold) may not be consuming adequate volume of electricity for a decent life standard due to income constraints. Therefore, a top-down approach will supplement the exercise.

Under the top-down approach we will study the electricity consumption pattern of households with certain minimum level of electricity consumption.

However, there is no generally accepted minimum electricity level. The current pricing policy of the CEB suggests 30kWh as a minimum amount because the CEB has subsidy tariff up to 30 units.

Practical Actions (2008) suggests 120kWhs per year per person as the minimum electricity requirement. Assuming a four member family this suggests 40 kWhs per month as minimum electricity requirement for the average family with four members.

In the present study we use all these alternative concepts of minimum electricity to examine the electricity consumption pattern and type of appliances used by those households.

Bottom-up Approach: Our definition of poverty threshold is the Rs. 2,641-3,641 per capita income bracket. In this section we examine the electricity consumption pattern and type of electricity appliances used by the households in this income bracket.

In the sample there are 368 households satisfying this condition. The average unit of electricity consumption of this group is 13.47 kWhs per-person per month. On average they spend Rs. 100 per person on electricity per month under the current (2010) pricing system. This is nearly 3 percent of their monthly income. The same group spends 14 percent on education, 3 percent on telephone bills and 4 percent of recreation per month.

However, it is observed nearly 58 percent of the respondents on threshold income range have consumed less than the average electricity volume and one percent of respondents have consumed over 52 kWhs per person per month during the reference month. Table 9 and Chart 9 show that the peak occurs at the left end of the frequency distribution indicating that the average unit would be an overestimate of the behavior of the majority.

Table 9: Cross tabulation of Per-capita electricity consumption by Economic status of Household

Class	Poor	Threshold	Non-poor	Total
0.00 to 3.33	7.35	5.16	1.80	3.27
3.33 to 5.33	17.82	7.07	4.24	7.05
5.33 to 7.43	13.81	14.95	5.98	8.66
7.43 to 9.13	9.58	8.97	5.40	6.65
9.13 to 11.20	12.25	10.05	6.62	8.11
11.20 to 13.00	7.80	11.41	5.46	6.73
13.00 to 15.17	**10.02**	**9.24**	**8.36**	**8.78**
15.17 to 17.50	6.46	9.24	7.20	7.36
17.50 to 20.2	4.45	8.70	8.01	7.48
20.2 to 22.83	4.23	4.35	7.37	6.38
22.83 to 26.25	1.34	2.99	6.85	5.31
26.25 to 30.2	1.78	3.53	7.43	5.87
30.2 to 35.5	0.67	1.36	6.50	4.72
35.5 to 40.5	0.67	0.54	3.71	2.72
40.5 to 46.67	1.34	1.36	4.88	3.74
46.67 to 52.33	0.45	0.00	3.37	2.36
52.33 to 63.67	0.00	1.09	3.31	2.40
63.67 to 90	0.00	0.00	2.38	1.61
90 to 99.5	0.00	0.00	1.16	0.79

Therefore, the average electricity consumption was re-calculated excluding the extreme values. (Households with less than 30kWhs per person is selected. This covers over 95 percent of the original data set). The resulted average volume of electricity consumption by the threshold group is 12kWhs per person per month. Assuming 4-member household this suggests that 48kWhs would be a more realistic estimate of the basic need electricity.

Chart 9: Frequency Distribution of Per-capita Electricity Consumption
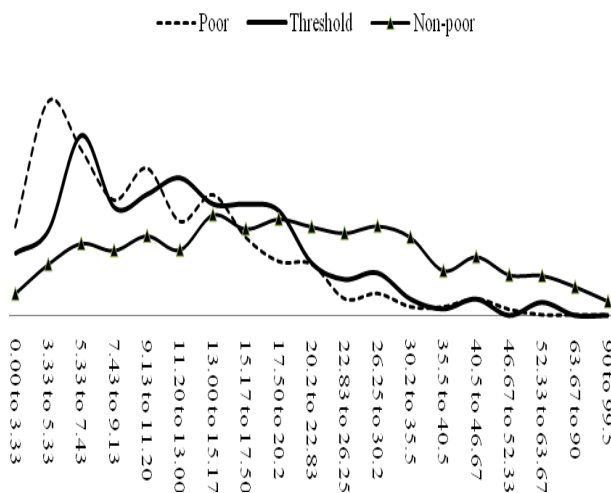
On average these households are with 5 light bulbs. Out of the total in the category over 85 percent of households have TV, nearly 70 percent has electric irons. Over 50 percent of households posses Radio and hand phones.

Households in the same income bracket in non-electrified households spend 6 percent of their income on energy. On average they spend Rs. 733 for energy. Average expense on kerosene is Rs. 400 for kerosene, Rs. 56 for solar systems[12] and Rs. 83 for other sources of energy.

Careful reading of Table 9 shows that the type of appliances used by the respondents in the reference category is numerous. These findings challenge the general perception on basic need electricity. In this context one has to decide which appliances should be considered as those satisfying basic needs.

Using rule of thumb if we decide that the appliances used by over 50 percent of households in the poverty threshold as appliances essential to satisfy basic needs, the list will contain 4 appliances including TV, radio, Iron and phone[13].

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[12] Average cost on solar systems was calculated assuming 10 years life time of a solar system. Direct depreciation method was used to calculate the monthly cost of solar systems.

[13] Exclusion of rice cookers and fans are questioned by representatives of consumer societies at the last FGD held at SLFI auditorium. With urbanization and modernization of life styles electric appliances like rice cookers, fridge and washing machines become essential. This is particularly important with increasing women labour force participation.

Table 10: Electric Appliances used by Households on Poverty Threshold

Appliance	%
Television	88.60
Electric Iron	72.30
Hand Phones	54.21
Radio	52.71
Cassette	34.51
Fan	36.80
CDMA Phone	35.96
Fridge	37.00
Water Heater	26.90
Water Pump	21.91
Rice Cooker	23.40
DVD Player	19.38
Grinders/Mixture/Blender	24.70
Computer	6.08
Electric Kettle	4.30
Oven	5.71
Toaster	4.90
Washing Machine	4.21
Electric Cooker	2.40
Emergency lights	1.69
Sewing Machine	1.12
Floor Polisher	1.12

Top-down Approach: Analysis in the previous section clearly shows that the average electricity consumption of the poor segments of the society (under selected poverty definitions) is around 48 kWhs per month. Electrical appliances available at these households show that their needs are not limited to lighting and TV. The list of electricity appliances available in those households however, does not mean that they use them regularly.

In this section, we perform the same analysis using several top-down approaches. Namely we use 30 kWhs, 40 kWhs and 90 kWhs as basic need electricity and then explore the electricity consumption pattern and socio-economic conditions of the households consuming the basic need electricity as defined.

30 kWhs as Basic Need: The tariff calculator available at the PUCSL website calculates the tariff for 30 kWhs is Rs. 120. In the sample survey of electricity consumers, there are 130 households consuming 30 kWhs in the reference month. The average income of households

with 30 kWhs electricity consumption in the previous month is Rs. 17,920 with the income range Rs. 3,000 to Rs. 70,000 per month. On average the electricity bill is 0.67 percent from their monthly income. This percentage varies from 0.17 to 4 percent for the highest and lowest income level in this income class. Comparison of this with share of other expenses observed that the electricity bill is the 13[th]out of 15 expenditure items in their relative size. These households spend on average 51 percent on their foods, 6 percent on each education and transport and 3 percent on telephone As compared to the Rs. 120 per monthly electricity bill, they spend on average Rs. 1,140 for education, Rs. 1,000 for transport and Rs. 453 for telephone.

On average households using 30 kWhs of electricity has 5 light bulbs (2.5 CFLs+1.95 Filaments. The rest contains of very few Florescent Bulbs). List of electric appliances used by these households is given bellow with the percentage of households with the appliance.

40 kWhs as Basic Need: According to the tariff calculator 40 kWhs per month means the electricity bill is Rs. 197. In the sample 20 households fall into this category. Average income of this group is Rs. 19,825 with the range of Rs. 7,500 at bottom and Rs. 40,000 at top. These families spend nearly one percent of their income on electricity.

90 kWhs as Basic Need: Average income of this group is 23,844. Out of the total sample there are 84 cases in this group. Most of the characteristics of this group are very similar to the other two groups.

Type of electrical appliances used by the three groups is summarized in Table 10 above. The cases with less than 10 percent are neglected when this list was prepared. Television, Electric Iron, Hand Phones and Cassettes and Radios are the most frequent appliance.

Table 10 above shows the type of electrical appliances available at the households consuming different units of electricity defined as minimum electricity requirement.

This clearly shows that the electricity consumption of these households is not limited to lighting, TV and Radio. Majority of them use electricity to satisfy varying needs of their day to day life. For example, in addition to lighting, majority of them use electricity for entertainment (TV and radio), electric iron, Fridge and Fans etc.

Table 11: Electric Appliances in Households using 30, 40 and 90 kWhs per month

Appliance	kWh 30	kWh 40	kWh 90
Television	83	85	92
Electricity Iron	64	65	87
Hand Phones	46	55	60
Cassette	40	45	58
Radio	38	55	36
Fan	32	65	38
Refrigerator	22	10	72
CDMA Phone	21	50	42
Water Heater	20	20	29
Grinders	15	05	45
Water Pump	14	35	32
Rice Cooker	13	15	39
DVD Player	11	25	35
Toaster	2	5	16
Electric Kettle	2	5	11
Computer	2	0	10
Oven	2	10	4

Duration of use of electrical appliances was collected only for lighting. According to the survey findings, three different types of light bulbs are used by Sri Lankans in general. Findings of the survey show that the respondents in poverty threshold light CFL bulbs for 9 hours a day, Filament bulbs for 8 hours a day and florescent bulbs for 4 hours a day. Only two respondents in the poverty threshold use halogen bulbs for 6 hours a day.

This suggests calculation of basic needs as the volume of electricity required to light 4 bulbs for 6 hours, a TV for 4 hours, electric iron for 30 minutes per week, fridge for 24 hours and fan for 4 hours.

4.4   Affordability

This section of the report examines the affordability of electricity by the households in the sample. In this study affordability is defined in two ways. First, the ability to pay their current bill (and willingness to pay by non-electrified households). Whether they can pay their current bill without any difficulty. Under the second method affordability is defined in terms of basic need electricity. In that we use the basic need electricity defined in previous section and examine the affordability to electricity basic needs.

Analysis in this section starts with an analysis of direct question on electricity affordability. In the survey respondents were questioned on their affordability and what actions they have taken to reduce the electricity bill.

Table 12: Affordability to Electricity

	%		
	Overall	Poorest	Richest
Difficult to Pay the Electricity Bill	15.39	42.22	9.04
Do not Pay Electricity Bill Monthly	14.06	25.00	9.60
Taken Steps to Reduce Electricity Bill	43.06	32.60	54.70
Actions Taken to Reduce Electricity Bill			
Use Alternative Energy for Cooking	93.90	100.00	92.19
Use Energy Saving Bulbs	79.54	73.33	78.85
Self Control	25.95	26.67	21.15
% of Monthly income on Electricity Bill	3.17	8.78	1.61

Table 11 summarizes survey findings on affordability to electricity. Little over 15 percent of responding households have reported that they cannot afford the electricity bill. Nearly 14 percent of respondents do not pay the bill regularly on monthly basis. These two variables are closely correlated with income of the family. While 15 percent of respondents feel that they find it difficult to pay the electricity bill, the same percentage for poorest group in the sample is over 40

For 72 percent of respondents who do not pay the bill on monthly basis, main reason is economic difficulties. They delay payment of the bill because they cannot do it with all other commitments.

Out of this 43 percent of respondents also reported that they have taken steps to reduce the electricity usage. All the responses to this question were classified into three broader groups as use of alternative energy sources for cooking, use energy saving bulbs and self control. Table 8 shows that 92 percent of respondents of the electrified households use alternative energy sources for cooking. Nearly 73 percent of respondents use energy saving bulbs and 23 percent uses self control. Percentages reported in this table do not add to 100 because of multiple responses. As it is reported in Table 8, the most popular sources of alternative energy sources are wood and gas both are relatively less expensive as compared to electricity.

Respondents' own opinion about the affordability of electricity bill is examined above. In addition to that affordability is also measured in terms of percentage of income (expenditure) spends on electricity. If respondents' spending on electricity exceeds certain percentage of

their income, it is defined as unaffordability. For example, European Bank (2003) defines that the share of income goes into electricity exceeds 10 percent the consumer is identified as unaffordable household. This method has no any scientific validation except rule of thumb. Therefore, in this study we compare the share of income goes into various other essentials with the share go for electricity bill.

Table 12 below further assesses the electricity affordability of the respondents of the electrified household survey.

According to the rule of thumb (10 percent or above on electricity) only the poorest group of households cannot afford electricity bill. Households with below Rs. 1,000 per capita income spend 15 percent of their average income on electricity. For them the electricity bill is nearly 25 percent of their expenditure on foods, three times the telephone bill and 2.3 times the expenditure on education[14].

Table 13: Share of Income Spent on Major Consumables

Income Class	Electricity	Food	Education	Transport	Telephone	Recreation	Water
less than Rs. 1,000	15.09	63.66	6.67	5.35	5.11	3.61	1.05
Rs. 1,001 to Rs. 2,000	4.16	74.86	9.66	4.33	3.70	1.90	1.38
Rs. 2,001 to Rs. 3,000	3.44	65.39	9.89	5.36	2.99	2.54	1.02
Rs. 3,001 to Ts. 4,000	2.99	59.08	7.66	5.04	2.99	2.41	0.69
Rs. 4,001 to Rs. 5,000	3.19	54.79	8.21	5.49	3.18	2.74	0.78
Rs. 5,001 to Rs. 6,000	3.93	47.53	6.17	5.03	3.75	2.39	0.61
Rs. 6,001 to Rs. 7,000	2.94	46.48	8.04	5.06	3.37	2.66	0.63
Rs. 7,001 to Rs. 8,000	3.69	48.50	6.43	4.81	3.01	2.17	0.73
Rs. 8,001 to Rs. 9,000	4.20	42.49	6.79	5.04	2.90	2.75	0.48
Rs. 9,001 to Rs. 10,000	3.18	42.62	7.10	4.18	2.90	2.53	0.54
Rs. 10,001 to Rs. 11,000	2.21	40.91	9.67	3.78	2.84	1.07	0.23
Rs. 11,001 to Rs. 12,000	3.43	33.56	6.11	3.90	3.03	2.92	0.36
Rs. 12,001 to Rs. 13,000	2.25	36.08	3.69	2.85	3.20	3.30	0.20
Over Rs. 13,000	2.30	28.61	5.87	3.71	2.82	2.96	0.42
Total	3.51	53.50	7.82	4.88	3.18	2.54	0.76

On average, a household in the sample spends 3.51 percent of household income on electricity. This is smaller than the percentage of income spent on foods, education and transport and closely comparable with the share on telephone.

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[14] Note that percentages reported in column one of Table 12 is not consistent with the figures reported in Table 6 above. Table 6 reports the income group averages of per-capita values whereas the column one of Table 12 reports the average income share goes into electricity bill.

These percentages vary between different income classes. For example, poorest group spends on average 15.09 percent of their income on electricity. For them this is next only to the share of income goes to foods. Table 12 shows a very clear negative relationship between level of income and percentage of income spends on electricity. This is a clear evident that the poorest segments of the society cannot afford electricity bill.

Analysis in Table 12 examines the affordability of current electricity consumption. We can also perform the same analysis using "basic need electricity" examined in previous section of this report. In the previous section we examined basic need electricity using two types of measures; a bottom-up approach and top-down approach.

In the following section of this report we examine the affordability for the basic need electricity as measured using the bottom-up approach. Namely, the affordability to 48 kWhs is examined. In order to consume 48 kWhs per month, according to current tariff rates[15] one has to spend Rs. 234.60

Using the tariff calculator available at PUCSL website the minimum required electricity for each family is converted into cost. Percentage of this cost to their total family income is calculated and the summary information of this variable is reported in Table 13 below.

Table 14: Affordability for basic need electricity

	Frequency	%
below 1	975	38.37
1 to 2	1004	39.51
2 to 3	340	13.38
3 to 4	95	3.74
4 to 5	47	1.85
5 to 6	29	1.14
6 to 7	10	0.35
7 to 8	7	0.28
8 to 9	9	0.35
Over 9	25	0.98
Total	2,541	

Table 13 shows that nearly one percent of respondents will have to spend over nine percent to buy basic need electricity. If the 10 percent threshold is considered, we can conclude that

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[15] Calculated using the electricity bill calculator available in PUCSL website.

basic need electricity is not affordable for 0.98 percent of the electricity consumers in the sample.

In responding to questions on electricity affordability from non-electrified households nearly five percent of households have expressed that they might not be able to pay the electricity bill regularly and on average all non-electrified households are willing to pay Rs. 320 per month on electricity. Roughly they plan to consume 60 kWhs per month.

4.5   Electricity Poverty

Measuring electricity poverty is one main objective of the present study. In this context, both relative poverty and absolute poverty measures are considered. Under the relative poverty, disparity of electricity consumption is examined. However, note that this sample includes only the electricity users. Therefore, the disparity explored in this study is an under-estimate of the actual disparity exists in the electricity market because zero electricity consumers are excluded from the study.

Chart 10: Relative Electricity Poverty and Income Poverty
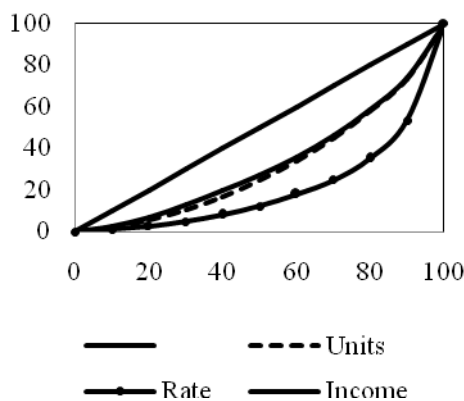
The absolute measures of electricity poverty are highly subjective. Therefore, several alternative measures are used. In order to define the absolute measure of electricity poverty "basic need electricity" should be defined. The basic need electricity must be the "minimum electricity requirement" for a family to have a decent life[16].

Quality of electricity supply and alternative energy sources[17] and difficulties to get electricity supply are the other dimensions of electricity poverty.

Relative Electricity Poverty: Disparities in Electricity consumption by the responding households is examined in this section. This section first explores the disparities in units

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[16] In this regard, question whether electricity is a "basic need" is remained unsettled. However, from government policy point of view, access to minimum units of electricity can be considered as a right or basic need. Then, it is a responsibility of a democratic government to guarantee the access of the basic need electricity to all citizens at an affordable price.

[17] Alternative energy sources are also included into electricity poverty because it determines the quality of life of un-electrified households.

consumption and expenses on electricity. These will be compared with the income distribution of the respondents. We use Lorenz curves and Gini concentration ratios to explore the disparities.

Chart 10 depicts relative poverty in electricity and income. The dotted line represents the disparity of units of electricity consumed. Solid line represents income distribution and the line with marks represents the disparity in expenses on electricity. Chart 10 shows that the Lorenz curve of income distribution and electricity unit distribution coincide. The disparity in expenses is greater than that of the disparity in units. This is because of the pricing policy. Our findings show that the disparity in electricity consumption is very significant. The lowest 10 percent household consumes only 2 percent of the total electricity consumption. However, the top 10 percent households consume 27 percent of the total electricity consumption. Expenditure disparity is more dispersed. Our calculations show that the first 10 percent consumers share only one percent whereas the last 10 percent consumers share 53 percent of the expenses on electricity. This is mainly due to the electricity pricing policy. These findings clearly show that the market of domestic electricity consumers is dominated by a very small group of consumers. As it is reported above 27 percent of electricity is consumed by 10 percent of consumers in the sample. Out of the total electricity bill paid by households 53 percent has come from 10 percent of households.

Absolute Electricity Poverty: Percentage of households which does not have access to basic need electricity is defined as absolutely poor in terms of electricity consumption. In order to assess this we compare the current electricity consumption with basic need electricity as defined above. All the households consuming below the basic need electricity are then classified into absolute poor category.

Table 15: Electricity Poverty and Income Poverty

		Electricity		
		Non poor	Poor	Total
Income	Non poor	1,275	610	1,885
	Poor	210	445	655
	Total	1,485	1,055	2,540
		Electricity		
		Non poor	Poor	Total
Income	Non poor	67.64	32.36	74.21
	Poor	32.06	67.94	25.79
	Total	58.47	41.53	100.00

Table 14 classifies all the respondents into poor and non-poor categories using two criteria; income criteria (poverty line) and electricity basic needs (as defined above).

Last row and last column of Table 14 show the incident of electricity and income poverty respectively. Table 14 shows that nearly 26 percent of the sample is below the official poverty line. This is consistent with the national estimates of percentage of poor in Sri Lanka which was 23 percent in year 2010[http://www.ophi.org.uk/wp-content/uploads/Sri-Lanka.pdf].

The last row of Table 14 shows the situation of electricity poverty. This shows that 42 percent of households in the sample are consuming below the basic need electricity. This means that they consume less than the estimated "required amount of electricity" for a decent life standard. Our definition of electricity requirement for decent life standard is 48 kWh per family (or 12 kWhs per person in a household). Our estimates above show that 42 percent of families do not consume the estimated required amount. According to the CEB (2009), the total number of domestic customers in year 2010 was 3,409,440. This means 1,431,965 electrified households are electricity poor. In order to get the full picture of it, un-electrified households should also be added to this. The Ministry of Power and Energy guesses that this could be around 500,000 [http://www.news360.lk/other/a-census-to-identify-households-without-electricity]. With the unelectrified households added, the percentage of households under electricity poverty will be nearly 49 percent. This suggests nearly half of the households in Sri Lanka are under the electricity poverty[18].

Distribution of electricity poor and non poor between income poor and non-poor is reported within the body of the table. It shows that 68 percent of the income poor families are also electricity poor and 32 percent of income non-poor households are electricity poor.

Quality of Electricity Supply (Grid): Quality of grid and other electricity supplies and alternative energy sources are elaborated in this section. Quality of electricity supply means not only the quality of electricity in terms of stability of the supply. It also means the customer services such as billing, breakdown services etc. In the present study only the stability of supply is examined.

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[18] This can be an over estimate of the electricity poverty in Sri Lanka. Many un-electrified households use alternative energy sources and therefore fulfill their energy requirements without electricity. statistics on the number of un-electrified households with no alternative energy sources is not available.

Regarding the stability of electricity supply respondents were asked three questions on frequency of power failures and power fluctuations. Reference periods for each were per-day, last week and last month. Averages of the information provided by respondents on these variables are presented in Table 15 by province basis[19].

Table 16: Quality of Grid Electricity Supply

Province	Interruptions	Low	High
Southern	4.63	4.17	3.00
Western	3.89	4.60	1.31
Sabaragamuwa	6.71	**5.92**	4.03
North West	3.73	3.48	**5.50**
Central	7.24	4.04	3.30
Eastern	7.26	4.22	3.33
North central	6.03	4.05	1.00
Northern	**12.86**	4.56	5.38
Uva	4.86	3.00	1.29
South East	7.84	3.26	0.00
Total	6.24	4.56	3.61

On average respondents have experienced 6 power failures, 5 power drops and 4 high voltage supplies. Highest incident of power failures are reported from North province. Low and high-voltage supplies were high in Sabaragamuwa and North Western provinces.

Problems with alternative energy sources: According to the rough calculations of the Ministry of Power and Energy, 500,000 households in Sri Lanka are un-electrified. They use various alternative energy sources to satisfy their energy needs. Alternative energy sources used by un-electrified households are already described in section 4.2 of this report (Table 8). Kerosene is the most popular energy source for lighting. Out of 500 respondents in un-electrified household survey, 69 percent use kerosene for lighting. Another 29 percent use solar systems and the remaining 2 percent use generators[20]. However, majority of respondents are not happy about the alternative sources and they will move to grid electricity once it is available and whenever they can afford for it[21].

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[19] These are highly subject to recall error. In many cases respondents do not remember very short power failures and power fluctuations specially that occurs in the day time. Therefore, the averages reported in this report would be an under estimate of the actual situation.

[20] Non-grid electricity is not covered in this study.

[21] This issue was raised by a representative of electricity consumer at the FGD held at SLFI.

Main complains the alternative energy users raised at the survey round are summarized in Table 17.

Table 17: Problems with Solar Systems

	No.	%
Inadequate Capacity Compared to the needs	133	26.60
Inefficient Technology	166	33.20
Need to Replace Battery in Short time period	3	0.60
No complain	198	39.60
Total	500	

Nearly 40 percent of respondents do not have any complain. Out of the remaining 60 percent the main complain about the solar system is that it is an inefficient technology. Specially, the system does not properly function in rainy days and the power supply with solar systems is not stable.

Inadequacy of electricity generated through solar systems to satisfy household needs is another comment raised by 27 percent of respondents.

Therefore, all they consider alternative energy sources as temporary solution. All they want to join grid electricity if it is available.

Respondents also stated main difficulties to obtain grid connection. This is an open ended question. All the responses are classified into 4 broader answers and the results are reported in the Chart 11.

Chart 11: Difficulties to Obtain Grid Connection
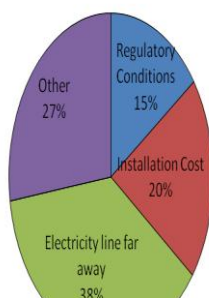
Main reason highlighted by many respondents is that the grid connection is far away from their home. For nearly 15 percent of respondents, main obstacle to get grid connection is that they cannot fulfill the regulatory requirements imposed by the CEB. Inability to pay the installation cost is also identified as a major reason. Nearly 27 percent of respondents are classified into "Other" category. This includes various other comments including negligence of government and CEB.

4.6   Projection of Electricity Demand by Prospective Consumers

Analysis in this section is based on both data sets. Using the data collected from electrified households the relationship between demand for electricity and a proposed determinant is established. In this exercise determinant variables are collected from both surveys. The determinant variables used in this exercise are Family size (N), Number of rooms in a house (R), Household income (Y), Education level of household head (E) and time of connection (T). Except for T, all other variables are also available for non-electrified households. In predicting the electricity demand by prospective consumers, the time of electrification is set at zero because they are new connections.

Summary measures of all variables and estimated prediction model are presented in Table 18 and 19 below.

Table 18: Descriptive Statistics of Variables used in Prediction Model

	Electrified			Non-electrified		
	Average	Min.	Max.	Average	Min.	Max.
Number of kWhs used	73	2	923			
Electricity Bill	688	33	28,952			
Family Size	4	2	11	4	2	10
Number of Rooms	4	1	7	4	1	11
HH Head's Education	11	0	16	7	0	13
Family Income Per month	23,935	750	400,000	18,089	1,850	134,150
Year of Electrification						
Less than 1 Year	254	10.00				
1 to 5 Years	434	17.08				
5 to 20 Years	1,362	53.60				
Over 20 Years	491	19.32				
Total	2,541					

First two variables and years of electrification are not available for the non-electrified households. The first column of each section of the table reports the averages of the variables and the second and third columns report minimum and maximum values of the variables. The averages of family size and number of rooms in the two samples are nearly the same. However, the family income varies between two groups. The average family income of electrified households is 1.2 times greater than the income of non-electrified households.

Variation of the income of non-electrified households is also high as compared to the electrified households.

The lower part of the table reports the year of electrification of the electrified households. Majority of households are electrified before 5 years.

Table 18 reports three prediction models. They vary from each other on the determinant variables. Model 1 includes only individual household characteristics. Model 2 also includes year of electrification as a categorical determinant variable in addition to the determinant variables included in Model 1. Model 3 further includes 21 categorical variables to capture district level determinants of demand for electricity. Colombo district is represented by the constant term of the regression model.

Improvement of the models as more variables add is indicated by adjusted R^2. The Adjusted R^2 indicates the explanatory power of the equation. Estimates show that 16 percent of the total variation of the electricity demand is explained by first two models. Explanatory power of the third model is slightly improved to 17 percent. High F-values of all the models also indicate that the model fit is statistically significant. Statistical significance of individual regression coefficients is indicated by t-stats reported in the table. In this regard, rule of thumb is that the absolute value of t-stat must be greater than 2. According to Table 18 all the individual household characteristics in the first set are statistically significant. However, in the second and third sets lot of variables are not statistically significant.

First columns of each model represent regression coefficients. According to the reported results, all the household characteristics have positive impact of electricity demand. For example, electricity demand increases with increasing family size. Our estimates show that on average as the family size increases by one family member, households need additional 5 kWhs per month. Electricity demand also increases with the size of the home. For each additional room, on average 7 kWhs is required per month.

Years of schooling of household head is included to the model to represent impact of family education on demand for electricity. In this model household head's education represents the family education background. According to the results education background of household increases demand for electricity.

Table 19: Determinants of Demand for Electricity

	Model 1		Model 2		Model 3	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	-14.87	-2.66	-15.50	-2.49	-15.13	-2.19
Family Size	3.30	4.12	3.46	4.33	2.99	3.68
Number of Rooms	7.62	10.04	6.84	8.88	8.40	10.37
Education Level	2.82	6.97	2.64	6.54	2.79	6.82
Per-capita income in Rs. 1,000	2.43	8.77	2.35	8.52	2.45	8.62
Square of per-capita income	-0.01	-2.44	-0.01	-2.23	-0.01	-2.48
Time Length of Electrification						
1 to 5 Years			-2.39	-0.58	-1.57	-0.38
5 to 20 Years			5.47	1.53	5.42	1.53
Over 20 Years			15.31	3.78	12.21	2.99
Districts						
Gampaha					-4.27	-0.95
Kalutara					1.38	0.25
Galle					6.66	1.20
Matara					-7.32	-1.19
Hambantota					-21.62	-2.93
Kegalle					-20.47	-3.23
Ratnapura					-15.78	-2.64
Kurunegala					-18.73	-3.57
Putlam					-2.26	-0.34
Matale					-6.31	-0.81
Kandy					-3.17	-0.60
Nuwara Eliya					1.99	0.32
Trincomalie					1.17	0.23
Anuradapura					-18.03	-2.82
Polonnaruwa					-22.43	-2.69
Jaffna					-6.50	-1.26
Vavuniya					-2.39	-0.47
Ampara					-14.52	-1.95
Batticolao					-7.27	-0.81
Badulla					-16.64	-2.64
Monaragala					-15.64	-1.79
Statistical Significance					-15.13	-2.19
Adjusted R-squared	0.14		0.15		0.16	
F-stat	82		56		18	
N	2,471		2,471		2,471	

Family per-capita income is included with its square term to capture the non-linearity of the relationship. Negative coefficient in the income-square indicates that demand for electricity

increases at decreasing rate as income increases. Demand for electricity is maximized at Rs. 122,500 per-capita income level.

Electricity demand elasticity with respect to family size, number of rooms, education and per capita income are calculated at average of all the variables and reported in Table 19 below.

Table 20: Demand Elasticity of Electricity

	Demand Elasticity
Family Size	0.15
Number of Rooms	0.46
HHH education	0.41
Per capita income	0.19

Elasticity measures the sensitivity of demand for each determinant. When each determinant increases by one percent, the percentage change of the demand is measured using elasticity. Table 19 shows that all the elasticity coefficients are positive and less than one indicating that demand increases with the increase of each determinant and the increase is less than one percent. When the family size increase by one percent the demand for electricity will increase only by 0.15 percent. When the number of rooms increases by one percent the electricity consumption increases by 0.46 percent. When family education background is increased by one percent demand for electricity will be increased by 0.41 percent and similarly the increase of income by one percent results in increase of electricity consumption by 0.19 percent. This shows that the electricity is an essential good [see, section 4.2, fn 7].

These elasticity coefficients also indicate that the electricity consumption increases at a decreasing rate with the increase of the three variables given above.
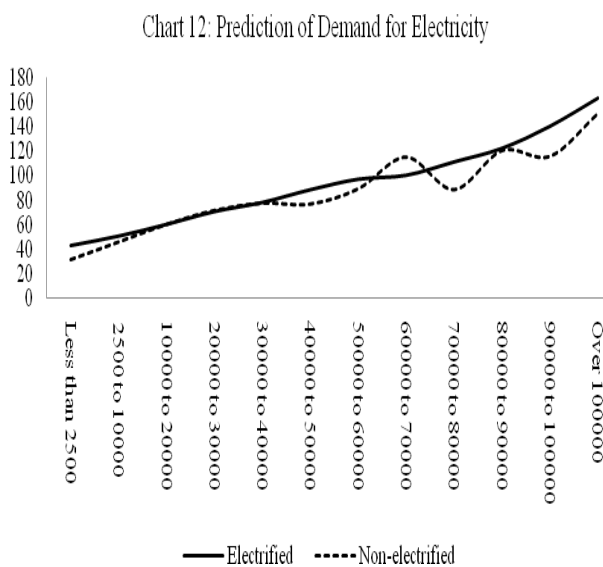
Chart 12: Prediction of Demand for Electricity

Predicted demand for electricity for non-electrified households by their level of income and the estimated electricity demand for the electrified households by level of income is represented in Chart 12. Estimated electricity demand for current consumers was calculated assuming as if they got electricity connection within one year. This is for comparisons of the two groups.

Solid line represents estimated demand by electrified households and dashed line represents the demand by non-electrified households. Predicted demand is lower than the estimated figure. However, both curves show same pattern. Therefore, the model is good for identifying the pattern of electricity demand.

5.   Summary and Conclusions

This study examines three interrelated issues pertaining to electricity demand of households in Sri Lanka. Namely, electricity basic needs affordability to electricity and electricity poverty.

Projection of demand for electricity by prospective electricity consumers is also a main objective of this exercise.

This exercise is based on the primary information gathered through a country-wide stratified sample of 2,541 households with electricity and 500 non-electrified households.

Findings suggest that the standard top-down definition of electricity basic needs a serious reconsideration for various reasons. First it is about the "electrical appliances required satisfying basic needs". In this regard current norm seems to be that electricity is required for lighting few bulbs and to watch TV for few hours. However, findings of this survey identify a list of appliances other than lighting and TV that a poor household uses and people consider as essential appliances. Findings of this study show that over 75 percent of households at poverty thresholds use electric irons, hand phones and radio cassettes in addition to lighting and TV. (This does not however, explore the level of utilization of those appliances).

Considering all the literature reviewed and empirical findings of this study, this report suggests that at least 12kWhs per-person per month should be considered as basic need and list of appliances considered as basic need appliances should be extended at least to include electric iron.

Regarding electricity affordability three alternative measures are considered in this study. One is the percentage of income goes into electricity bill. Following the literature 10 percent rule of thumb threshold is adopted for this study too. Findings show that under this definition only the poorest segment in the sample (earning less than Rs. 1,000 per-capita) cannot afford electricity. They spend 15 percent of their monthly income on electricity.

Percentage of income goes into other essentials such as foods, education etc. are also compared with percentage of income goes to electricity bill. This is the second measure used in this regard. In that it is observed that on average electricity bill is 7 percent of food expenditure and nearly 43 percent of education expenditure. The same shares for the poorest category show that the electricity bill is 19 percent of their food expenditure and the electricity expenditure is as twice as education expenditure. This indicates that the poorer segments of the society are facing a severe constraint on electricity consumption.

The third measure of electricity affordability is based on basic need electricity. Assuming that average family requires 48kWhs for a decent lifestyle per capita electricity requirements for a family is calculated. Then the per capita requirement is multiplied by the family size of each household to obtain the minimum electricity requirement for each family. This amount is then compared with the actual electricity consumption of each family. Then the families consuming less than the estimated required amount of electricity are defined as electricity poor. Findings of this study show that 42 percent of households consume less than the minimum requirement. When the un-electrified households are also added to this the electricity poverty incident of Sri Lanka closes to 50 percent suggesting that nearly half of Sri Lankan households do not have access to minimum electricity requirement for a decent life standard.

Relative poverty of electricity is also examined and observed that the entire electricity supply (for households) is dominated by the high end consumers. Findings of this study show that the households at the low end (the lowest 10%) consume only 2 percent of total electricity availability for domestic users whereas the top 10 percent consume 27 percent of it. This shows very high disparity in electricity consumption.

This suggests that the majority of electricity consumers under-consume it and the richest 10 percent over-consume the facility. In future policy discussions this needs to be considered.

Demand for electricity model is estimated and observed that the demand for electricity depends on three types of characteristics, family characteristics (income, education, family size and household size), experience with electricity and district specific factors. Rich and educated families consume more than the poor and less educated counterparts.

Demand elasticity of all the above variables are less than one and greater than zero indicating that demand for electricity increases at a decreasing rate with all the above variables.

Demand for electricity increases with years of electrification. There is no significant change of electrification within first five years time. However, it is increasing after that. Estimated annual average growth during first 20 years time is greater than that of the period after first 20 years time.

Average demand for electricity change over districts. In the analysis, Colombo district and households with less than one year experience of electricity was considered as reference category. Therefore, negative district coefficients mean that the average electricity consumption is less than that of Colombo district and positive coefficients mean otherwise.

Relative cost for energy for electrified and non-electrified households was calculated for different income groups and compared. It is observed that the relative cost of energy of non-electrified households is greater than that of electrified households for lower income classes and the reverse is true for the higher income groups. This is against the conventional wisdom that provision of electricity eases the life of poor families because it reduces the cost energy. Findings in this study show that energy cost would go up once electricity is provided. Therefore cost saving cannot be a justification for electrification of poor households.

6. Policy Recommendations

This study is an attempt to look at the electricity consumption from consumers' point of view. In this context, one of the key issues raised by respondents as well as representatives of electricity consumer society at FGDs plays a prominent role. According to that electricity itself cannot be considered as a basic need. However, in the modern lifestyle so much of electricity appliances have become essentials. Electric iron, refrigerator and washing machines have become essential home appliances of the busy lifestyle especially of the working women.

However, recommendations on future electricity policy should not be based only on consumers' perspective. It is a scarce economic resource. In terms of its domestic resource cost, foreign exchange cost, environmental cost and its opportunity cost, wasteful consumption of electricity should not be encouraged.

Therefore, any policy recommendation should balance the both aspects. To make consumers' lifestyle convenient is only one fact that the policy maker should consider. Encouraging

consumers to use electricity efficiently and economically is the other fact that the policy makers should consider.

Considering both facts the following policy recommendations are drawn from this study.

- Definition of basic-needs electricity should be reconsidered. Currently practiced basic need definition is top-down and it considers only lighting and watching TV as electricity basic needs. However, analysis in this study clearly shows that even the poorest households in the sample use more electrical appliances than lighting and TV. Considering also the views expressed by the participants at the FGDs therefore, this study recommends including electric iron, washing machines and fans.

- This study explores two alternative approaches to calculate the basic need volume of electricity. Considering the average volume of electricity consumed by families on the poverty threshold, it is proposed that the basic need electricity volume should be 12kWhs per-capita per-month. Basic need volume can also be calculated using minimum electricity requirements to use basic need appliances. According to that minimum volume of electricity required to light 4 CFL bulbs for 6 hours, a TV for 4 hours, electric iron for 30 minutes per week, single door mini-refrigerator for 24 hours and fan for 4 hours can also be considered as a pragmatic calculation of basic need volume of electricity. This study recommends whichever the smaller volume as the basic need electricity.

- This study also reveals that there is a massive disparity in electricity consumption. Poor households heavily under-consume and richer households over-consume the utility. Findings in this survey show that on average the top 10 percent households consume 29kWhs of electricity per-person per month and the lowest 10 percent consume only 10kWhs per-person per month. As compared to the basic need electricity of 12kWhs per-person per-month, lowest class consume very close to the basic needs whereas the top 10 percent consume almost three times the basic need electricity. Carefully designed pricing mechanism, popularization of energy saving appliances and an effective awareness campaign would help reducing the over consumption.

- Use of mechanism with multiple criterion for subsidy could be a solution to this problem. For example, instead of using only consumption levels to determine subsidy, if maximum income level is also identified for subsidy and varying subsidies are given to

them based on their level of consumption (gradually decreasing amount of subsidy as level of consumption increases) poor households can be guaranteed with the basic need volume of electricity while the both groups are discouraged over consumption.

- An alternative strategy in this regard is to promote energy saving electrical appliances. In this regard the CEB is promoting energy saving light bulbs. This can further be recommended. At the same time, if the government can encourage producers of electrical appliances other than light bulbs such as iron, cookers etc. to produce energy saving varieties that can improve the life standards of poor households with the same level of electricity consumption.

- Some participants in FGDs also suggested introducing new subsidy system. Instead of subsidizing electricity bill it is proposed to introduce subsidies for energy saving bulbs and initial cost of electrification. This can be justified on two grounds. Any form of subsidy of electricity bill encourages wasteful consumption and such subsidies will not address the problems of unelectrified households.

- Exclusion of micro enterprises and various other income generating activities is considered as a serious limitation of the present study because at the end any form of subsidy for domestic consumers are given at the cost of enterprises. Therefore, issues pertaining to the electricity needs of households engage in micro enterprises should also be considered when the new pricing policy is designed.

- In a wider sense this study also recommends that the consideration of electricity pricing policy in isolation is not acceptable. Electricity pricing policy must be an element of the wider energy policy.

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Annexes I _ Electrified Questionnaire

Electrified   **Serial Number:………….**

Electricity Requirements of Prospective Electricity Consumers and

Fuel (electricity) Poverty & Affordability Study

1. Province   :-…………………………………….
2. District   :- …………………………………
3. GN Division   :-…………………………………
4. Name of   Village / Town / Estate :- …………………………………
5. Interviewed by (Name)   :-…………………………………….
6. Checked by Field (supervisor)   :- ………………………………
7. Coded by (Name)   :- …………………………………
8. Electricity account No   **:-…………………………………….**
9. Name of the Respondent   :-...
10. Gender   1. Male   2. Female
11. Age   :-...........................
12. Civil Status

      1. Single never married

      2. Married,

      3. Widowed

      4. Divorced

      5. Separate

13. Educational levels

Studying Year 1 10	00	Passed Year 10/Grade	
Passed Year 1	01	Passed G.C.E (OL/N.C.G.E	11
Passed Year 2	02	Passed G.C.E. (AL)/H.N.C.E	13
Passed Year 3	03	Passed GAQ/GSQ	14
Passed Year 4	04	Degree	15
Passed Year 5	05	Post Graduate Degree/ Diploma	16
Passed Year 6	06	No Schooling	19
Passed Year 7	07		
Passed Year 8	08		
Passed Year 9	09		

14. How many school children are in the family?:- …………………………

15. Employment   :- ……………………………

16. Monthly salary   :- ……………………………

17. Monthly income from other sources   :- ……………………………

   (Inclusive of other employees in the family)

18. Number of other employees in the family   :- ……………………………

19. Total members in the family   :- ……………………………

Section B: Housing Condition

B_ 1. What is the <u>main</u> type of material used on the outer walls of this dwelling?

1. Mud / Mud brick / soil	
2. Wood	
3. Metal Sheet/ slate / asbestos/ corrugated iron	
4. Stone	
5. Bricks	
6. Cement blocks / concrete	
7 Other (Specify:	

B_2. Is the dwelling owned or rented?

        1 – Owned

        2 – Rented

        3 - Family dwelling, without payment

        3 – Squatting, without payment

        5 – Other (Specify:_____

        6 – Don't know

B_3. How many rooms? (Include separate kitchen as a room. Do not count toilets)?

      ………………

B_4. What is the source of lighting?

      1. Electricity 2. Kerosene oil 3. Other (Specify) …………..

B_5. Energy for cooking

      1. Electricity 2. Kerosene oil   3. Fire wood   4. Gas   5. Other……………….

B_ 6. Can you pay the electricity bill under the current economic condition?

               1. Yes   2. No

B_7. Have you taken any steps to induce the electricity bill?

               1. Yes   2. No

B_8. What are they?

Section C : Data related to Energy

C_1.   Does this house have grid electricity?

               1. Yes   2. No

C_2.   if Yes, when was the connection taken?

     i. 20 years ago

     ii. 05-20 years

     iii. Less than 5 years

C_3.   Have you received alternative energy?

               1. Yes   2. No

C_4.   if yes, what is the source?

     1. Solar

     2. Micro hydro

     3. Biomass

     4. Biogas

     5. Wind

C_5.   What are the electric items that your household has?

	Number
Radio	
Oven	
Cassette player/ Recorder	
TVs	
Refrigerators	
Electric Irons	
Electric cookers/stoves	
Rice cooker	

Electric kettle	
Toaster	
Grinder/blender/cake mixer etc.	
Water heater	
Hot water for bathrooms	
Computers	
Water pump	
Air conditions	
Hot plate	
Hand phones	
CDMA phone	
Floor polisher	
VCD/DVD/VHS Tape recorder	
Table Fan	
Washing machine	
Electric sewing machine	
Home theatre system	
Hair Dryer	
Emergency light	
Pans	
Other Specify………	

C_6.   Do you use electricity for income generating activities?

      1. Yes   2. No

C_7.   If yes, what are the activates

	C_8. How many bulbs do you have in your HH?		
	Type	**Number**	**Usage per day- No of hours**
1	CFL		
2	CFL		
3	CFL		
4	CFL		
5	CFL		
6	CFL		
7	CFL		
8	CFL		
1	Filament bulbs		
2	Filament bulbs		
3	Filament bulbs		
4	Filament bulbs		
5	Filament bulbs		
6	Filament bulbs		
7	Filament bulbs		
8	Filament bulbs		
1	Fluorescent bulbs		
2	Fluorescent bulbs		
3	Fluorescent bulbs		
4	Fluorescent bulbs		
5	Fluorescent bulbs		
6	Fluorescent bulbs		

7	Fluorescent bulbs		
8	Fluorescent bulbs		
1	Halogen bulbs		
2	Halogen bulbs		
3	Halogen bulbs		
4	Halogen bulbs		
5	Halogen bulbs		
6	Halogen bulbs		
7	Halogen bulbs		
8	Halogen bulbs		
	Other …………		

		No. of times per day	No. of times per week	No. of times per month
1	Interruptions			
2	Low voltage			
3	High voltage			

Quality of Power

C_10

C_11. Total number of torch batteries used per month

C_12. Cost for that Rs………………

C_13. Do you use car batteries that are charged by electricity?

                  1. Yes   2. No

C_14. If yes, number of times charge per month?....................

C_15. Lifetime of the battery

    1. Six month

    2. One year

    3. Other – Specify………………….

Section D: Electricity consumption

D_1.   What is your electricity bill account number …………………

D_2.   Is the bill affordable?

        1. Yes   2. No

D_3.   Kerosene oil budget within two days.

		No	Amount paid Rs.
1	Bottles		
2	Liters		

D_4.   Use of candles ……………..

D_5.   Do you settle the electricity bill monthly on time?

        1. Yes   2. No

D_6.   If not, why don't you settle the bill monthly?

……………………...

Section E: Information on monthly Family EXPENSES (for the last month)

No	Item	E_1. Average daily expenditure total (Rs)	E_2. Average monthly expenditure total (Rs)
1	Food		
2	Beetle/Smoking		
3	Liquor, heroin and other		
4	Recreation, hospitality and entertainment		
5	Education (tuition fees, stationery etc)		
6	Clothing		

7	Water		
8	Telephone		
9	Transport		
10	Medicine		
11	Fuel		
12	House rent/ lease		
13	Interest for loan		
14	Other (Specify)		

15. Does your family receive Samurdhi?

      1. Yes   2. No

Non Electrified HH   **Serial Number:………….**

Electricity Requirements of Prospective Electricity Consumers and
Fuel (electricity) Poverty & Affordability Study

Section A

20. Sector   :-   1.Urban 2. Rural 3. Estate

21. Province   :- …………………………………….

22. District   :- ……………………………………

23. GN Division   :- ……………………………………

24. Name of   Village / Town / Estate   :- ……………………………………

25. Interviewed by (Name)   :- …………………………………….

26. Checked by Field (supervisor)   :- ……………………………………

27. Coded by (Name)   :- ……………………………………

28. Name of the Interviewee   :- ……………………………………

29. Sex   01.Male ☐   02. Female ☐

30. Age   :- ……………………………………

31. Civil Status

    1. Single never married

    2. Married,

    3. Widowed

    4. Divorced

    5. Separate

32. Educational levels

Studying Year 1	00	Passed Year 10/Grade	10
Passed Year 1	01	Passed G.C.E (OL/N.C.G.E	11
Passed Year 2	02	Passed G.C.E. (AL)/H.N.C.E	13
Passed Year 3	03	Passed GAQ/GSQ	14
Passed Year 4	04	Degree	15
Passed Year 5	05	Post Graduate Degree/ Diploma	16
Passed Year 6	06	No Schooling	19
Passed Year 7	07		

Passed Year 8   08

Passed Year 9   09

14. How many school children are in the family? :- ……………………………

15. Employment   :- ……………………………

16. Monthly salary   :- ……………………………

17. Monthly income from other sources   :- ……………………………

    (Inclusive of other employees in the family)

18. Number of other employees in the family   :- ……………………………

19. Total members in the family   :- ……………………………

Section B: Housing Condition

B_ 1. What is the main type of material used on the outer walls of this dwelling?

    1. Mud / Mud brick / soil

    2. Wood

    3. Metal Sheet/ slate / asbestos/ corrugated iron

    4. Stone

    5. Bricks

    6. Cement blocks / concrete

    7. Other (Specify):

B_2. Is the dwelling owned or rented?

        1 – Owned

        2 – Rented

        3 - Family dwelling, without payment

        3 – Squatting, without payment

        5 – Other (Specify)   :- ……………………………

        6 – Don't know

B_3. How many rooms? (Include separate kitchen as a room. Do not count toilets)?

    ………………

B_4. What is the source of lighting?

        1. Kerosene oil 2. Coconut oil   3. Other (Specify) …………..

B_5. Energy for cooking

    1. Fire wood   2. Kerosene oil 3. Gas   4. Other……………….

B_6. What is the household's usual <u>main</u> source of drinking water?

        1 – Piped born water,

2 – Shared tap in community

3 – Well

4 -- River, stream

5 – Other (Specify)   :- ……………………………

B-7.   What is the material used for the roof?

01. Tile

02. Asbestos sheet

03. Tin

04. Palm tree leaves/Straw/ Iluk

05. Other (specify)   :- ……………………………

B-8.   What is the material used for the floor?

01. Cement

02. Floor tiles

03. Earth

04. Other (specify)   :- ……………………………

Section C

C-1.   What are the electric items that your household has?

	Yes =1 No=2	*Number*
1. Radios		
2. Cassette players		
3. TVs		
4. Refrigerators		
5. Electric Irons		
6. Electric cookers/stoves		
7. Computers		
8. Air conditions		
9. Hand phones/ CDMA phones		

10. VCR		
11. Table Fan		
12. Washing machine		
13. Sewing machine		
14. Torch- rechargeable		
15. Pumping motors		
16. Other Specify……………..		

C-2 What is the distant to the nearest power line? KM………….

C-3 If you get electricity within next three months what do you suppose to buy?

    1……………………

    2…………………..

C-4 Do you suppose to use electricity for income generating activities?

    1. Yes   2. No

C-5 If yes, what are the activities that you suppose to start?

    1……………………….

C-6 How many bulbs do you suppose to buy for your HH?

	Type	**Number**
1	CFL	
2	Filament bulb	
3	Fluorescent bulb	
4	Other	

C-7 Can you pay the Electricity bill?

    1. Yes   2. No

No	Item	E_1. Average daily expenditure total (Rs)	E_2. Average monthly expenditure total (Rs)
1	Food		
2	Beetle/Smoking		
3	Liquor, heroin and other		
4	Recreation, hospitality and entertainment		
5	Education (tuition fees, stationery etc)		
6	Clothing		
7	Water		
8	Telephone		
9	Transport		
10	Medicine		
11	Fuel		
12	House rent/ lease		
13	Interest for loan		
14	Other (Specify)………		

Section D

D-1   How much can you pay for electricity? Rs……………….

D-2   Do you spend money for other sources of energy?

         1. Yes   2. No

D-3   If yes, what is the monthly cost for other sources of energy for the last month?

D-4   Do you spend money for solar panels? ……………………

D-5   If yes, how much it costs?   ………………........

Section E: Information on monthly Family EXPENSES (for the last month)

E-1   Does your family receive Samurdhi?

    1. Yes   2. No

E-2   If you get electricity from solar power what are the difficulties that you face?

1. It is not enough during the rainy season
2. Number of bulbs is not enough.
3. Lighting time is not enough
4. Can not use iron
5. Can not watch colour TVs
6. it does not work all the time

E-3 What are the difficulties that prevent you from electricity consumption?

Annexes III _ The Key informant interviews

The Key informant interviews conducted by SPARC regarding the survey were done with the following prominent researchers in the field of electricity and poverty.

List of Key informants

1) Chamindra Weerakkody_ Freelance Consultant
2) Priyanthi Fernando _CEPA
3) Karin Fernando _CEPA
4) Harsha Wickcramasinghe_ SEA
5) Dr. Siyabalapitiya
6) Asoka Abegunawardhana_ Energy Forum
7) Damitha_ Practical Action
8) Mr. Namiz Musafer_ Practical Action
9) Mr. Dileepa_ Open University

The discussions were mainly focused on electricity poverty and associated issues.

Following comments were given as the background of the electricity industry in Sri Lanka.

Out of the total electricity generated within the island, 60% is from Thermo power plants while 40% is generated by Hydro power.

It was stated that, 81-84% households in Sri Lanka are grid electrified. While Off – Grid households are around 4%. Off Grid was mainly Mini Hydro power plants and solar power systems. It was revealed that 120000 solar power systems, which means around 2%

households get electricity through the solar systems. While another 9000 households have access to electricity generated through Mini Hydro power plants.

The National Average household consumption of grid electricity was exposed to be 67 units per household per month. About 40% consumers contribute to around 70% of the grid connected electricity, while the remaining 60% consumes utilize the balance. Furthermore, it was revealed that 50% of grid electrified households consume less than 50 units per month, while the crucial groups of electricity are considered as 'low middle level' households, who consume between 50 – 90 units per month.

Most of the off- grid users are continually using Off- Grid electricity primarily due to non availability but not necessarily due to affordability issues. And their basic requirement of electricity was lighting, followed by watching tv and ironing.

Among the issues with regard to the topic, several points were observed and discussed.

The main users of electricity are classified in to three categories by the CEB. Namely, household, commercial and industrial users. And three different levels of tariff plans for these three categories are incorporated. One issue identified was since small shops are also considered as commercial users, the unit cost becomes relatively high which will intern negatively impact the small businesses.

Also according to the key informants, almost all off- Grid users are willing to get grid connected electricity supply. This is mainly due to the cost involved with Off – Grid supply and due to the inconveniences occurred during usage of the same. For example to watch the Television they might have to switch off all the lights in the house to get sufficient voltage.

Also it was stated that, among the off- grid Households, the main energy source is Kerosene and they spend a considerable amount on it, Hence it was assumed that there will be less affordability issues once they are connected to the grid.