ASSESSMENT OF THE IMPACTS OF ELECTRICITY SUBSIDIES IN SRI LANKA

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To my dearest Parents

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Abstract

Government of Sri Lanka provides subsidy on electricity to uplift the living condition of citizens for decades. This research project mainly scrutinize, whether the objectives of the electricity subsidies have been fulfilled or not. Further, both positive and negative impacts of electricity subsidy is descriptively discussed. Appropriate remedial actions are proposed for the betterment of identified indirect negative impacts. In the analysis, it was found that some primary objectives of the electricity subsidy have not been achieved. One of the most subtle negative impact recognised is the encouragement of energy inefficient equipment usage among subsidized consumers. A case study was conducted in Ratnapura District to investigate the energy inefficient equipment usage and to quantify the electricity wastage. Findings were used to estimate the electricity wastage in whole country due to inefficient equipment. Further, it was found that the existing tariff structure encourages the energy inefficient equipment usage and it acts contradictory to the fundamentals. As a possible way of saving electricity and catering the demand at night peak, replacement of incandescent lamps were analyzed and possible saving were estimated. Moreover the investment on replacing incandescent lamps by energy efficient equipment was estimated and financially evaluated with the returns.

Additionally, it was found that the eligibility criteria of current subsidy is having many loopholes. The major shortcoming is that it allows unwanted people to enjoy the subsidy. The additional burden to the treasury has been estimated as LKR 11 billion per year. It was seen that modifications are needed for electricity subsidy eligibility to ensure only needy people receive the electricity subsidy.

Meanwhile modifications are needed for tariff rates fixing method. New equation shall be introduced based on actual generation cost for the tariff rates calculation with appropriate justifications. Further it is recommended to reduce the electricity subsidy gradually to zero. Discouragement of energy inefficient equipment usage by introducing new taxes, promoting energy efficient equipment, introducing subsidies to energy efficient equipment and conducting awareness programs regarding the electricity conservation are the other recommendations to minimize the negative impacts of electricity subsidy.

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LIST OF ABBREVIATIONS

Abbreviation	Description
ABC	Ariel Bundled Conductor
AC	Alternative Current
AR	Annual Report
CEB	Ceylon Electricity Board
CFL	Compact Fluorescent Lamp
CPC	Ceylon Petroleum Cooperation
DCMG	Direct Current Micro Grids
GES	Global Energy Statistics
NCRE	None Conventional Renewable Energy
IESL	Institution of Engineers Sri Lanka
LECO	Lanka Electricity Company
LED	Light Emitting Diode
LKR	Sri Lankan Rupees
MFP	Ministry of Financial Planning
RE	Rural Electrification
SL	Sri Lanka
UNEP	United Nations Environmental Program
US	United State
WB	World Bank
PUCSL	Public Utilities Commission of Sri Lanka

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1. INTRODUCTION

A subsidy is simply identified as assistance for a product, service, economic sector or business. A subsidy may include direct grants, tax reductions or exemptions. Furthermore it controls prices and indirect regulations that skew the market in favor of the particular commodity. Most subsidies are placed by the government to achieve certain outcomes. Subsidies are one of the powerful policy tool in hands of the government to rectify the economic, social and environmental impacts. In many countries, subsidies are used to achieve a wide range of objectives for decades. Indeed, one of the most challenging responsibilities of the government is allocating financial resources to carry on subsidies. There are number of criterion with long-term planning and development process by which a subsidy strategy may be assessed.

Often a subsidy may be achieving its intended objectives effectively, sometimes it may have few negative unintended consequences such as corruption, inefficiency and environmental degradation. Error corrections and fine tunings should be continuously implemented to minimize those indirect negative impacts. Economically, some subsidies can have a direct impact on price and demand of the subjected good or service since it includes government grants, tax reductions or exemptions for price control. Hypothetically, it is said that social welfare is rich when the price of each good and service is freely determined by the interaction on demand and the supply in open and competitive markets. Practically, it is not easy to implement due to the various barriers to market entry.

As other developing countries in the region, Sri Lanka also provides large varieties of subsidies. Energy, agriculture, petroleum, education and health are key sectors which contain subsidies in Sri Lanka. Those subsidies have made a tremendous impact on life style of Sri Lankans during last few decades.

Focus of this research is to assess whether original intention of the electricity subsidy in Sri Lanka has been succeeded. It further evaluates its positive and negative impacts and effect on the environment in which people live and the economies in which they earn their living.

1.1 HISTORY OF SUBSIDIES IN SRI LANKA

In Sri Lankan history, subsidies could be found from present government to ancient King's periods. Obviously the main intention of those subsidies was to give a relief for poorest among the poor. In past, governments had given subsidies to people in various categories. Fuel, fertilizer, wheat flour, electricity, education and health were some of famous subsidies highlighted in last couple of years. Sometimes process of implementation of those subsidies was not smarter to capture exact targeted group and it has resulted failure to achieve all preliminary intentions. Sometimes unexpected outcomes have been taken place indirectly.

However subsidies cater the country needs, unless let it being controlled according to the narrow agendas of hidden parties. A critical analyze should be done to compare actual outcomes with forecasted outcomes. It would be vital to have an investigation to identify the nature of various subsidies in Sri Lanka and their impact to the public.

1.1.1 Fertilizer subsidy

Fertilizer subsidy is one of politically sensitive policies, which has implemented for intention of promoting rice cultivation in Sri Lanka. It was initiated in 1962 with main objective of encouraging farmers to switch from traditional rice varieties to high yielding rice varieties, which were highly responsive to chemical fertilizers.

During the period from 1962 to 1989, the subsidy had provided for fertilizers containing Nitrogen, Phosphorus, and Potassium. Subsidy was abolished during 1990 to 1994 and again it was reintroduced in 1995. The subsidy was again restricted to nitrogen fertilizers during the period of 1997 to 2004. Since 2005, the subsidy has again been expanded to cover all three types [8].

Currently, the fertilizer subsidy has become a massive burden on the Treasury. The government has been under constant pressure to continue the fertilizer subsidy since paddy cultivation provides livelihood for more than 1.8 million farmers [8]. Certain environmentalists, based on their preliminary findings, have initiated discussions in the public media about the pollution of waterways by heavy metals, such as Cadmium, which caused by application of inorganic fertilizer. They also argue that accumulation of cadmium in water bodies as well as in plant and animal tissues have led to increase

the prevalence of chronic renal failures [2]. As a result, the government has to allocate a special fund for chronic renal failures from the budgets.

Traditional rice cultivation has totally declined with new trend of the fertilizer subsidy. The statistics of health sector say that health issues such as cancers also increased during last three decades.

It was found that there were plenty of minor impacts due to fertilizer subsidies. Some farmers sold the fertilizer little lower than the market value to others where they got as subsidy from the government [19]. It was common that most of the vegetable and other types of farmers buy fertilizer from subsidized rice farmers. Hence subsidies encourage to commercialize the benefit they received. Due to the subsidy, using of high quantity of fertilizer more than recommended for higher yield was also a long term problem in agriculture field.

Ultimately the fertilizer subsidy became a huge burden not only in economic aspects, but also in health, social, and environmental aspects too.

1.1.2 Fuel subsidies

1.1.2.1 Heavy fuel subsidy

Before 2012, heavy fuel was sold with a huge subsidy to Ceylon Electricity Board (CEB). Therefore, the loss to Ceylon Petroleum Corporation (CPC) increased due to arrears of fuel payment of CEB. In 2011 CPC was supplying furnace oil to the CEB at a price of forty rupees per litre when its actual price was hundred and ten rupees and CPC incurred a loss of ninety billion rupees within the 12 months of 2011. Thus, it seems that the majority of the loss of the CPC has occurred mainly due to the heavy fuel subsidy. Thus, the Bank of Ceylon (BOC) and the People's Bank faced a huge crisis by supplying loans to the CPC [12].

Accordingly the results of the heavy fuel subsidy have become a burden to CPC, CEB, BOC and People's Bank. Ultimately it will be loaded to the general public by indirect manner with the time.

1.1.2.2 Diesel subsidy

Diesel is the widely used fuel type for transportation sector in Sri Lanka. All types of consumable items including foods and services are priced by adding the transportation component. Government tends to give a subsidy for diesel since the price of diesel highly influence the day to day expenses of citizens. Normally diesel and petrol are usually in same price range in the world market, but in Sri Lankan market the diesel price is considerably low. The fluctuation of diesel and patrol prices in Sri Lanka compared with the world market is shown in Figure_1.1.

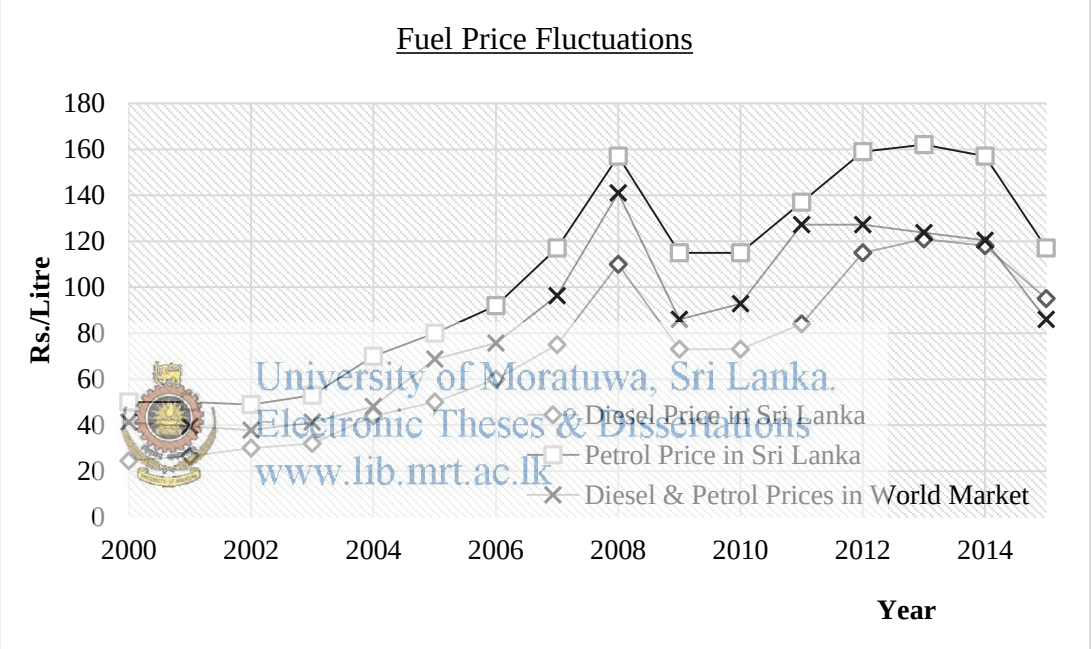


Figure_1.1: Fluctuation of selling prices of diesel and patrol in Sri Lankan market and world market

Sources: www.ceypetco.gov.lk, www.oil-price.net and www.globalpetrolprices.com

Sri Lanka purchases 60% of oil requirement as refined oil. The stock capacity of crude or refined oil in Sri Lanka may be adequate nearly for 45 days for the country's demand. Iran was the main fuel supplier to Sri Lanka and the prices of Iranian fuels were reasonable compared to the open market.

International sanctions have been imposed on selling Iranian fuel. Therefore, Sri Lanka has to purchase oil from the open market at competitive prices. CPC continued to sell

the fuel at same prices for a short period and incurred a loss. Raising the fuel prices is the only alternative that the government could take at that juncture since the subsidy became a heavier burden to the government. The CPC was unable to pay the General Treasury even though the direct tax income it earned in the past two years till the world fuel prices drops.

In the end of 2014 and beginning of 2015 CPC gave a relief again. But majority of the society agreed that this price reductions seems to be more politically biased targeting the Provincial Elections and Presidential Elections.

1.1.2.3 Kerosene subsidy

Around 96% of the population of the country uses electricity for their household energy requirement [6]. Kerosene is used only by a small segment of the population. It is believed that kerosene is used in the very remote villages in the country who are deprived from facilities.

But, according to government statistics, 40% of kerosene consumption is reported from Gampaha District. A large portion of kerosene goes to factories and fishing industry. It was found that some people use kerosene as a substitute for diesel.

Even when other areas are concerned, consumption of kerosene is very high in the coastal line and in estate areas such as Nuwara Eliya, Kandy and Badulla even though most of the houses in estates have been provided with electricity.

Thus, the government decided to grant relief to the public who are affected by the fuel hike in 2011. Accordingly LKR 61 million rupees has been allocated by the treasury for kerosene stamps to be given to households which do not have electricity [12].

Kerosene subsidy was further increased in September 2014 targeting Uva Provincial Council election. This price reductions for kerosene was suddenly announced by the government by twenty rupees per litre. Meanwhile, political experts said that the government move has provoked opposition allegations that it was fearing defeat in September poll in the Uva Province.

1.1.3 Education and health subsidies

Although the education is fully subsidized, majority children attend private tuitions to get ready for competitive examinations. The main reason was the dissatisfaction for quality of the subsidized education. Same scenario could be seen also in health sector. Often government hospitals do not have enough human resources, drugs and other facilities to provide high quality service. Most of the patients are unconsciously directed to private channeling for consultancy and pharmacies for drugs. Subsidies on education and health is not much effectively functioning in Sri Lanka. Indirectly, it creates lot of loopholes to spend money for private practices.

1.2 SUBSIDIES IN THE WORLD

Subsidies can be found in all over the world. Economic experts of prospective countries introduce, enhance, reduce or remove the subsidies time to time. Nowadays subsidies of most of the countries become highly political biased. Many subsidies can be identified that they directly influence to the vote base at elections. It is clearly identified that some subsidies given early elections were not based on long term economic analysis but temporary benefit of ensuring the power of existing government.

The economic costs of energy subsidies can place a heavy burden on government finances by weakening the foreign trade balance and stunting the potential of economies. These costs are comparably large when energy is heavily subsidized. The report of "Energy Subsidies: Lessons Learned in Assessing their Impact and Designing Policy Reforms by UNEP" says Indonesia, Korea and Iran are countries when the economic cost of subsidies have become a heavy burden to country's economy.

Electricity subsidies in India, for example, by undermining the financial steadiness of the state electricity boards, weaken the investment and the quality of electricity service. Subsidies to specific technologies can also hinder the development of competing technologies that might be economic in the longer term. In other words, subsidies can freeze inappropriate technologies may be they are already expired or identified energy inefficient [17].

Table_1.1: Summary of subsidies in some selected countries

Country	Type of subsidy	Impact assessed	Environmental effect	Social effect
India	Electricity	Subsidies encourage waste and hold back investment in power sector, major constraint on economic development. Removing subsidies would trim demand in long run by 34%	Removing electricity subsidies along would cut CO_2 emission by 99 million tones, equivalent to a third of current power sector emission	Subsidy removal would raise cost of service to households, but would improve quality of service and enhance utilities' ability to extend and expand the capacity
Chile	Oil and Coal	The elimination of coal subsidies in 1995 was economically beneficial. Removing remaining oil subsidies would incur short-term economic cost	Large reductions in CO, particulate and CO_2 emissions.	Removing oil subsidies completely would have a slightly larger negative impact on richer household incomes.
Indonesia	All types of energy subsidies	Net economic cost of subsidies to kerosene, diesel, gasoline and heavy fuel oil amounted to $4 billion in 2001	Subsidies exacerbate pollution, specially particulate and lead.	Reducing subsidies would free up resources to support the poor in more effective ways.
Korea	All types of energy subsidies	Coal subsidies of around $500 million per year and large cross-subsidies in electricity and gas, together with tax systems, distort energy-sector performance.	Subsidies to coal and to industrial users of electricity and gas encourage over-consumption of fossil fuels and consequently boost emissions.	Removal of coal subsidies would have serious economic and social consequences for mining communities.
Iran	All types of energy subsidies	Subsidies caused inefficient energy use, are a major burden on public finances and have resulted in poor energy sector performance.	Excessive energy use has aggravated local and regional pollution, a major public health issue.	Mainly benefit higher income groups, which consume lager amounts of subsidies energy. But eliminating subsidies would have a dramatic impact on household budgets.

Source: United Nations Environment Programme (2001). Energy Subsidies: Lessons Learned in Assessing their Impact and Designing Policy Reforms.

Many energy subsidies are harmful for the environment. Subsidies encourage production and usage of fossil fuels inevitably causing harmful environmental effects. This can lead to higher emissions of noxious and greenhouse gases as well as other forms of environmental damages, such as water contamination and spoiling of the landscape. Table_1.1 gives a summary of various energy subsidies in some countries in the World. It contains impact assessed, environment effects and social effects from the particular subsidy.

Recent international legal frameworks, such as the 1997 Kyoto Protocol, explicitly require a reduction of subsidies that encourage greenhouse gas emissions in many developing countries. More pressing environmental cost of subsidies relates to the health impacts of local pollution, as well.

1.3 INTENTIONS OF SUBSIDIES

There are many reasons for subsidies. In Sri Lanka following can be identified as major intentions for the subsidies in common.

1.3.1 Political reasons

1.3.2 To promote a selected sector

1.3.3 To give a relief to citizens at an emergency situation

1.3.4 To uplift a particular industry or a profession

1.3.5 To uplift the life condition of government servants

1.3.1 Political reasons

Subsidies are highly politicized policy intervention in Sri Lanka. Existing government tends to give subsidies just before an election. The most common election promise made by the ruling and opposition parties in their election campaigns is that they will continue the existing subsidy programs or modify them to make more favorable to voting citizens.

The majority of voters are connected either directly or indirectly, so the subsidies have the power to make new government or break existing government. For an example, the political importance of the subsidy is evident from a statement made by the minister

of agricultural development at a press briefing on April 01, 2010, just before the general election on April 08, 2010 that government has shouldered a burden of LKR 26,065 per acre for the fertilizer subsidy since 2005 [19].

Similarly fuel and electricity subsidies were increased targeting the Uva Provincial election in September 2014. Electricity was reduced by 25%, reduction in diesel was three rupees per liter, reduction in petrol was five rupees per liter and the reduction in kerosene was twenty rupees per liter [20].

Fuel subsidy was further increased in December 2014 by targeting Presidential election 2015. The prices of petrol, diesel and kerosene have been reduced effectively from December 05, 2014 just three days before announcing the Presidential election on December 08, 2014. Accordingly, seven rupees a liter have reduced the prices of petrol and diesel while five rupees a liter have reduced kerosene.

New subsidies are promised by political parties to win election. For an example, in "2015 Presidential Election" the fuel price reduction was a main promise of the opposition candidate. As promised at the election the newly elected President and new government further reduced the fuel prices.

Accordingly price of a petrol liter has been reduced from LKR 150.00 to LKR 117.00 while the price to diesel which were LKR 111.00 has been reduced to LKR 95.00, while kerosene has come down from LKR 81.00 to LKR 65.00 per liter.

Hence subsidies are key topics at election campaigns in both government and opposition parties in Sri Lanka. The impacts of subsidies just before an election can influence for election results. It is seen the subsidies are highly political biased and most of the cases subsidies are offered to obtain short term political benefits without having proper long term investigations regarding the sector.

1.3.2 To promote a selected sector

Theoretically, promoting a particular sectors the primary intention of a subsidy, practically with political issues it becomes the secondary. Government has given fertilizer subsidy to promote high yield rice cultivation in Sri Lanka. Government subsidized the entire education flow from primary education to university education.

Free education is a valuable gift to keen children. Majority executive officers in the country were produced through free education. Free health gives a relief to patients who do not have capacity to spend money for private hospitals. Subsidized fuel, electricity and other power and energy related goods will affect for development of the country.

1.3.3 To give a relief to citizens at an emergency situation

At disasters like floods, droughts, earth slips and tsunami it is the responsibility of the government to provide basic needs to the victims. For example, government provided shelters and all the other basic requirement for the victims free of charge at tsunami in 2004, the north-eastern war until 2009, the earth slip in Badulla in 2014. However mismanagements and corruptions can take place at sudden developments. It is recorded that sometimes the entire allocation of funds are not going directly to the victims.

1.3.4 To uplift a particular industry or a profession

Government tends to give subsidies to absorb risks of a particular sector temporarily until the system is getting stable at a natural disaster, market struggling for a particular industry, profession, product or service might be in threat. For an example government bought the entire harvest of from onion farmers in 2014 when the market was fallen down. Sometimes government cancels interest for loans or exempts taxes for selected sectors.

1.3.5 To uplift the living conditions of government servants

Government offers vehicle permits for the executive officers and tax free motor bicycles for the other staffs of government servants. Soft loans and medical schemes are also provided to uplift their life condition. Those subsidies were given only for selected government servants for their service to the nation.

2. ELECTRICITY SUBSIDIES IN SRI LANKA

Electricity subsidy is a measure that keeps the electricity prices for consumers below its generation cost. Sri Lankan electricity subsidy is complex to a certain extent. Even though heavy subsidy is given to lower consuming blocks, high-end consumers are charged more than the actual cost. Recently, government subsidized electricity connection charges to enhance access of electricity in rural areas. Subsidies to renewable and energy efficient new technologies are growing in response to environmental concerns, particularly climate change and local pollutions. It may help to diversify the fuel mix and to promote decentralized generation.

In particular, no evidence could be found that policy makers were concerned about any environmental and social benefits and costs that might be associated with certain types of energy activities. It also creates barriers to market entry for energy efficient consumer end new technologies. This would be the proper time for the government to intervene in electricity sector in pursuit of environmental and social objectives. Subsidies can be justified if overall social welfare is increased unless it is restricted to a narrow section. This situation occurs, when the social gains and environmental improvements are also achieving simultaneously. Nevertheless, it can be argued that in many instances, the net effect of subsidies was negative when considering the past experiences and evidences. As a temporary solution subsidies may work to a certain extend but for long term overall social welfare would be higher without subsidies. For an example, high concentration on single objective is put on a particular policy goal leads for detriment of substitutes. The way in which the subsidy is applied or implemented procedure may also be ineffective, if the basis of the subsidy is not fixed wisely. Even though primary objectives are achieved along with the net positive benefits, electricity subsidy may not be the most efficient or effective way of achieving policy goals. This report summarizes evidence of kinds of economic, environmental and social impact of the electricity subsidy when compared with other subsidies in Sri Lanka and some other countries in the World. This research would be helpful to understand the complex relationship between the intention and real outcomes. In addition, the assessments of direct and indirect impacts of electricity subsidy will be discussed whether they are either positive or negative. Lessons learned in assessing

about these impacts will be helpful for the future decision makers of subsidies in Sri Lanka.

2.1 ELECTRICITY SECTOR IN SRI LANKA

In modern world, power sector is a key factor is initiating in development of a country. In Sri Lanka, governmental department for electrical undertakings was established in 1926 for electricity generation and transmission. Later, Ceylon Electricity Board (CEB) was established. CEB was entrusted with the responsibility of generation, transmission and distribution of electricity in 1969 by parliament act. Subsequently, the government established Lanka Electricity Company Limited (LECO) to cooperate in the electricity distribution function in the outer suburbs of Colombo and selected areas in the Western and Southern parts of the country. At present, the CEB and independent power producers participate in generation of electricity. Main system operator of the country is CEB, while power generated by the independent power producers is procured by CEB under purchase agreements. Hydro plants and coal power plants are the major contributor for the generation. Wind other NCRE power plants also contribute for the generation mainly from private sector.

Table_2.1: Sri Lankan electricity capacity and the annual generation by source throughout past decade

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Available grid capacity by source (MW)											
Hydro power	1,247	1,281	1,293	1,316	1,326	1,357	1,379	1,382	1,401	1,584	1,628
Thermal	1,233	1,215	1,155	1,155	1,155	1,285	1,290	1,390	1,690	1,638	1,635
Other renewables	3	3	3	3	3	3	15	45	50	90	99
Total availability	2,483	2,499	2,411	2,434	2,444	2,645	2,684	2,818	3,141	3,312	3,362
Annual generation by source (GWh)											
Hydro power	3,310	2,960	3,451	4,634	3,947	4,130	3,881	5,634	4,622	3,292	6,926
Thermal	4,298	5,080	5,314	4,751	5,864	5,763	5,975	4,995	6,785	8,339	4,772
Other renewables	3	3	5	4	4	8	27	86	121	169	262
Total production	7,611	8,043	8,770	9,389	9,815	9,901	9,883	10,715	11,528	11,801	11,962

Source: CEB Annual Reports, Various Years

Government goal for future electricity generation is to use least cost sources. CEB supports using renewable electricity as a part of the generation mix, as evidenced by their investment in wind resource assessment.

Table_2.1 gives details of Sri Lankan electricity capacity by source and annual generation throughout past decade. Sri Lanka has some of the highest electricity costs in Asia. The country did not own any fossil fuels for its history; all fossil fuel resources are imported, which consume about 15% of export earnings. Thermal power contribution for the national supply has been higher than hydropower. Thermal electricity generation consumes the fuel imports considerably. In Sri Lanka, currently hydro and thermal are the main electricity sources and wind power plants are slightly used for the electricity generation. Hydro-thermal mix of past couple of years is illustrated in the Figure_2.1.

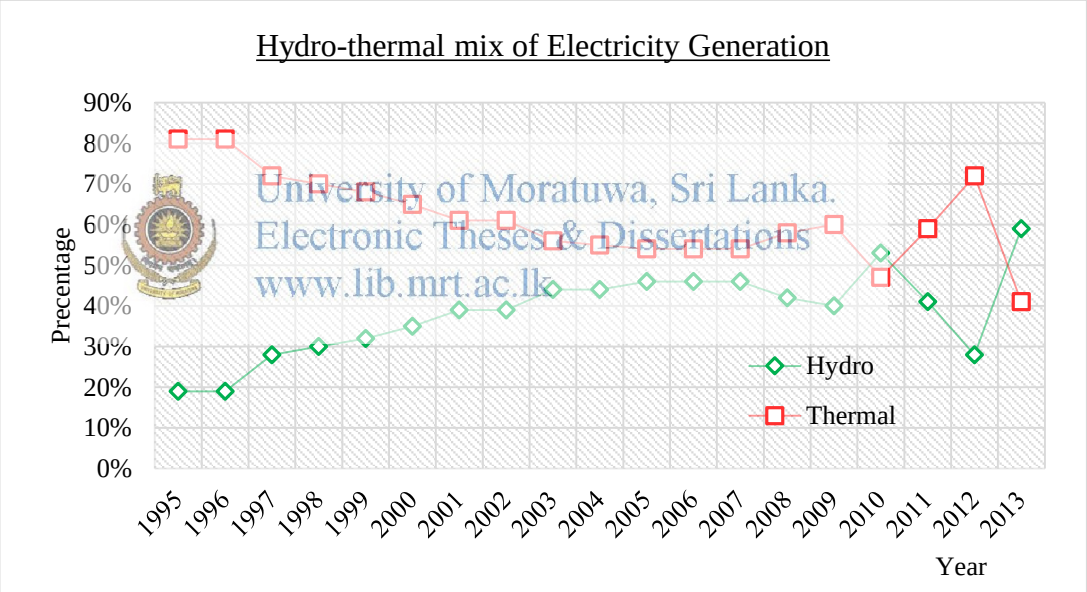


Figure_2.1: Hydro-thermal mix of past couple of years in Sri Lanka
Source: CEB Annual Reports, Various Years

The hydro power generation is attached with its inherent limitations with the rains fall and the availability of water resource. Hydro-thermal mix should be decided extremely carefully and strategically considering both reservoir water availability and rain fall. It is not a wise decision to use reservoir water carelessly for generation of electricity in dry sessions.

The system for providing electricity subsidies is more complex than other products, since policies and tariff rates on electricity differ between consumer categories and different blocks. Moreover, government provides subsidy for providing electricity connection to new consumers, but also grants capital subsidies to utilities. The utilities then approach the government and respective electricity regulatory commissions for approval of the tariff rates. The final approval is provided by the regulatory commission, Public Utilities Commission of Sri Lanka (PUCSL), which was established by Act No. 35 of 2002 by the Parliament of Sri Lanka. The approved tariffs are often lower than those petitioned by the utilities. This markdown is done with the aim of meeting social and developmental objectives for different consuming categories.

Maximum electricity demand for the country is about 1850 MW. Daily energy consumption is about 30 GWh. Generation capacity, annual generation and average unit cost in year 2011 and 2012 of CEB power plants are shown in Table_2.2 [5], [6].

Table_2.2: Generation capacity, annual generation and average unit cost in year 2011 and 2012 of CEB power plants

Power Plant/ Complex	Type	Capacity (MW)	2011		2012	
			Annual generation (GWh)	Average unit cost (LKR)	Annual generation (GWh)	Average unit cost (LKR)
Mahaweli Complex	Hydro	660	1984.9	1.63	1,348.3	2.71
Laxapana Complex	Hydro	335	1365.2		884.9	
Samanala Complex	Hydro	212	670.3		501.4	
Thermal Complex	Diesel	540	1493.6	20.33	2,023.6	23.88
Lakvijaya Plant	Coal	300	1038.0	7.29	1,404.0	11.30

Source: CEB Annual Reports, 2011 & 2012

Actual generation cost of an electricity unit is dependent on the contribution of those power plants. In dry seasons, more thermal power plants dispatch due to be short of water of hydro power reservoirs. Sometimes thermal power contribution goes up to 75% of the total.

Anticipating the actual electricity unit cost is very complex since it is highly dependable with rainfalls to catchment areas of hydro power plant reservoirs, hydro capacity and storage of reservoirs, dispatch priority, availability of the power plants and electricity demand.

However the annual average electricity unit cost is calculated considering the expenses for the Ceylon Electricity Board with its overhead cost for the electricity generation. Figure_2.2 shows the average generation cost and average selling price for last couple of years.

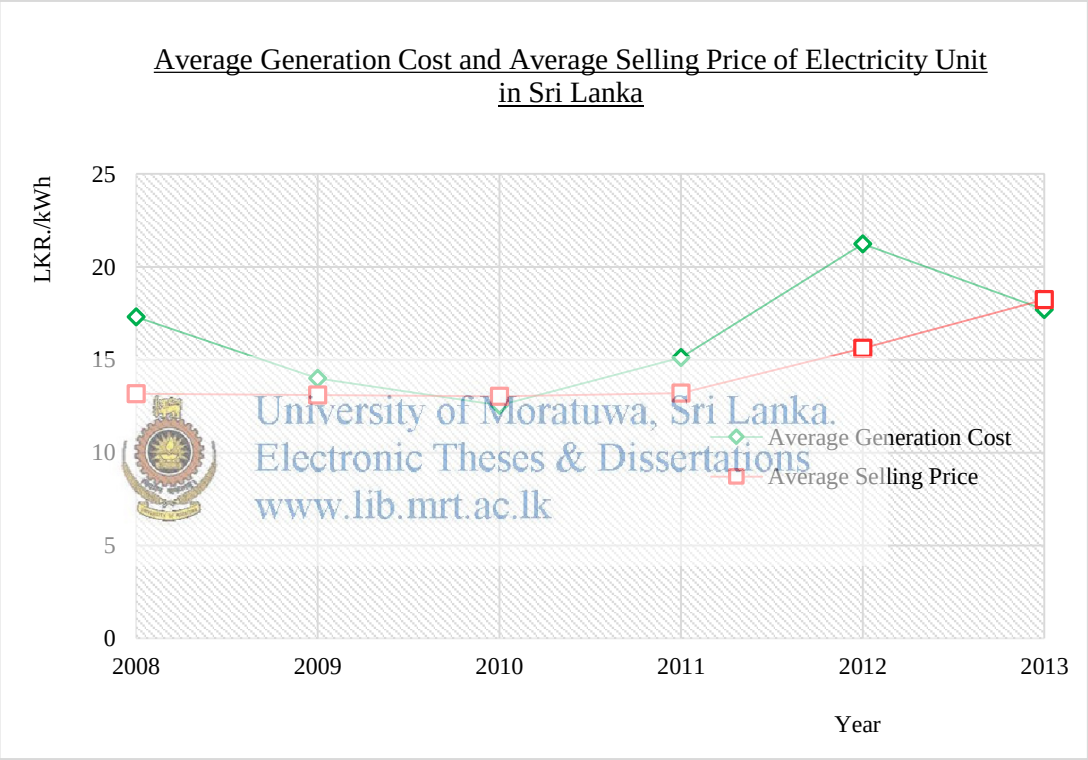


Figure_2.2: Average generation cost and average selling price of electricity in Sri Lanka

Source: CEB Annual Reports, Various years.

2.2 ELECTRICITY TARIFF STRUCTURE IN SRI LANKA

In Sri Lanka block tariff structure is applicable to domestic electricity consumers, with 30 kWh blocks. Electricity tariff has been revised during last couple of years, Once in April, 2013 and again in September 2014. Table_2.3, Table_2.4 and Table_2.5 show tariff rates for domestic consumers.

Table_2.3: Domestic electricity tariff in Sri Lanka, until April 2013

Monthly Consumption kWh	Unit Charge (LKR/kWh)	Fuel Adjustment Charge %	Fixed Charge (LKR/Month)
0-30	3.00	25	30
31-60	4.70	35	60
61-90	7.50	40	90
91-120	21.00	40	315
121-180	24.00	40	315
>180	36.00	40	420

Source: Publications of PUCSL

The electricity tariff was increased in April 2013 to reflect the cost of power generation. Still the tariff revision applicable with a heavy subsidy to domestic consumers who consume less than 60 units was kept unchanged.

The intention was safeguard low income consumers. However, energy charges for consumers who consume more than 60 units were increased on different scales as shown in Table_2.4.

Table_2.4: Domestic electricity tariff in Sri Lanka, from April 2013 to September 2014

Monthly Consumption kWh	Unit Charge (LKR/kWh)	Fuel Adjustment Charge %	Fixed Charge (LKR/Month)
0-30	3.00	25	30
31-60	4.70	35	60
More than 60 units			
0-60	10.00	N/A	N/A
61-90	12.00	10	90
91-120	26.50	40	315
121-180	30.50	40	315
>180	42.00	40	420

Source: Publications of PUCSL

Around 4.5 million numbers of domestic electricity accounts were available in Sri Lanka in December 2013. The financial position of the CEB improved significantly after the tariff revision. According to the unaudited provisional financial data, CEB recorded an operating profit of LKR 24.6 billion in 2013 in contrast to an operating loss of LKR 62.1 billion in 2012.

Table_2.5: Domestic electricity tariff in Sri Lanka, September 2014 onwards

Monthly Consumption kWh	Unit Charge (LKR/kWh)	Fuel Adjustment Charge %	Fixed Charge (LKR/Month)
0-30	2.50	N/A	30
31-60	4.85	N/A	60
More than 60 units			
0-60	7.85	N/A	N/A
61-90	10.00	N/A	90
91-120	27.75	N/A	480
121-180	32.00	N/A	480
>180	45.00	N/A	540

Source: Publications of PUCSL

Distribution of those consumers among the tariff blocks are given in Table_2.6. It is clear almost 90% of consumer use below 120 kWh per month and 75% of consumers use below 90 kWh. Upper blocks consumers are not entitled for the electricity subsidy. It is clear consumers who are using over 120kWh per month have to pay more than cost of what they consume. Some of them go for net metering solar systems to reduce the electricity cost.

Table_2.6: Domestic consumer distribution among tariff blocks

Block	Average No of Consumers	Consumer Percentage in Blocks
Units <= 30	**818,374**	**19.68%**
30 > Units <= 60	**1,257,004**	**30.23%**
60 > Units <= 90	1,136,860	27.34%
90 > Units <= 120	512,048	12.32%
120 > Units <= 150	217,271	5.23%
150 > Units <= 180	98,819	2.38%
Units > 180	117,134	2.82%
Total	**4,157,510**	**100.00%**

Source: Billing data of Ceylon Electricity Board, 2013

It is much essential to investigate intentions of the electricity subsidy and evaluate whether expected objectives has been addressed. The main target of the government is

to give relief to the poor people of the country. Subsidy is given based on the electricity consumption and the burden of the lower blocks absorbs by the Treasury. Selection criterion of the electricity subsidy is highly questionable. There is a possibility of excluding the poor people and including rich people since income is not concerned for eligibility.

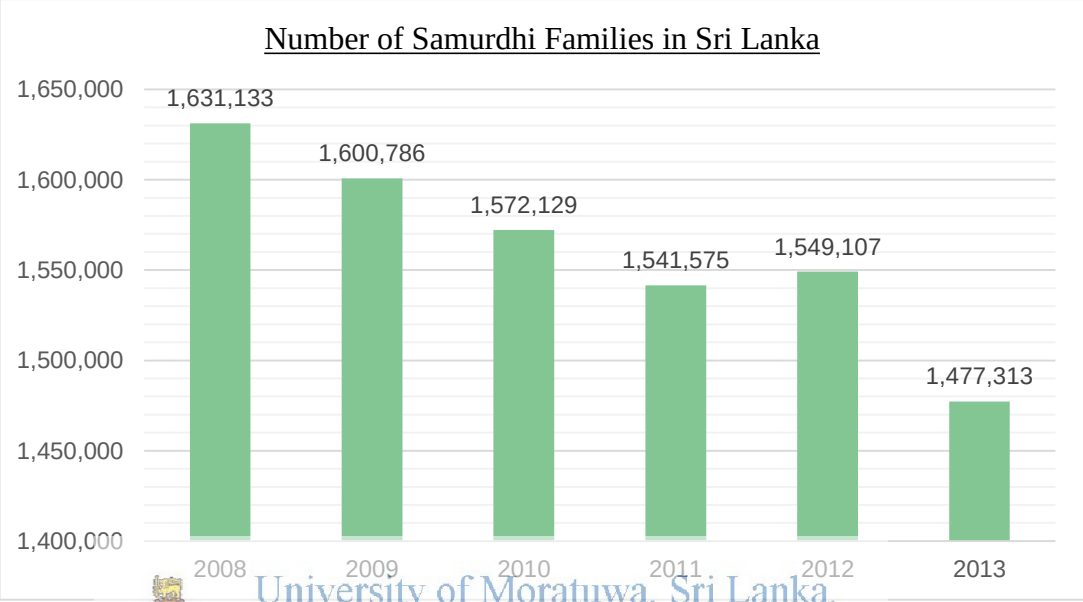


Figure_2.3: Number of Samurdhi Families in Sri Lanka
Source: Central Bank of Sri Lanka, 2013

However government already has a special methodology to identify poor people called "Samurdhi". Samurdhi holders are selected on the recommendation of Grama Niladari, who is the public officer appointed by the government to carry out administrative duties in the smallest administration unit, which is a subunit of a divisional secretariat. The number of Samurdhi holders available in last few years are illustrated in Figure_2.3. In 2013 there were around 1.5 million households receiving "Samurdhi" benefits but utility billing data shows there were around 3.2 million households enjoy the electricity subsidy. Ultimately around 1.7 million non Samurdhi holders also received the subsidy. Average energy consumption and percentage for each blocks of domestic category for the year 2012 is shown in the Table_2.7. It is clear that 75% of consumers are using less than 90 units and 85% of consumers are using less than 120 units.

Table_2.7: Domestic energy consumption among tariff blocks

Blocks	Consumption (kWh Units)	Percentage	Average Consumption Per Account (kWh)
Units <= 30	15,488,111	5.40%	18.9
30 > Units <= 60	56,780,577	19.80%	45.1
60 > Units <= 90	84,574,379	29.49%	74.4
90 > Units <= 120	52,291,083	18.23%	102.1
120 > Units <= 150	28,582,917	9.97%	131.6
150 > Units <= 180	15,951,746	5.56%	161.4
Units > 180	33,143,785	11.56%	283.0
Total	**286,812,598**	**100.00%**	**65.9**

Source: Billing data of Ceylon Electricity Board, 2013.

Electricity tariff varies by country. Many reasons can be found for these differences. Electricity prices depend on the type of power plants or fuels used, government subsidies, government or industry regulation and weather patterns.

2.3 COMPARISON OF THE ELECTRICITY TARIFFS AMONG SOUTH ASIAN COUNTRIES

Electricity consumption pattern of a country is a complex and unexpected scenario to understand. The energy consumption growth in the G20 slowed down to 2% due to economic crisis in 2011, after the strong increase of 2010 [10].

However, Sri Lanka is not a big energy consumer among Asian countries. The main reason is the low population of little more than 21 million. Tabe_2.8 shows the energy consumption data in the Asian countries.

Sri Lanka is at the third place in per capita energy consumption in south Asia and it is little lagging the regional average. India and Pakistan consume more than Sri Lanka by the country per capita consumption. Per capita electricity consumption details for south Asian countries are given in Table_2.9.

The lowest domestic electricity tariff rates are available in Bangladesh. The electricity generation in Bangladesh is based on natural gases [11]. India has the highest for industrial consumer category, while in Sri Lanka industrial tariff is slightly subsidized.

Table_2.8: Population, energy production and usage of south Asian countries

	Population (Million)	Energy Production (Million Tons of Oil)	Energy Usage (Million Tons of Oil)	Fossil Fuels Percent of Total Use %
India	1,140.6	468.3	621.0	71.1
Pakistan	178.5	63.3	82.8	61.8
Bangladesh	151.3	23.4	27.9	68.4
Nepal	28.2	8.7	9.8	10.9
Sri Lanka	21.1	5.1	8.9	43.4

Source: Jamil, F., "Comparison of Electricity Supply and Tariff Rates in South Asian Countries", 2011.

Table_2.9: Per capita electricity consumption in south Asian countries

Country	Electricity Consumption (kWh per capita)			Average
	2009	2010	2011	
India	604.9	641.2	684.1	643.4
Pakistan	450.3	457.8	449.2	452.4
Bangladesh	220.8	297.4	258.6	258.9
Nepal	98.2	103.4	105.5	102.4
Sri Lanka	416.8	449.2	490.2	452.1
South Asia Average	540.0	571.7	605.1	572.3

Source: World Development Indicators, World Bank.

A comparative electricity tariffs for domestic category based on year 2010 in US Cents for south Asian countries are given in Figure_2.4.The tariff structure of Sri Lanka is unique compared to other neighboring countries. Initial blocks are heavily subsidized which is not offered by any other country in the region. However the end blocks are heavily charged more than the cost of generation.

The ratio between the highest block and lowest block of electricity rates is given in Figure_2.5. Bangladesh, Nepal and India maintain it around 2 to 3 times. In Pakistan it is around 7.

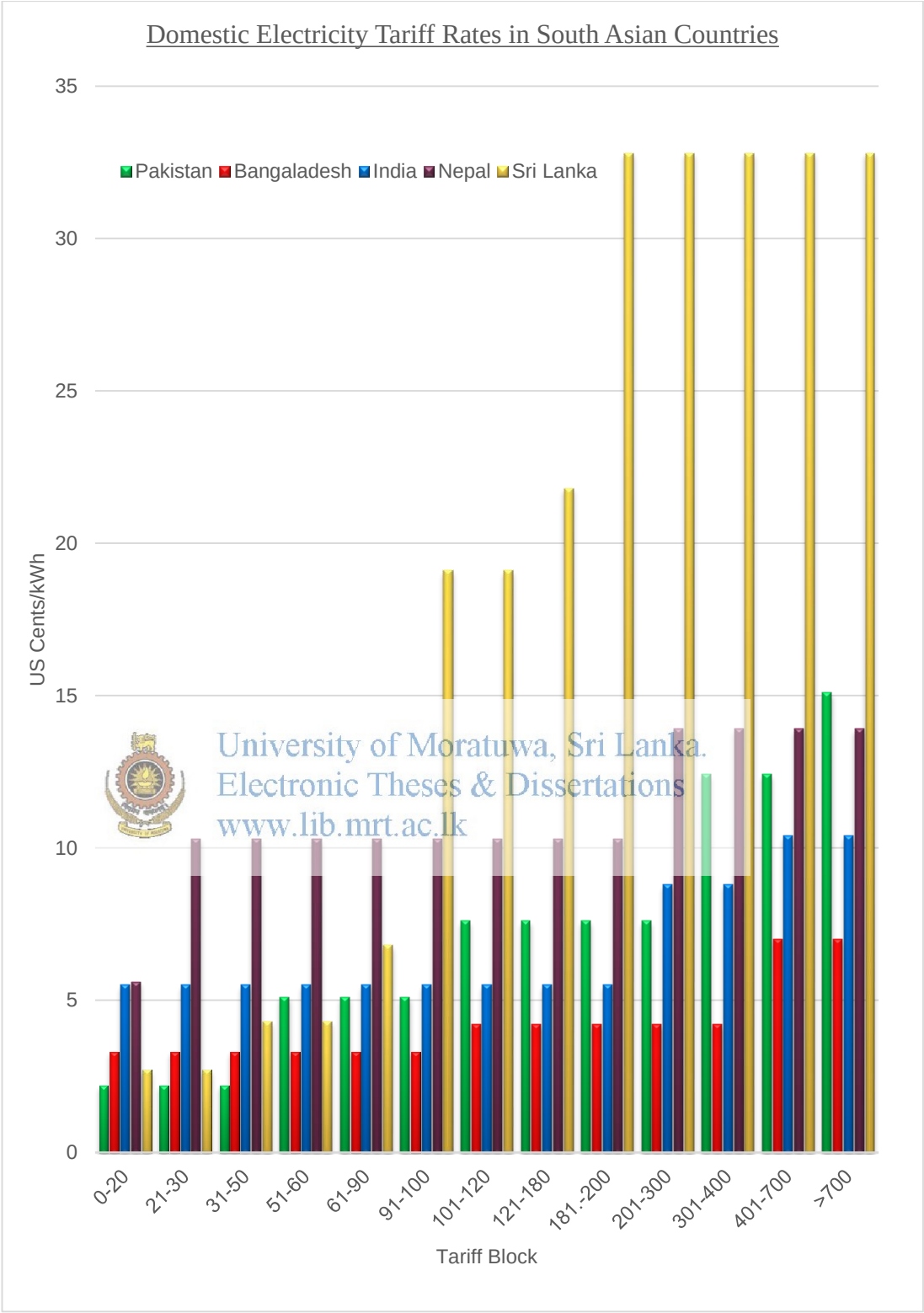


Figure_2.4: Domestic Electricity Tariff Rates in South Asian Countries
Source: Jamil, F., “Comparison of Electricity Supply and Tariff Rates in South Asian Countries", 2011.

In Sri Lanka the ratio is almost 12 times and it is the highest in the region. Highest electricity consumers pay twelve times as lowest consumers. This might be also encouraged for migration of educated people. Clear idea can be taken from Figure_ 2.5.

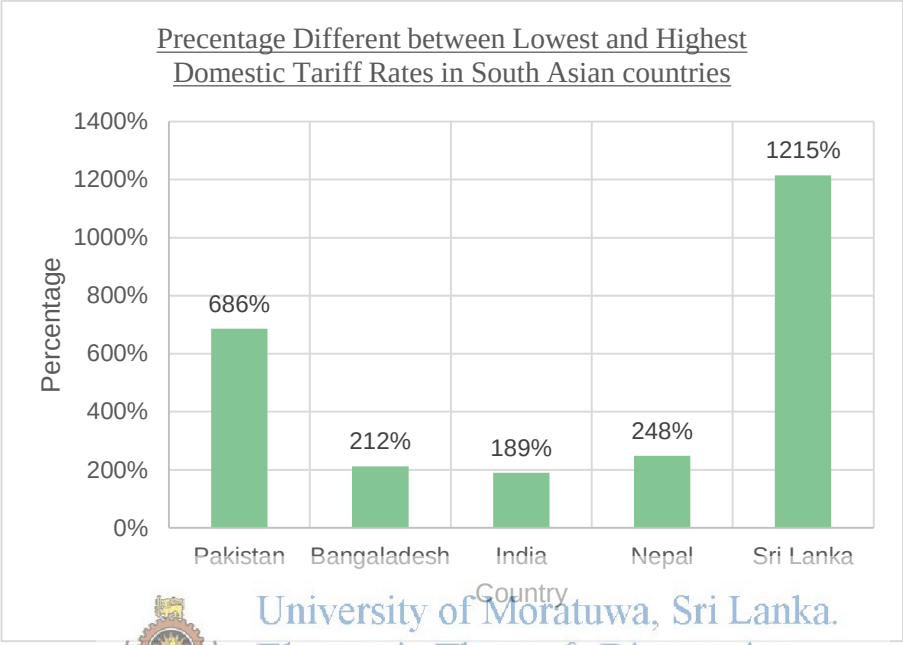


Figure_ 2.5: Ratio between highest and lowest domestic tariff rates in South Asian countries

Commercial electricity rates are somewhat fair in Sri Lanka compared with other South Asian countries. It would be a good trend for industries. Investments in industrial sector is directly proportional to job opportunities in a country. A comparison of commercial electricity tariff rates in Asian countries is given in the Figure_2.6.

A World Bank Report "More and Better Jobs in South Asia" showed that electricity is the main constraint for enterprises in Sri Lanka and it is at least in the top five list of constraints for all South Asian countries.

In Sri Lanka, main bottlenecks concerning electricity in rural industrial firms are accessibility, reliability and affordability [18]. However the government has already identified this issue and has implemented projects on distribution enhancement and quality improvement. It will address the issues on electricity of rural industries.

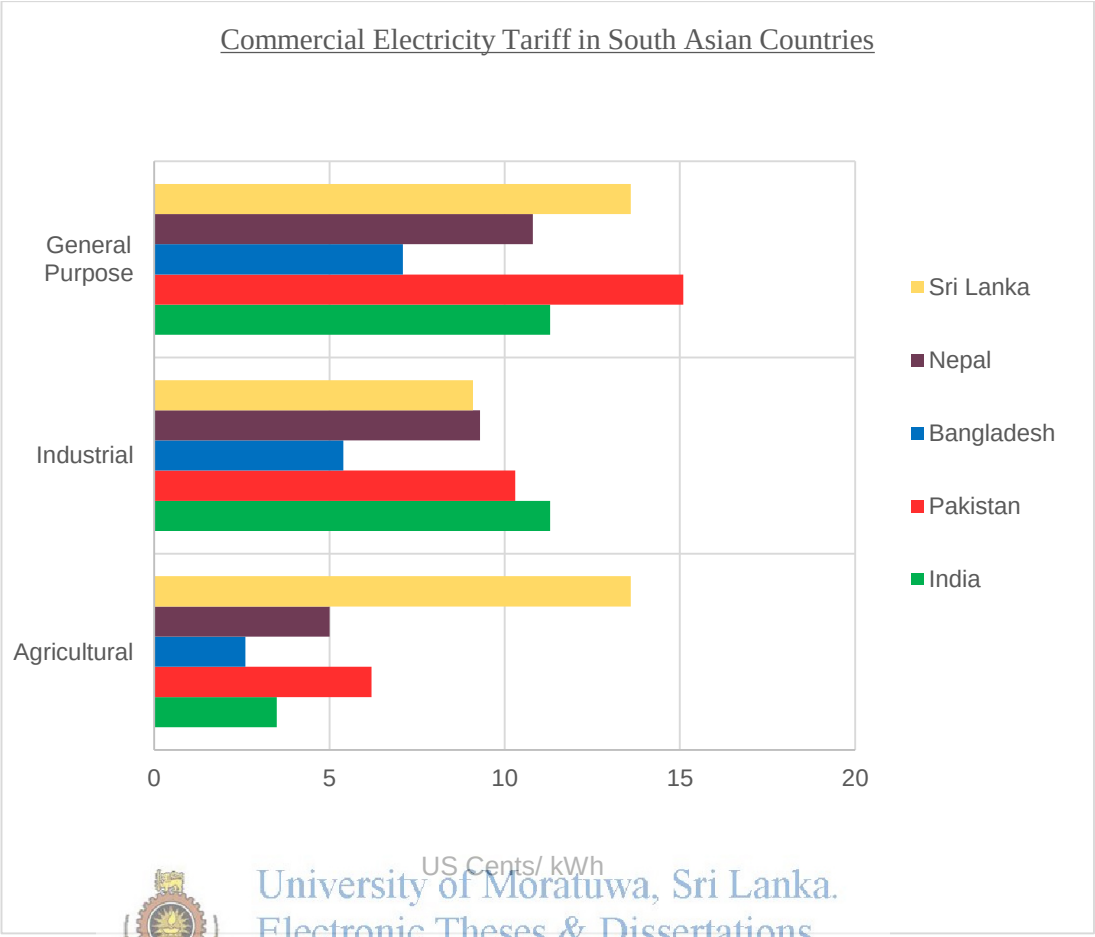


Figure_2.6: Commercial electricity tariff rates in South Asian Countries
Source: Jamil, F., "Comparison of Electricity Supply and Tariff Rates in South Asian Countries", 2011.

2.4 ELECTRIFICATION LEVEL

To achieve this target the government encouraged rural electrification projects all over the country where the electricity shall be available to any existing household within a maximum distance of 50m. A rapid increment of electrification ratio could be identified from year 2007 and it is shown in Figure_2.7.

Government policy stated that Sri Lanka should be uplifted as an energy hub in south Asia if the country can make use of potential oil explorations in the ocean surrounding the country. Also the government gave positive hopes for new oil refineries within the country and wish to provide uninterrupted, high quality electricity supply at affordable rate [15].

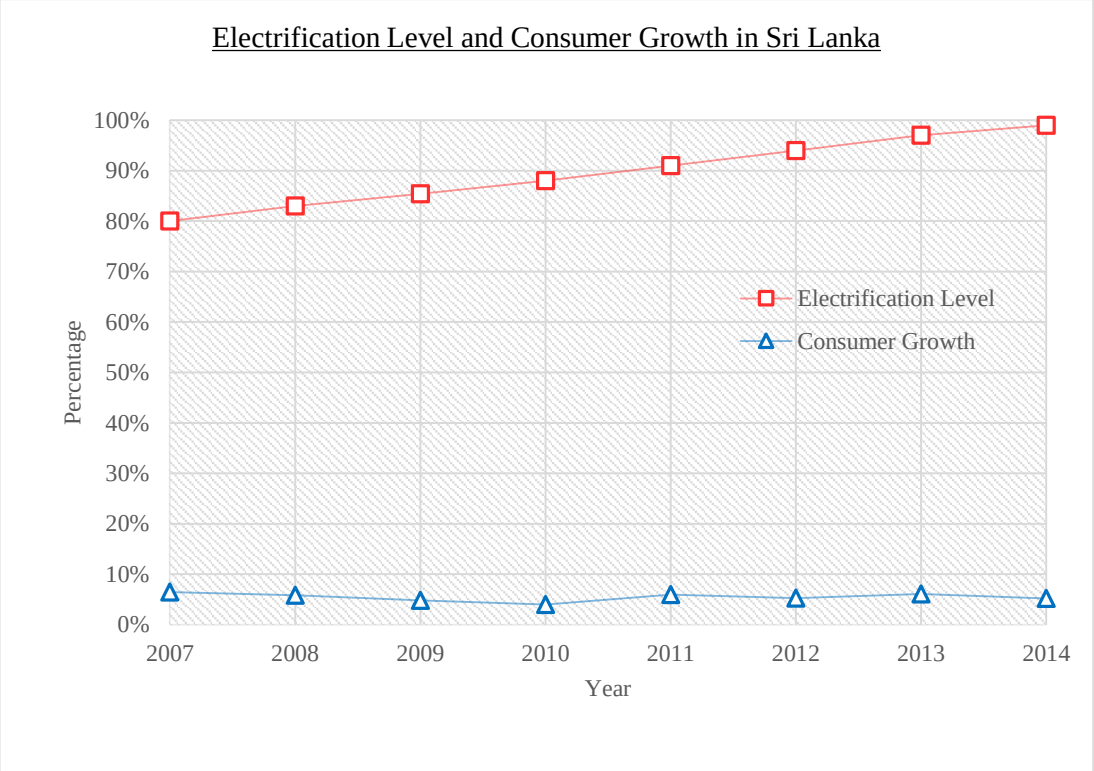


Figure_2.7: Electrification level and consumer growth in Sri Lanka
Source: CEB Annual Reports, Various years

The gradual increment in the proportion of budget allocation on rural electrification programs further ensure that most of rural households have gained access and will continue to gain access to electricity. It is well reflected in the annual electrification level growth and the consumer growth, which are shown in Figure_2.7.

However the analysis of the budgetary allocations for several years in the past would be an ideal yardstick of policy implementation. Actual implementation of policies and impact will only take place through the budgetary allocations. Figure_2.8 shows the budgetary allocations in electricity sector on generation enhancement and distribution enhancement.

Power generation projects are targeted to increase generation installed capacity to 4,000MW by 2016 [14]. Distribution development projects were targeted to achieve 100% electrification level at the end of year 2014 along with reduction of system losses while transmitting and distributing electricity.

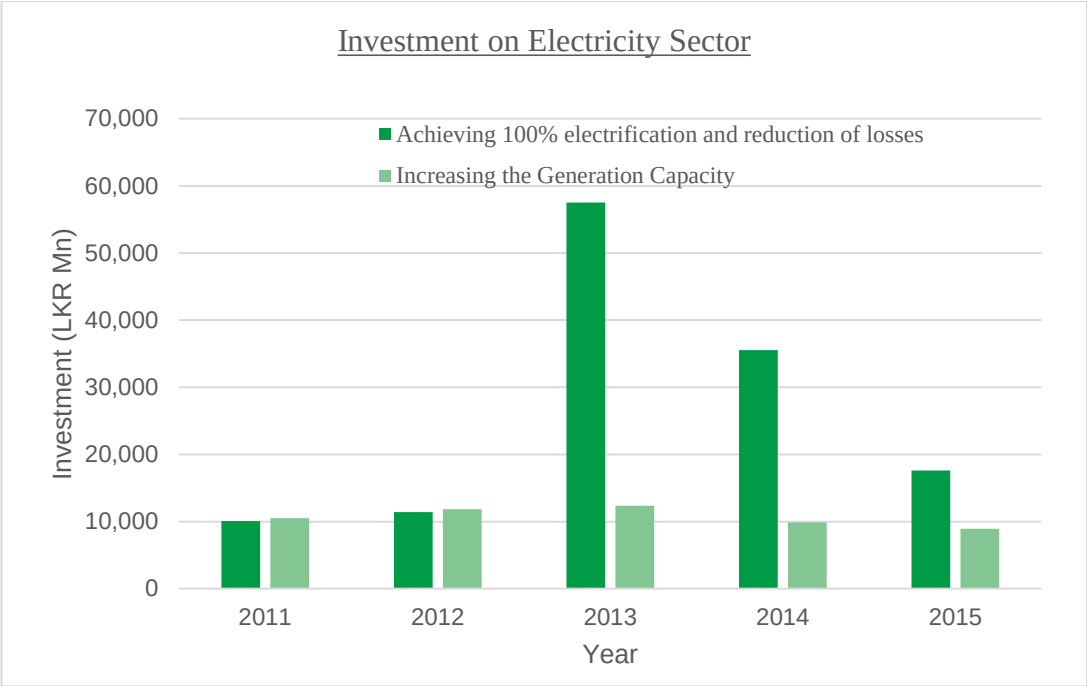


Figure_2.8: Investment plan in Power Sector in Sri Lanka
Source: Department of National Budget, 2011 and Ministry of Finance and Planning, 2012

With the government's target to meet 100% electrification, the CEB intensified and expedited implementation of Rural Electrification (RE) projects, so that there were simultaneous developments of infrastructure and energy. Figure_2.9 shows the implemented RE schemes by CEB in recent years.

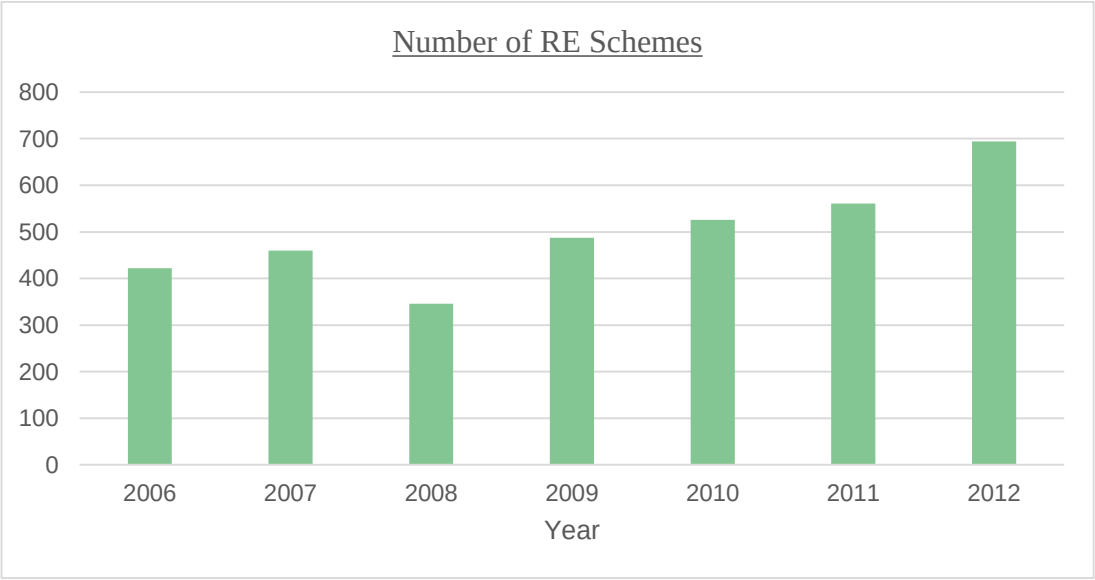


Figure_2.9: Implemented RE Schemes in Sri Lanka
Source: CEB Annual Reports, Various years

3. METHODOLOGY

In Sri Lanka, rural and urban sectors are categorized primarily based on the type of administrative boundaries of each area. Areas with a Municipal or an Urban Council is considered as an urban area whereas all other areas are considered as rural. However this doesn't represent the actual categorization of the rural people who live in remote areas and who are marginalized in terms of economic and social comfort. This research study's qualitative aspects are purely based on the latter description of the rural sector since subsidized electricity users commonly available in rural areas.

Few years back, although rural villages were provided with electricity, certain households cannot afford the high initial cost that have to be incurred to obtain electricity to their houses from the grid connection. This is because of wiring charges and initial connection charges. When the household income is low and they can barely afford their basic expenses, makes it impossible for them to spend on the electricity connection. Recently government has implemented rural electrification projects to enhance the distribution networks and soft loan schemes for such households for wiring and obtaining electricity connection.

The objective of this study is to assess the impacts of electricity subsidies in Sri Lanka. It is mainly focused for intentions of electricity subsidy, whether those intensions were properly addressed, positive and negative impacts and to find remedial actions to minimize the negative impacts. Study was done through a combination of two social science research strategies, surveys and case studies.

3.1 FIELD DATA COLLECTION ON ELECTRICITY SUBSIDY

Survey was conducted for a random sample from a selected rural area where majority of the people are enjoying electricity subsidy. Main concerns of the survey have been, energy inefficient equipment usage, quantifying system peak electricity consumption by the energy inefficient equipment and possible saving by introducing energy efficient equipment. The analysis was done to find out the possible energy saving and electricity demand saving if the all subsidized houses are equipped with energy efficient equipment.

After considering electrification level, population and other socio economic factors, Kahawatta area (Figure_3.1) was selected for the case study.

Kahawatta is one of the 17 divisions in Ratnapura district, which is t popular for gem mining in Sri Lanka. It consists of 10, 205 hectare of land area, and it is 3.1% of the total district land area. It has 21 Grama Niladari Divisions and 12,764 families. Total population of the area is 45,330. Electrification level of the area is around 93.2% in 2013. Average monthly income per house hold is Rs. 36,173 and per person is Rs. 9,132 in the area in 2010 [3], [4].

The required number of samples were selected through the stratified random sampling method. In this technique, each member of the population has an equal chance of being selected as the subject. The entire process of sampling is done in a single step with each subject selected independently of the other members of the population.

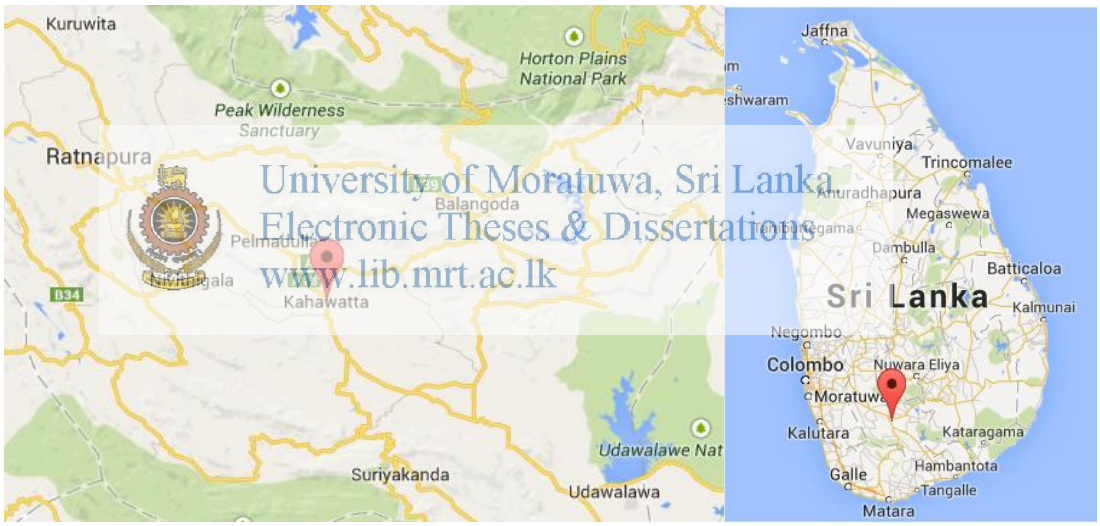


Figure_3.1: Kahawatta Area

Statistical data shows, percentage energy consumption for lighting and cooking from various sources in Sabaragamuwa Province compared with country value in Figure_3.2 [4].

It is clearly shown that people use electricity mainly for lighting. However the percentage of electricity consumption for lighting is 6.2%, lower than the country average. The main substitute is kerosene and the usage is higher 4.7% from country average.

Kahawatta area still not fully electrified, kerosene is used for the second main source for the lighting. Obviously the lighting by kerosene is expensive than electricity and there are many other drawbacks in safety for the users and quality of lighting.

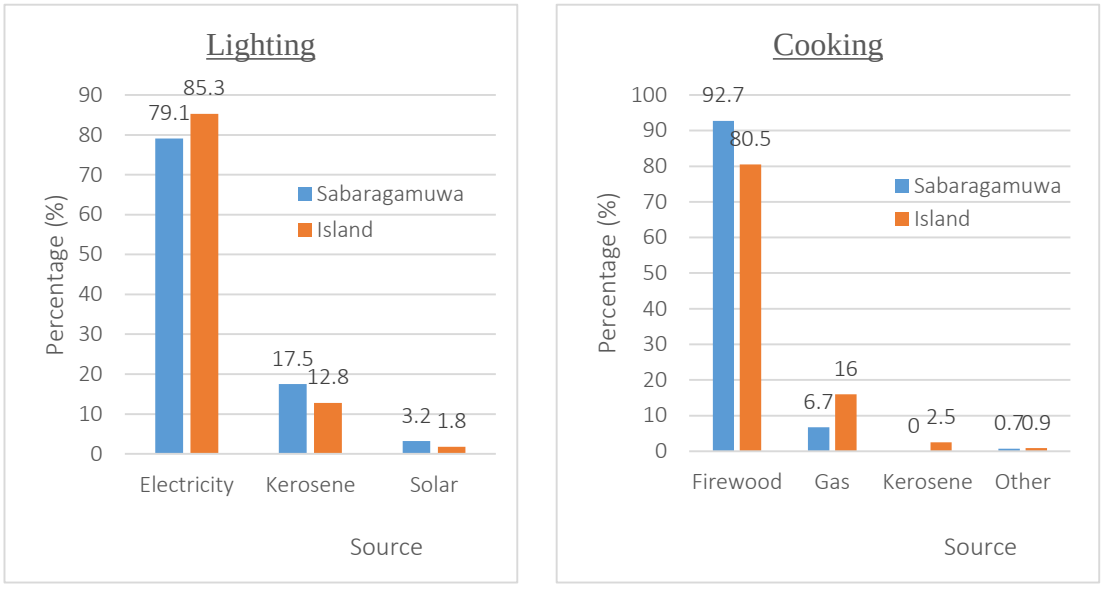


Figure_3.2: Percentage energy consumption for lighting and cooking

In statistics, a confidence interval (CI) is a type of interval estimate of a population parameter. It is an observed interval in principle different from sample to sample, that frequently includes the parameter of interest if the experiment is repeated. [7]. A confidence level refers to the percentage of all possible samples that can be expected to include the true population parameter. For example, suppose all possible samples were selected from the same population, and a confidence interval were computed for each sample [9]. 95% of confidence level and 3.75 confidence interval were chosen for deciding the sample size.

Accordingly the sample size is calculated to be 648 for the population of 12,764. Therefore sample study was conducted for the randomly selected 648 households.

Divisional Secretariat and 80 number of newly recruited management trainees helped in data collection. The methods intended to be used in this work were questionnaires and interviews. The interviews were one to one with the family representative of the household selected, preferably head of the households.

As the first step an awareness program was conducted for the newly recruited management trainees attached to Kahawatta DS Office. Program was conducted by the

researcher at the auditorium of Kahawatta DS Office with the cooperation of Divisional Secretariat. Data collection forms were distributed among them with verbal instruction for the surveyors.

Data survey was conducted for the random sample during four weeks period. Information were taken by direct interviews. The electrical equipment usage, duration of usage and the tariff block type was observed during the survey. The data collecting format used for the survey is shown in Annex_1. Those sample data were taken for the modeling the consumption pattern for the whole country.

Mainly two categories of data has been collected as follows.

1. Socio economic data
    a. Average monthly income of households
    b. Number of members of the family
2. Electricity consumption data
    a. Monthly electricity consumption
    b. Wattage, duration of usage per day and time of usage (system peak or off peak) of following electricity equipment.
        i. Lighting (Incandescent, CFL, LED)
        ii. Cooking (Rice cookers, Hot plates, Heaters)
        iii. Refrigeration
        iv. Communication media (TV, Radio)
        v. Ironing
        vi. Water pumping

Electricity subsidies have been given to the electricity connection as well. Apart from the data surveying on electricity consumption in Kahawatta area, case study is focused on examining the distribution line enhancement Rural Electrification (RE) projects in Ratnapura District.

Statistical details were taken from CEB Sabaragamuwa Provincial Office and Lighting Ratnapura Distribution Development Project. Survey was conducted in randomly

selected newly constructed RE schemes. The target was to analyze the impact of subsidy on electricity connection for the rural villages.

There were 201 RE schemes that had been implemented by end of 2014. Random sample of 155 was selected for the case study to comply with 3.75 confident interval and 95% confident level. Survey was focused on the following sections.

1. Electrification level improvement in Ratnapura District
2. Details of RE Schemes implemented
    a. Beneficiaries
    b. Work content
    c. Per consumer cost
3. Socio economic impact of electricity for the beneficiaries
    a. Education
    b. Entrepreneurships
4. Basis of priorities for the implementation of RE schemes

The data collecting format used for the survey is shown in Annex_2.

4. RESULTS AND ANALYSIS

Findings of the literature surveys, case studies and experiments are analyzed in this chapter.

4.1 INTENSIONS OF ELECTRICITY SUBSIDIES

4.1.1 To enhance vote base at elections

History shows that electricity subsidy mainly focused on the election campaigns in both government parties and opposition parties in Sri Lanka. There are a lot of examples available to show that the electricity subsidy is highly politically biased and focused to gain short term political benefits although it was a heavy burden to the country. Reduction of electricity prices by 25% in September 2014 targeting Uva Council election was the recent example.

During the survey, 78% said that they were not biased for the elections due to electricity subsidy. Most of the time electricity tariff revisions were heavily influenced by the political agendas. Normally electricity prices are not adjusted according to the actual cost of electricity generation.

4.1.2 To give a relief for low income consumers

Fundamental requirement of the electricity subsidy is to give a relief to low income electricity consumers. Government assume that low income families consume low electricity.

Hence the subsidy was given based on consumption. Lowest 30 unit block receives the largest subsidy. The amount of subsidy gradually reduces for another three, 30 unit blocks.

4.1.3 To uplift the industrial sector in Sri Lanka

Government of a country shall not look only for the electricity business as an individual case.

Hence the government used to absorb that burden from the electricity and allows to people to do the production. As a country it could be ultimately a profit receives from

the products and services which were manufactured or offered using electricity are considered.

The employment of many sectors are dependent on electricity. Hence income of people will be influenced by quality and prices of electricity.

4.2 ASSESSING WHETHER THE TARGETED OUTCOMES OF THE INTENSIONS ARE ACHIEVED

4.2.1 Influence for the vote base of elections

History shows that the electricity subsidy is mainly focused at election campaigns of political parties in Sri Lanka. There are lot of examples available to show that electricity subsidy is highly political biased and focused to gain short term political benefits although it was a heavy burden to the country.

Electricity prices have reduced by 25% in September 2014 targeting Uva Provincial Council election, although the CEB was at a financial crisis [6]. Results comparison of 2014 Uva Provincial Election with year 2009 is given in Table_4.1.

Table_4.1: Results comparison of 2014 Uva Provincial Election with year 2009

	Badulla District		Monaragala District	
	Governing Party	Opposition Party	Governing Party	Opposition Party
2009	68%	26%	81%	16%
2014	47%	45%	58%	32%
Progress	-21%	19%	-23%	16%

Source: Sri Lanka Election Commission, 2009 & 2014

Badulla District has more than 30% votes from estate Tamils. Statistics shows that kerosene usage is comparably higher in estates. Government targeted about 30% of votes in create kerosene price reduction.

Nowadays people are highly concerned on many other factors than election promises. It is obvious that the electricity price reduction of 25% has not much influenced the election results.

4.2.2 To give a relief for low income families

Fundamental requirement of the electricity subsidy is to give a relief to low income electricity consumers. Government assume that low income families consume low electricity.

In Sri Lanka, lowest 30 unit block receives largest subsidy and it remains until 120 units. The amount of subsidy gradually reduces for higher blocks. It couldn't able to say that electricity consumption is only based on the income of a household. There is no direct relationship between the income and the electricity consumption. Graph_4.1 shows the monthly income distribution in the sample study.

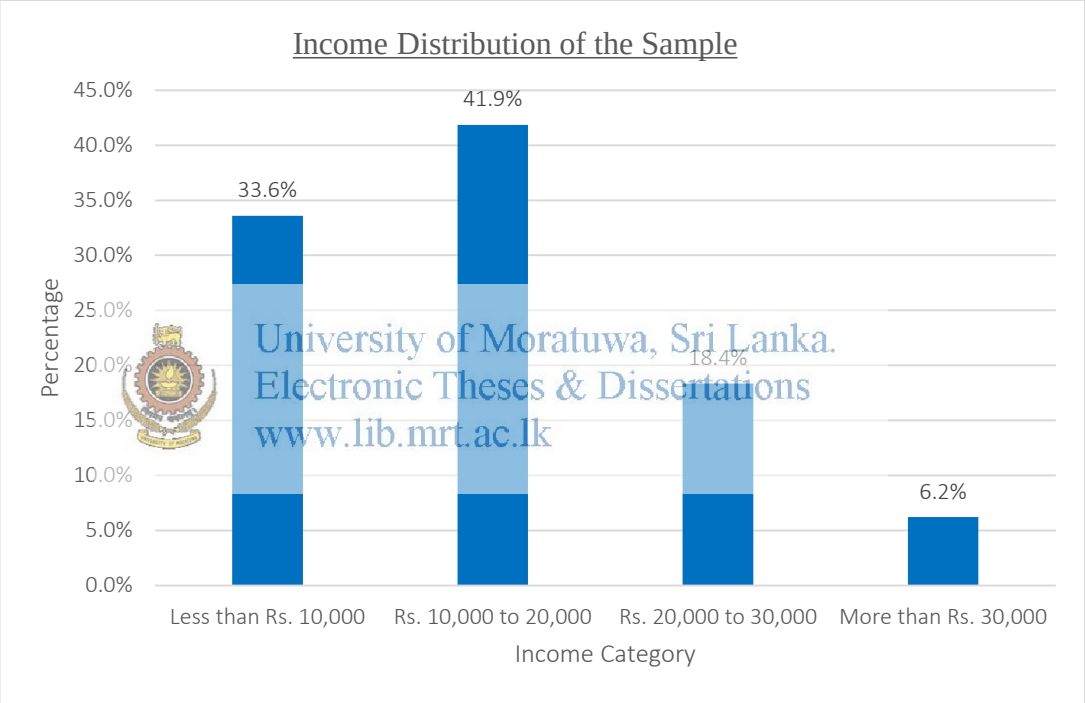


Figure_4.1: Monthly income distribution in the sample study

Monthly income of people in rural area is highly dependent on the weather, work availability and many other reasons. Majority people of Kahawatta area are engaging in gem mining and agriculture.

The distribution of the electricity consumption with their income is tabulated in Table_4.2. Income details were taken by interviewing the sample families.

Table_4.2: Electricity consumption of different income limits

Tariff Category	Monthly Income			
	Less than LKR 10,000	LKR 10,000 to 20,000	LKR 20,000 to 30,000	More than LKR 30,000
Below 30	41.2%	25.6%	14.5%	18.7%
31 to 60	45.6%	56.3%	52.0%	26.3%
61 to 90	12.3%	16.0%	25.6%	34.6%
91 to 120	0.9%	2.1%	7.9%	15.9%
121 to 150	0.0%	0.0%	0.0%	4.5%
151 to 180	0.0%	0.0%	0.0%	0.0%

Although the subsidy was given based on the consumption on the basis that poor people use less electricity, with the actual data, it could be proved that it is completely wrong. Number of members in a family also influence the electricity consumption even though their income is low. It is difficult to keep the electricity consumption within the subsidized region if a family has more members. Figure_4.2 shows average monthly electricity consumption variation with number of family members.

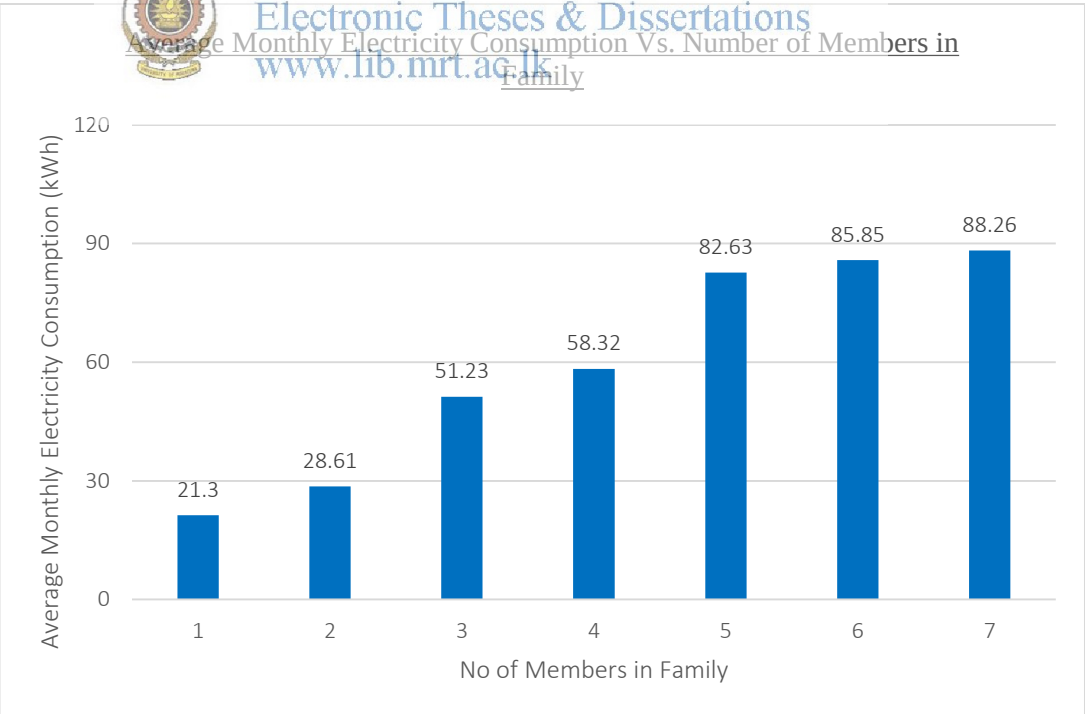


Figure_4.2: Average monthly electricity consumption for different members in a family

It is interesting to see most of the consumers are used to consume electricity to remain within a particular tariff block. Mostly, electricity consumption is artificially limited towards to a margin of a tariff block. Some people said that they are more concentrated to electricity meter in last few days of billing cycle to ensure not to exceed the ceiling value of the block they are aiming. Some people used to avoid the usage of water pumps or refrigerators during last few days to adjust their consumption. On one hand it encourages electricity saving but it could be interpreted as a violation of right to use electricity for the life comfort as they wish. If any discrimination is created it will be a pressure against the governing party in a country. Hence equal opportunities shall be made in all possible ways to the citizens irrespective of any constrains.

In addition electricity consumption is having a mutual relationship with the society they living in. The consumption of a consumer in an urban area is much higher than a consumer in rural area [4].

Electricity consumption for different purposes of the sample analysis is illustrated in Figure_4.3

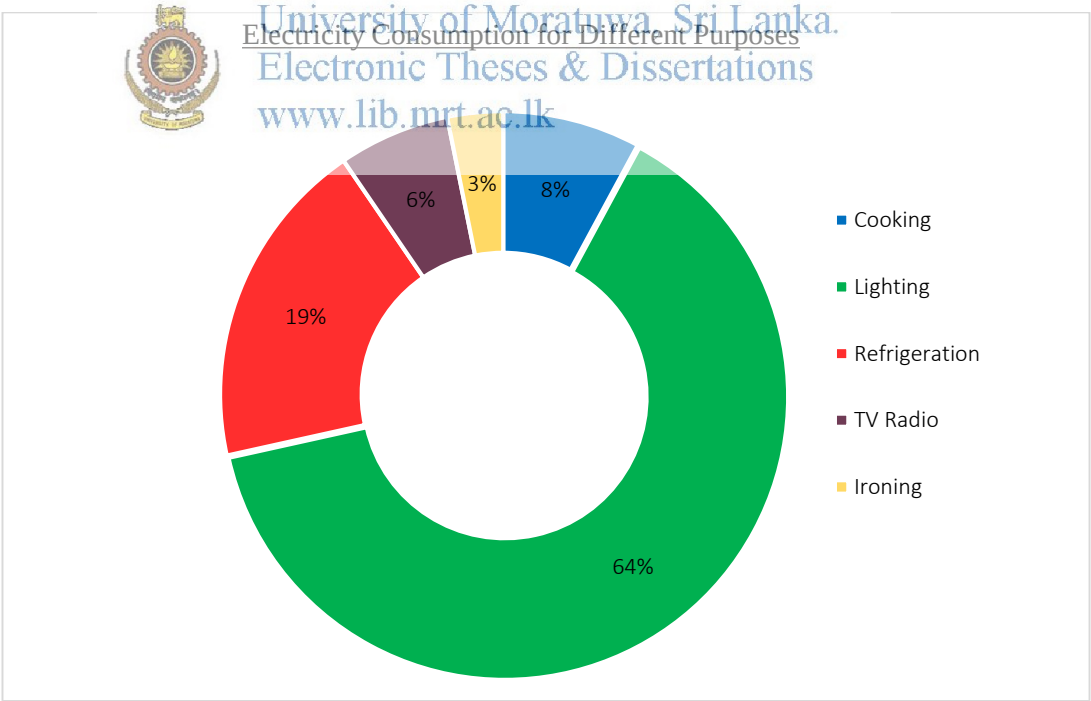


Figure_4.3: Electricity consumption for different purposes

Further, inmates of rural areas use fire woods for heating and cooking. Fire wood is freely available for them. Unfortunately for low income people in urbanized areas, this facility is not available. Therefore they have to spend many on cooking and heating instead of using firewood although their income is low.

In the study conducted to assess the socio economic impact of electricity in rural village benefitted by a RE project in Ratnapura district, it has been found that though there has not been increment of income due to the introduction of electricity to rural households, there is a significant improvement of the living standards of the people. Also the students of rural areas were able to study long hours with the electricity illumination which was given by RE schemes and also helped to reduce the accidents caused by the kerosene lamps which were used for providing lighting.

4.2.3 Industrial sector benefited from electricity subsidy

Electricity price is a critical factor to consider for both local and foreign investments on industries. Hence electricity would be a critical factor for the Gross Domestic Product (GDP) and macro-economic indicators of a country.

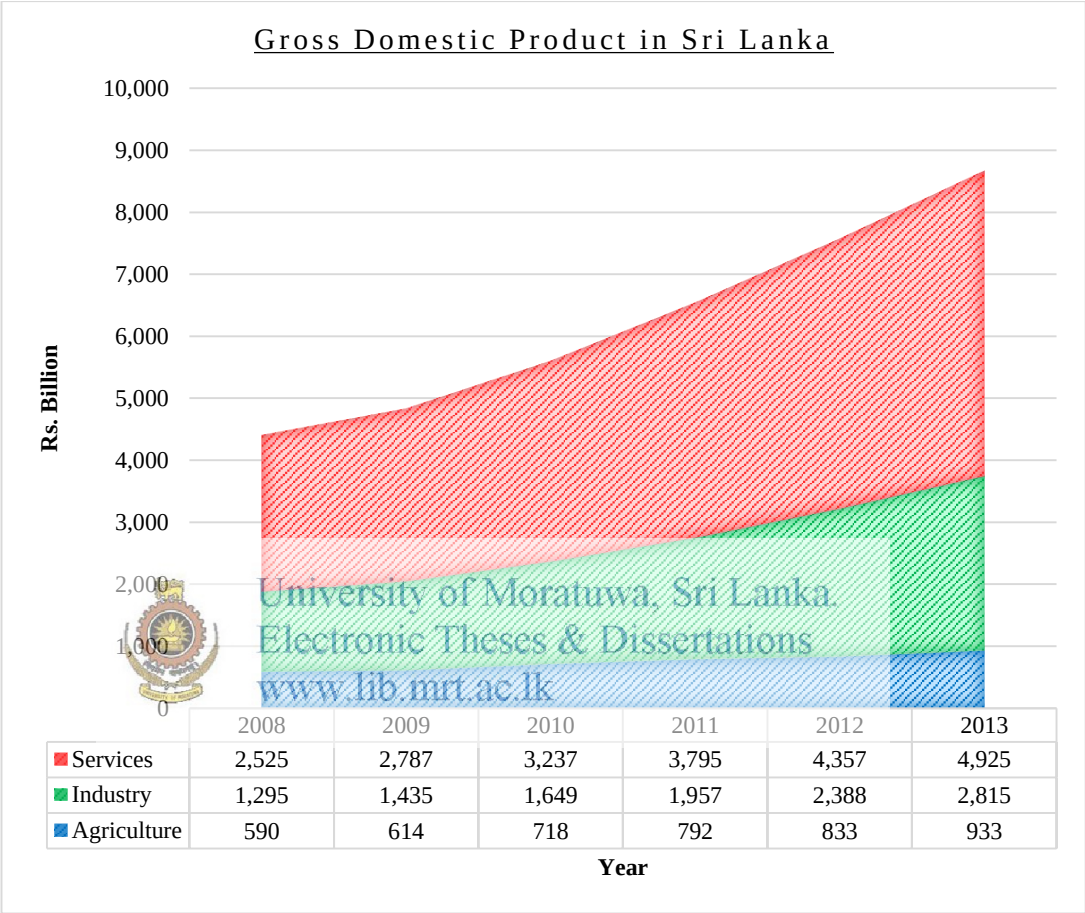
Comparatively industrial electricity tariff of Sri Lanka is fair within the south Asian countries as described in Chapter 2. Reasonable rates of electricity encourage investments on industries and it will contribute to uplift economy of the country and the living condition of the citizens.

The main contributor for GDP is the service sector in Sri Lanka. Second contributor is industrial sector. Figure_4.4 shows the GDP variation in Sri Lanka for couple of past years. It shows a positive increment. Reasonable electricity tariff on industrial sector might be a reason for this.

Nevertheless, industries contribute to create job opportunities in a country. Otherwise unemployment will be a major issue. Figure_4.5 shows the percentage distribution of employment in different sector in Sri Lanka.

It is clear that most of employments are directly influenced by cost of electricity such as manufacturing, services and agriculture. Demand for the employment in technical field of the country is high. For an example engineering graduates have high demand than arts graduates.

Sri Lanka is an agricultural country. Around 30% employments are available in agricultural field. Electricity is used for many activities in agriculture. Electricity cost is the highest component of production cost for some manufacturing industries such as ceramic, glass, steel and cement. Accordingly the electricity is become a critical factor for development of the industrial sector.



	2008	2009	2010	2011	2012	2013
Services	2,525	2,787	3,237	3,795	4,357	4,925
Industry	1,295	1,435	1,649	1,957	2,388	2,815
Agriculture	590	614	718	792	833	933

Figure_4.4: Gross Domestic Product in Sri Lanka
Source: Sri Lanka socio - economic data, 2014

Macro-economic indicators are showing the economic prosperity of a country. Growth rates of macro-economic indicators of Sri Lanka have remained varying for last several years as shown in Figure_4.6.

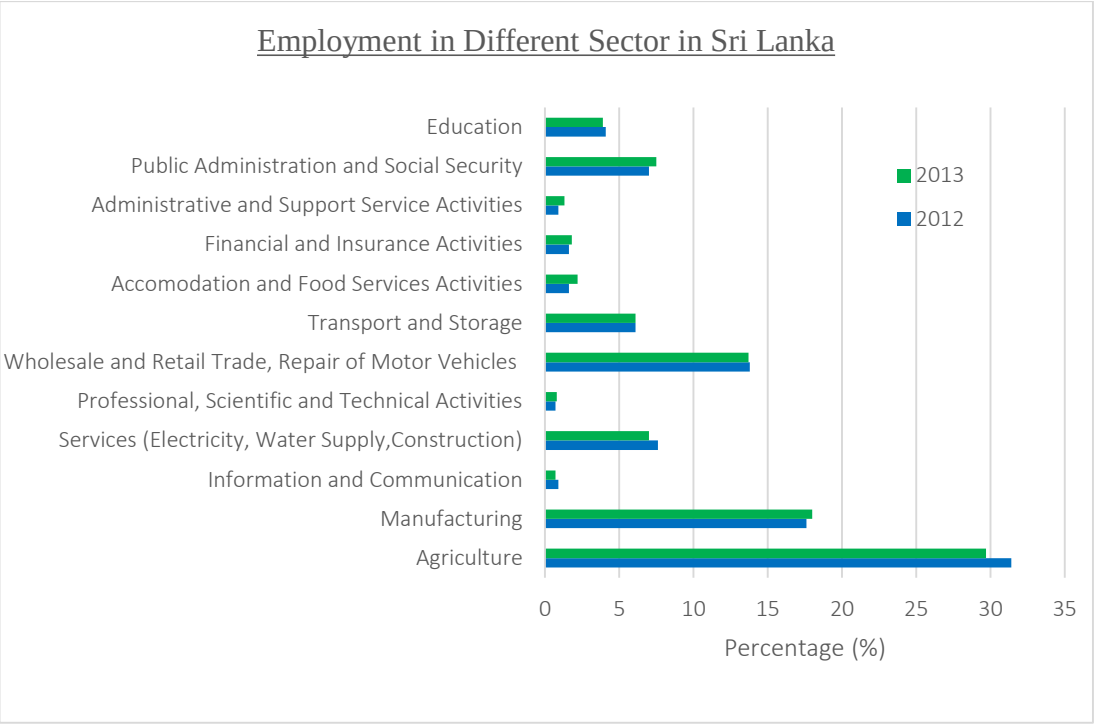


Figure_4.5: Employment in different sector in Sri Lanka
Source: Sri Lanka socio - economic data, 2014

Hence, it could be argued that impact of subsidy on electricity contributes to the economic development of the country.

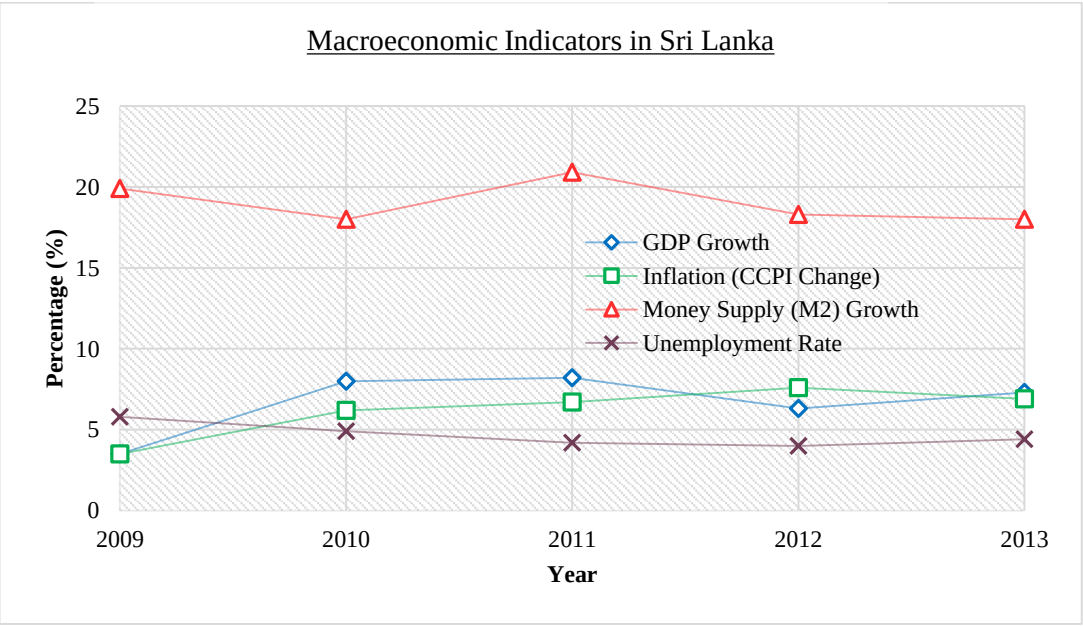


Figure_4.6: Macroeconomic Indicators in Sri Lanka
Source: Sri Lanka socio - economic data, 2014

4.3 ASSESTMENT OF POSITIVE IMPACTS OF ELECTRICITY SUBSIDIES

The intention of electricity subsidy is to achieve positive outcomes for the society. 75% of the domestic consumers enjoy the electricity subsidy. Many positive impacts of electricity subsidy were identified at the case study as follows.

4.3.1 Group of low income people also have the opportunity to enjoy the electricity

Electricity was a luxurious service when it was introduced. Very few rich urban residing people only got opportunity to enjoy electricity. Until the government introduce Rural Electrification (RE) Projects, total expenses for service connection was charged from the prospective consumer. Payment for the service connection was very difficult for rural people.

However, it would be important to analyze the main policy statement directing the country's energy sector stated in National Energy Policy and Strategies of Sri Lanka. Under the section of energy policy elements, point 2.1 addresses the vital aspect of provision of basic energy needs. It has been clearly identified that the primary social responsibility of providing basic energy needs of the population solely lies with the state.

Furthermore, implementing strategies of government highlights priority that the state will be giving improved access by rural areas to commercial energy forms such as electricity. Another sub point recognizes need to provide subsidies to deserving groups to ensure such groups have access to their basic energy needs at affordable prices.

There is general policy guidelines specifically set out on the electricity industry by the Public Utilities Commission of Sri Lanka (PUCSL). These policy guidelines have given high priority to rural electrification and PUCSL is supposed to recognize electricity as an essential requirement for rapid economic growth. The most remarkable fact is that PUCSL will accordingly perform the role of economic, technical and safety regulator for the electricity industry. In doing so PUCSL has to ensure transparency, fairness and flexibility for the industry participants. Thus it can be understood that PUCSL has greater discretion as per the regulation and control of

main institutions engaged in the energy sector, thereby creating a huge impact on the political environment.

Accordingly policies have been revised to make electricity available for maximum of 50m distance to any household in Sri Lanka. Government gives a soft loan for the basic charges for the service connection which can be paid through the electricity bill in long term. Ultimately, every person in the country specially the low income category got the opportunity to enjoy the facilities of electricity.

4.3.2 Consumers in the boarder hardly try to save electricity

A rough estimation of the electricity bill assessed at 30 days is shown in Figure_4.7. It can be identified three rapid changes at 60, 90 and 120. Some households may face the risk of this rapid change. Single unit of consumption can result in a large increment in the electricity bill. Increment of the bill for a single unit at 60 units is 291.00 rupees and at 90 units, it is 418.00 rupees. Worse thing was 87% of the people during the survey were not aware of this fact.

Because of this sudden impulses people tend to go for energy efficient equipment. It was seen that consumers in 90th border do not use single incandescent lamp for lighting. Investment for CFL or LED lamp may be less than the increment of electricity bill. But consumers in 60th broader were still not keen in saving electricity.

During the survey it has been identified that consumers in the border are highly motivated to cut down their electricity consumption at last few units. Some consumers said that they save electricity by completely shutting down the refrigerator during the last couple of days of the billing cycle in their houses. Some said that they don't use electric motor driven pumps and save electricity. In the point of view of conservation of electricity, it is a positive trend, but it influenced on people's convenience.

Further, some said that if they could not be able to manage within limit, they are trying to negotiate with meter reader to put that one or two units to next month bill. Also it is giving negative impact to the revenue collection of electricity utility by receiving the subsidy in illegal manner.

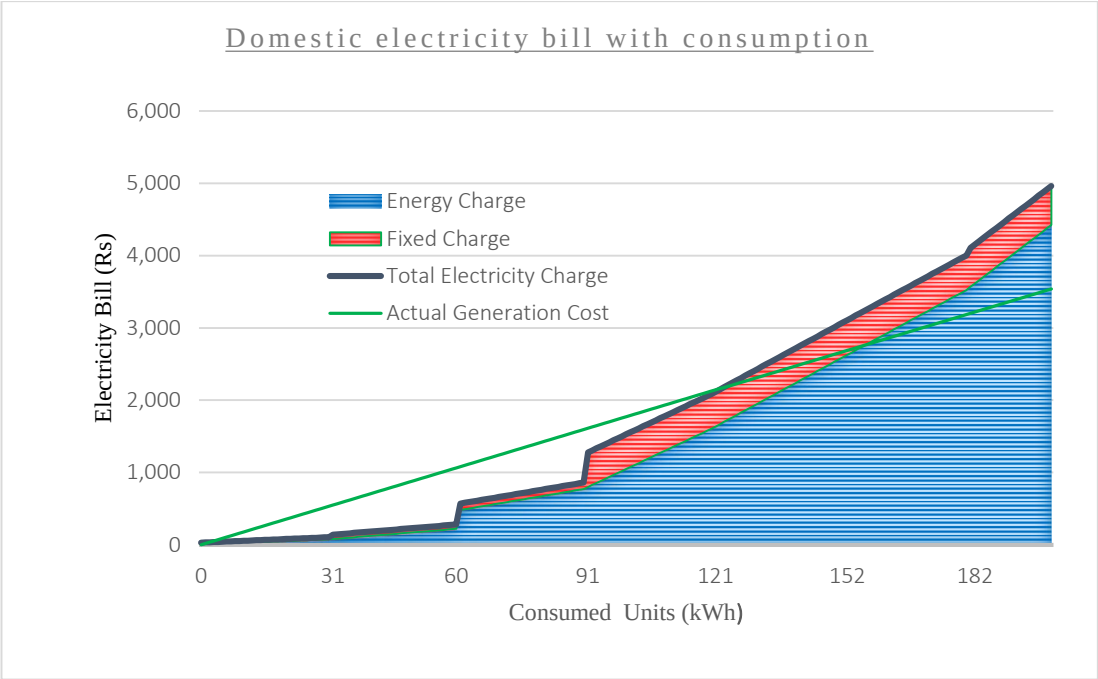


Figure_4.7: Domestic electricity bill with consumption

4.3.3 Development of the infrastructural facilities

Sri Lankan government has formulated many policies and laid stress on rapid and effective implementation of the Rural Electrification (RE) projects. The funds for RE schemes are brought in by the government as well as international and national development banks.

According to Table_2.9 it can be identified that the number of RE schemes have gradually increased from year 2006 to 2012. With the government's target to meet 100% electrification, the CEB intensified and expedited implementation of these projects.

In addition to that several system augmentation and rehabilitation projects were also in progress to improve the distribution network and thereby reduce the system loss.

The electrification level improvement during last seven years in Ratnapura district where the case study has been done is shown in Figure_4.8. RE projects have two categories. Extending the existing low voltage feeders are called "Extensions" and construction of 33kV distribution line, substation and low voltage feeders are called "Schemes".

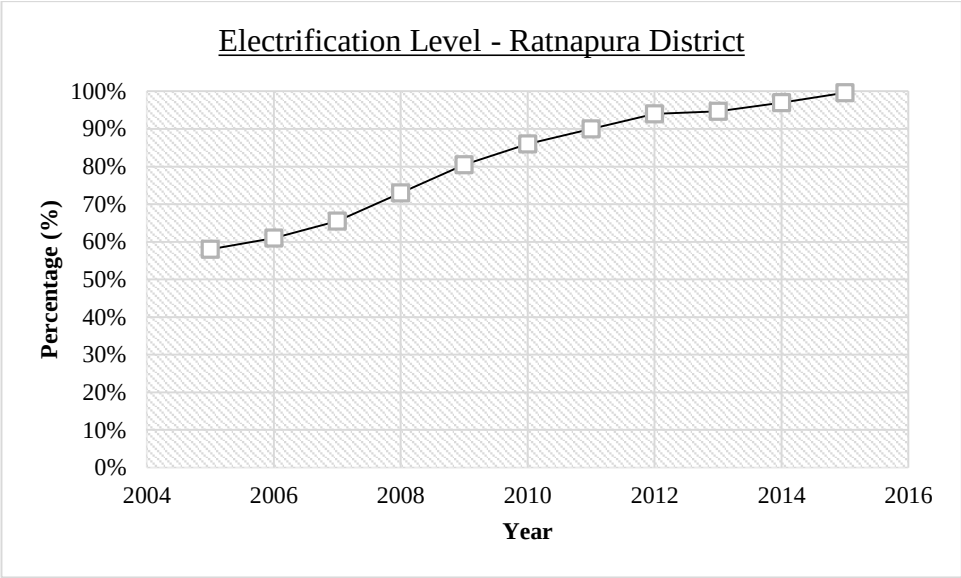


Figure_4.8: Electrification level in Ratnapura District
Source: Lighting Ratnapura Project, 2015

The electrification level has rapidly increased due to several locally and foreign funded of RE projects. Summary of the RE projects implemented in Ratnapura District is shown in Table_4.3. The total invested cost as LKR million 4,322.3 during last 7 years.

Table_4.3: RE Projects details implemented in Ratnapura District

Name of the Project	Funding Agency	No. of Projects		Cost (LKR. Million)
		Schemes	Extensions	
Lighting Ratnapura Development Distribution (LRDD) Project	GOSL	59	1,073	1,498.8
Accelerated Rural Electrification Program (AREP)	GOSL	21	0	321.6
Swedish International Development Agency (SIDA) Project	Sweden	21	0	292.0
Iranian Funded Rural Electrification (RE8) Project	Iran	100	2,173	2,209.9
Total		**201**	**3,246**	**4,322.3**

Source: Lighting Ratnapura Project progress report, 2014.

Figure_4.9 gives the distribution of 201 RE schemes during the period from 2008 to 2014. It is a vast investment on infrastructural development in rural areas. All these distribution lines became assets of CEB. In low voltage distribution lines, 85% were implemented using arial bundled cables instead of bare conductors and 65% were

using low weight concrete poles instead of wooden poles. Hence the maintenance of the lines will not be a burden to the CEB in future.

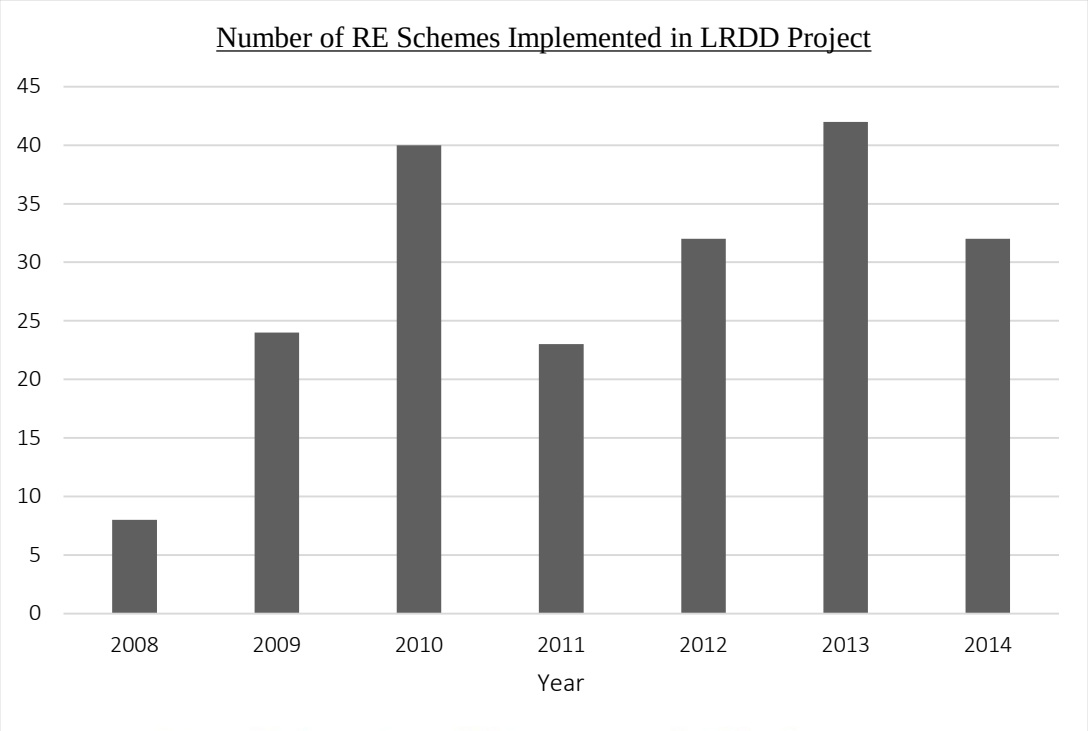


Figure_4.9: Number of RE schemes implemented in LRDD project
Source: LRDD Project, 2014

4.3.4 Encourage the entrepreneurships in villages

Based on the case study, it has been identified that 2.5% of the beneficiaries took the advantage of electricity to improve their income sources. Groceries, tailor shops, sweet manufacturing, cycle repair shops and saloons are places where electricity is used to enhance the entrepreneurships in villages. Rest of 97.5% used electricity for their day-today domestic consumption only.

4.3.5 Increment of direct and indirect job opportunities

As discussed in Chapter 2, electricity tariff for the industrial sector is fair in Sri Lanka, when compared with other south Asian countries. Additionally, the assessment of the industrial tariff as discussed in section 4.2, there is no argument that the investment on industrial sector has increased job opportunities in the sector due to low industrial tariff

rates in Sri Lanka. It could be identified as a positive impact of the current tariff structure.

Apart from that, indirect job opportunities were created in the field by the RE project constructions. Most of those projects were undertaken by the local private contractors.

4.4 ASSESTMENT OF NEGATIVE IMPACTS OF ELECTRICITY SUBSIDIES

Subsidies always cannot be perfect as their intensions imply. Lot of short comings could be expected at practical operations. Following negative impacts can be found in the electricity subsidy.

4.4.1 Targeted group could not be filtered

The intention of electricity subsidy was targeted to give a relief to low income people. Filtering low income people is difficult and complex. Hence the subsidy was implemented in an assumption of low income people consume low electricity. At sample studies it was identified that there is no sharp relationship between the income and the electricity consumption.

During the survey it was identified that low income households which have more family members shifted to high tariff blocks. The methodology is not smart enough to choose most suitable people for the subsidy.

4.4.2 Unwanted people may enter to the targeted group

Although the subsidy targeted the poorest among the poor, some rich people are also gaining the benefits.

In 2013, the number of “Samurdhi” holders were 1,477,313 whereas the total number of subsidy receivers were around 3,212,238. It shows that 1,734,925 of “Non-samurdhi” holders receive the electricity subsidy. An estimated consumer distribution in subsidized tariff blocks are shown in Table_4.4.

Apart from that some people used to have multiple service connections for multiple levels of their houses. Then the subsidy will be applied multiple times for the same consumer. Sometimes same owner has number of houses. The current system detect those are separate households.

Table_4.4: “Samurdhi” and “Non-Samurdhi” consumer distribution

Block	Average number of consumers	Average number of Samurdhi holders	Average number of Non-samurdhi holders
Units <= 30	818,374	376,356	442,018
30 > Units <= 60	1,257,004	578,112	678,892
60 > Units <= 90	1,136,860	522,844	614,016
Total	**3,212,238**	**1,477,313**	**1,734,925**

The monthly average electricity bill for the “Non-samurdhi Holders” who receives electricity subsidy and actual electricity generation cost for them are hypothetically calculated for the year 2013 and they are shown in Table_4.5. This calculation is based on assuming that any given household consumes the average consumption for the particular tariff block. The equivalent average monthly bill is taken from the Figure_4.7. Accordingly, government takes a burden of around LKR 900 million per month to give electricity subsidy to “Non-samurdhi holders”.

Table_4.5: Electricity bill calculation and quantify the electricity subsidy on “Non-samurdhi” consumers in year 2013.

Block	Average consumption per consumer (kWh)	Average Monthly Bill (LKR)	Non-samurdhi Holders	Revenue from Non-samurdhi Holders (LKR)	Actual Generation Cost for the Non-samurdhi Holders (LKR)	Balance (LKR)
Units <= 30	19	78	442,018	34,477,385	148,650,571	114,173,186
30 > Units <= 60	45	208	678,892	141,209,482	540,737,272	399,527,790
60 > Units <= 90	75	711	614,016	436,565,022	815,105,580	378,540,557
Total			**1,734,925**	**612,251,890**	**1,504,493,423**	**892,241,534**

4.4.3 Unexpected illegal practices

It has been identified that some nearby consumers used to share the electricity consumption among their houses although it was illegal. It happened when low consuming and high consuming households are situated very near. It was identified that most of the time those consumers are close relatives. It was not recorded direct

illegal tapings during the survey. It can be also taken place due to unfair distribution of electricity. The provisions of legal frame have loopholes in catching the illegal tapings.

4.4.4 Wastage and inefficiency is promoted

When a good or service is received at under value, careless consumption and wastage are natural. For an example low efficient electrical equipment are common in the subsidized groups. The usage of incandescent lamps among the subsidized group was investigated to build a conclusion on that.

Calculation was done based on the collected data from the field survey to find possible electricity demand saving and possible energy saving. As an example, calculation of the possible saving by replacement of incandescent lamps at night peak is shown in Table_4.6. Since the consumed electricity units are 81, it was recorded under 61-90 category.

Replacement of an incandescent lamp by an energy efficient lamp will be resulted 80% saving. It could be benefitted in two ways; demand reduction and energy consumption reduction. Both values were calculated separately and summations were taken. The results of the entire 648 random sample were summarized in the respective tariff blocks as shown in the Table_4.7.

Table_4.6: Sample calculation for possible demand saving and possible energy saving by replacing incandescent lamps

Name : **Mr. M. D. M Kumara**
CEB Acc No: **6310074008**
Units: **81**

No	From	To	Incandescent Lamp							Energy saving (kWh)
			15 W	25 W	40 W	60 W	100 W	Total (W)	Possible Saving (W)	
1	**6:00**	**18:30**			1	1		100	80	0.24
2	**18:30**	**21:30**			2	2		200	**160**	0.48
3	**21:30**	**6:00**			1			40	32	0.272
										0.99

Further, per consumer possible demand saving and per consumer energy saving at night peak for the each tariff blocks are calculated. It was found on average 106.63W demand saving and 0.47 kWh energy saving could be possible per consumer by introducing energy efficient lighting equipment.

Tabe_4.7: Total possible demand saving and the energy saving at night peak in each tariff blocks

Category	No of Consumers	Percentage %	Peak Factor %	Total Demand Saving During Night Peak (W)	Demand Saving per Consumer During Night Peak (W)	Total Energy Saving (kWh)	Energy Saving per Consumer (kWh)
Below 30	162	25	94.5	16,508	101.9	69.66	0.43
31 to 60	276	42.6	89.6	31,839	115.36	146.28	0.53
61 to 90	170	26.2	78.2	16,244	95.55	98.6	0.58
91 to 120	26	4	75.6	2,304	88.6	8.08	0.31
121 to 150	12	1.9	63.2	481	40.1	2.04	0.17
151 to 180	2	0.3	60.2	73	36.3	0.24	0.12
Total	**648**	100		69,097		324.9	

Since the total domestic consumer details for each blocks are available, it could be predict the possible saving for the entire country based on the assumptions. All other factors are remaining unchanged, the sample is rational and unbiased. Table_4.8 shows the predicted possible savings on demand.

Table_4.8: Predicted possible demand saving for the country

Category	Average consumers in the population	Possible saving per one consumer (W)	Possible saving (MW)
Below 30	818,374	101.9	83.39
31 to 60	1,257,004	115.36	145.01
61 to 90	1,136,860	95.55	108.63
91 to 120	512,048	88.6	45.37
121 to 150	217,271	40.1	8.71
151 to 180	98,819	36.3	3.59
Total			396.47

The possible demand saving is about 20% of the maximum demand of the country. It is graphically illustrated in Figure_4.10.

Practically these values may be difficult to achieve; even 25% would be a great achievement since the highest expensive 100MW power plan could be shut off down during the peak.

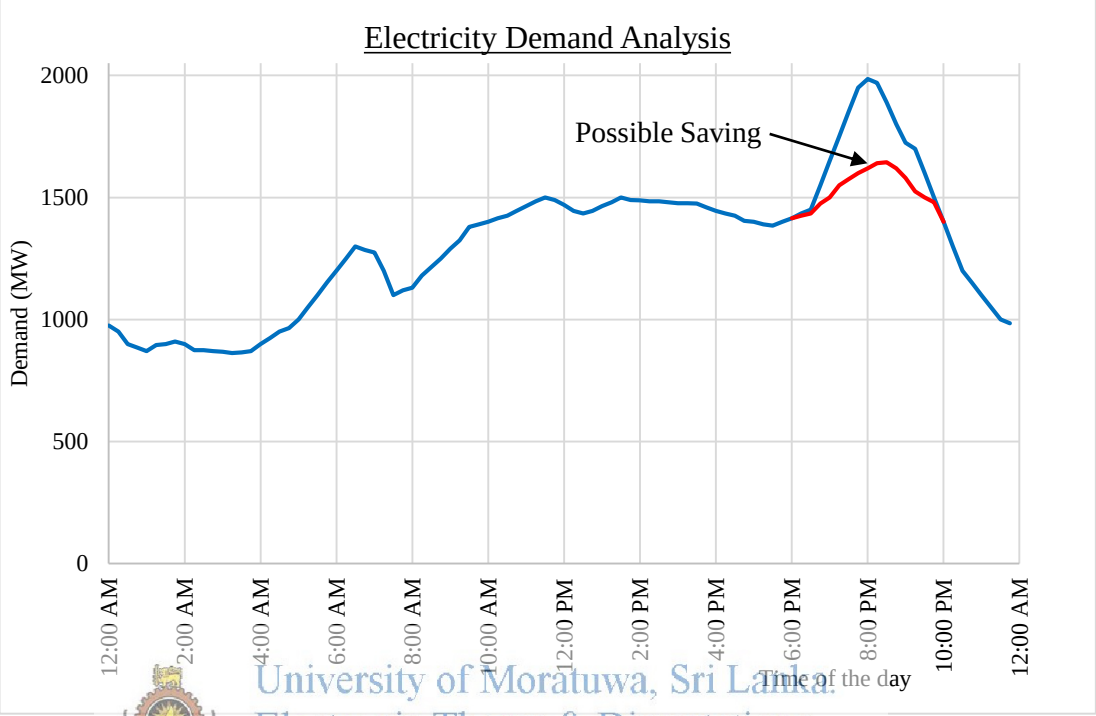


Figure_4.10: Possible demand saving in night peak
Source: Extracted from system control data of Ceylon Electricity Board

Possible energy saving details are given in the Table_4.9. The possible daily saving would be 6.67% of daily consumption of the country. It is roughly 35.9 million rupees saving per day. It is wise to allocate that money to subsidize energy efficient lighting equipment.

Table_4.9: Possible energy saving per day.

Category	Average consumers in the population	Possible saving per one consumer (kWh)	Possible saving (MWh)
Below 30	818,374	0.43	351.90
31 to 60	1,257,004	0.53	666.21
61 to 90	1,136,860	0.58	659.38
91 to 120	512,048	0.31	158.73
121 to 150	217,271	0.17	36.94
151 to 180	98,819	0.12	11.86
Total			**1,885.02**

The case study was only limited to Ratnapura district. Various factors of Ratnapura district compared with the country average is given in Table_4.10. Multiplication of all factors is around 0.5 and it could be taken as a correction factor for estimation.

Table_4.10: Compartment of Ratnapura district with country averages of various factors.

Description	Ratnapura District	Country Average	Factor
Electrification level (%)	97.3	95.6	1.02
Poor household percentage (%)	22	12.6	0.57
Literacy rate (%)	88.4	91.1	0.97
Income per household (Rs.)	36,173	36,451	0.99
Prosperity (%)	55.8	60.6	0.92

Table_4.11 shows the possible energy saving per day and possible demand saving at night peak with correction factor. Accordingly 942 MWh of electricity per day and 198 MW of peak demand could be saved by using energy efficient lighting.

Table_4.11: Estimated possible energy and demand saving

	1	0.9	0.8	0.7	0.6	0.5
Possible energy saving per day (MWh)	1,885.02	1,696.52	1,508.02	1,319.51	1,131.01	942.51
Possible peak demand saving (MW)	396.47	356.82	317.18	277.53	237.88	198.24

During the verbal interviews in the survey, it was found that incandescent lamps were most common energy inefficient equipment used among the heavily subsidized group. Four reasons were found for that ; cost of CFLs or LEDs are not affordable, lack of knowledge about the energy consumption, do not bother because already they receive cheap electricity and the non-availability of CFLs and LEDs in nearby shops are them. The distribution is illustrated in Figure_4.11.

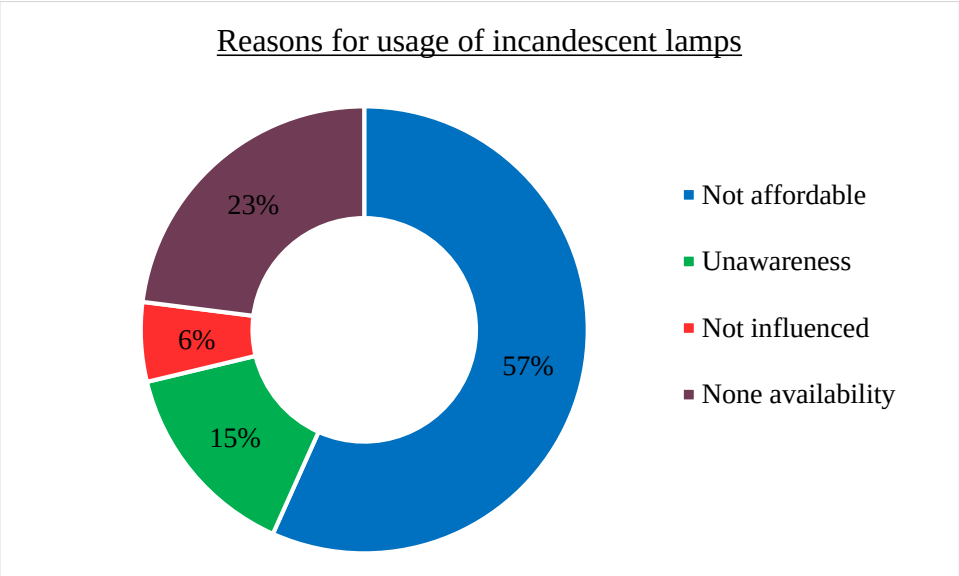


Figure_4.11: Reasons for usage of incandescent lamps

4.4.5 Increment of losses

Highest efficiency available at world for thermal power plants by sources are shown in Figure_4.13. Normally it lies in the range of 40%-50%. Transmission and distribution losses are about 10%, 60% of energy dissipated on the way. Ultimately 40% of energy is transferred to the end user.

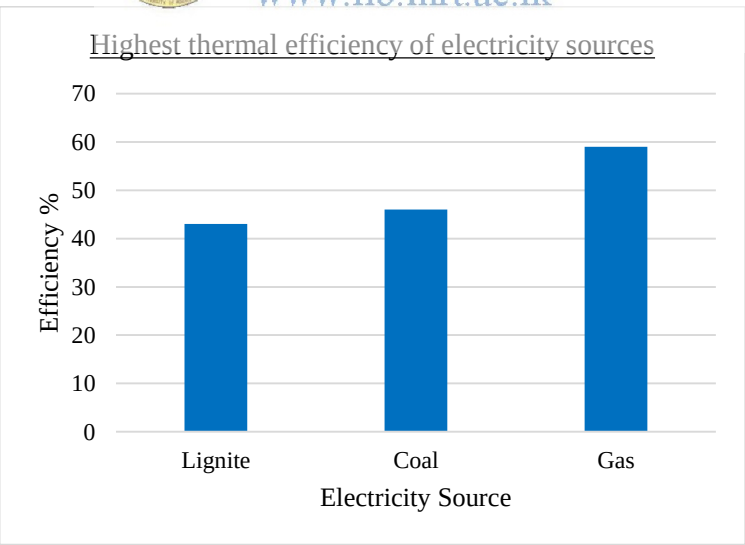


Figure_4.12: Highest thermal efficiency of electricity sources
Source: RWE Facts & Figures, 2008

Using inefficient equipment such as incandescent lamps may cause 38% of loss by the remaining 40%, finally the useful output will be about 2%. Figure_4.14 illustrate a clear picture. Mostly this happens in the heavily subsidized categories.

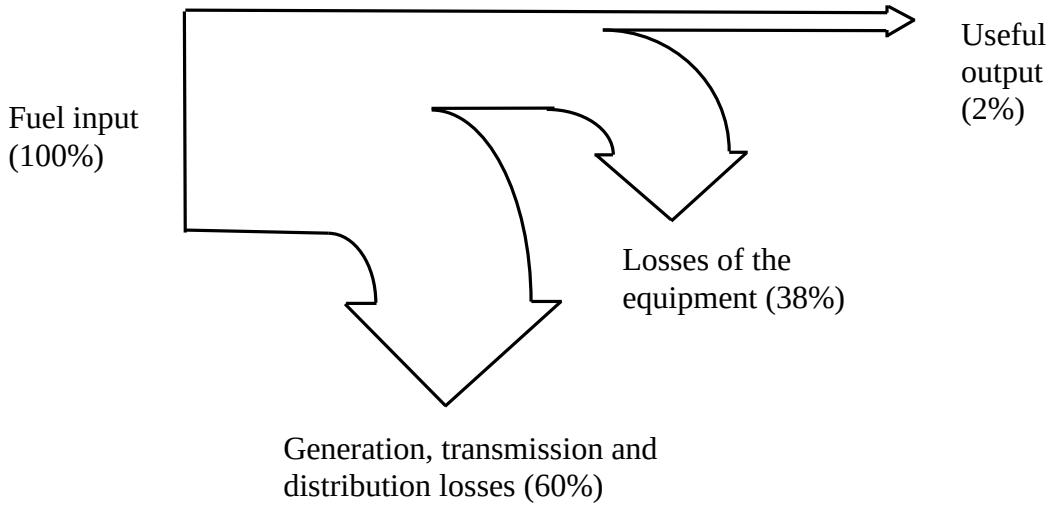


Figure_4.13: Energy flow diagram for incandescent lamps

4.4.6 Non electricity consumers also charged for electricity

Actual generation cost is not charged from consumers due to the electricity subsidy. Although high end consumers are heavily charged, excess money is not sufficient to cover up the deviation since more than 75% receives the subsidy. The deviation between the actual generation cost and revenue collection for electricity is absorbed by the treasury.

Treasury collects its revenue from the various taxes from the citizens. All electricity consumers and non-consumers are included for the taxes. Indirectly, electricity non-users also taking the burden of electricity which is caused by electricity subsidies.

The government collects money from taxes for infrastructural development of the country. Because of the electricity subsidy remarkable potion of the revenue collection of the treasury has to be spent for settlement of deviation. Indirectly, electricity subsidy may cause retardation in development. Figure_4.15 graphically shows the cash flow due to electricity subsidy.

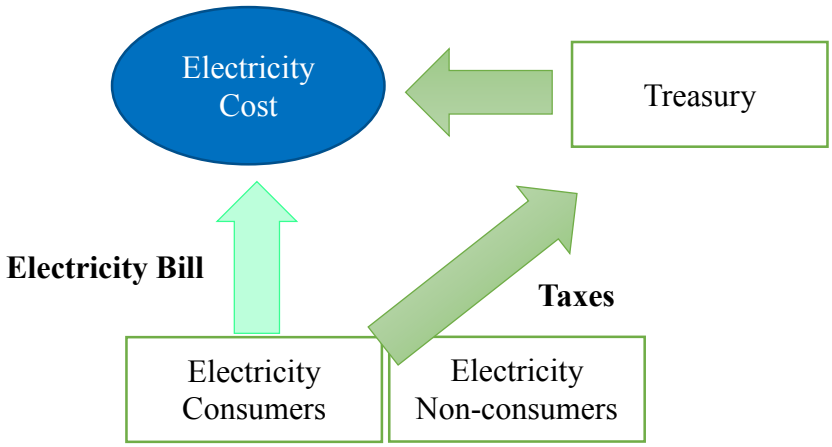


Figure_4.15: Financial cycle of electricity sector

4.4.7 Funds allocated for quality improvement will be limited

Nowadays the government policy is to enhance the electrification level. Top priority goes to 100% electrification. Quality of the service is not much considered because of it. Most funds were allocated for the new constructions. System augmentation and loss reduction projects were a little lagging.

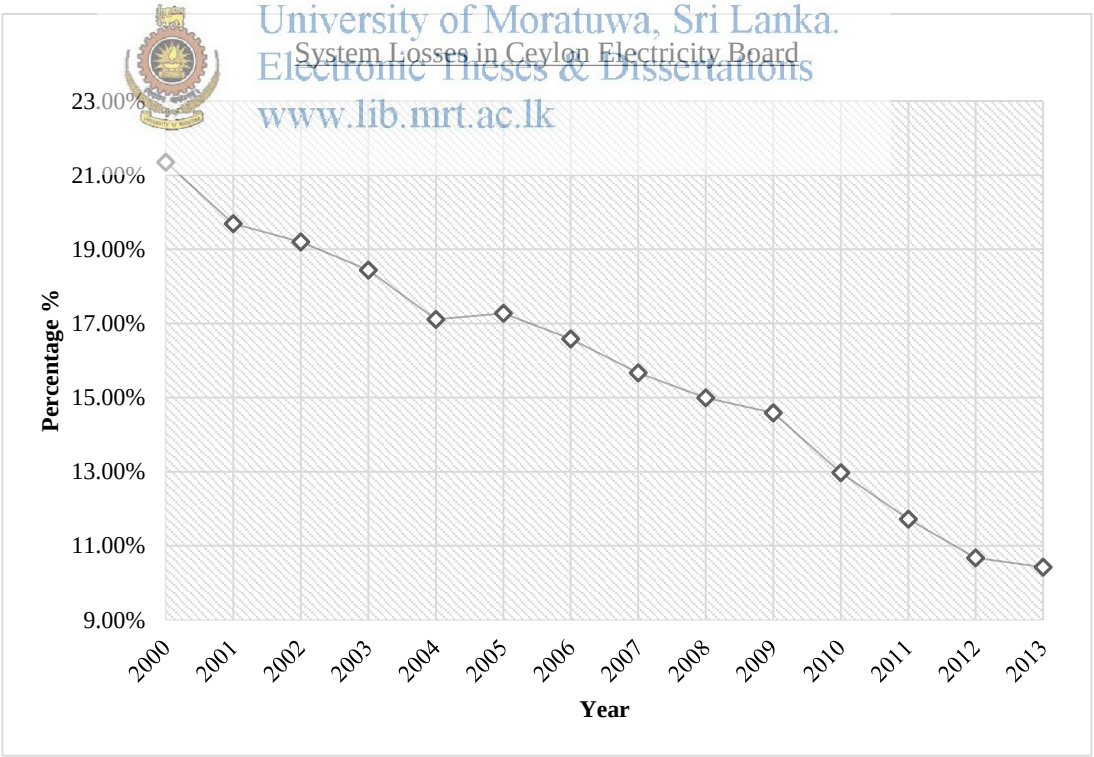


Figure_4.16: System loss in CEB
Source: CEB Annual Reports, Various years

In addition to that several distribution enhancement projects were also in progress to improve the distribution network and it will increase the losses further. However the losses are currently reduced up to 10% and it is targeted to further reduce to 8% in future. Figure_4.16 shows yearly progress of system loss in CEB. Usage of insulated Arial Bundled Cables for the low voltage distribution lines and adoption of advanced connection techniques such as crimping for both medium voltage and low voltage feeders helped to reduce distribution loss gradually after 2010 [6].

4.4.8 Negative attitudes are developed among subsidized groups

Subsidies always should be targeted to the poorest sectors in the country. It is seen that subsidies encouraging poverty among people. Currently, the subsidized people electricity consumers have become a burden to the treasury.

Once something is given free or on subsidy, people will start to believe it is a right to receive it continuously. Then the negative attitudes are developed in the society to receive all the things free. It will retard the development of the country.

5. RECOMMENDATIONS AND CONCLUTION

Although electricity tariff has been subsidized, still some unsolved problems are existing in electricity sector. Number of hidden negative impacts daunt the expected outcomes of electricity subsidy. Following facts may helpful to overcome the negative impacts of electricity subsidies without losing the comfortable life.

5.1 MODIFICATIONS FOR ELECTRICITY SUBSIDY ELIGIBILITY

Instead of giving the electricity subsidies on basis of consumption, the researcher proposes to introduce smarter method, which could address the intention of the subsidies properly. As discussed in section 4.1.2 effective intention of the electricity subsidy was to give a relief to the poorest among poor. The government of Sri Lanka has identified around 1.5 million poor families (Figure_2.3) as "Samurdhi" receivers but electricity subsidy has been received by around 3.2 million households. It says 1.7 million non-poor families also enjoy the electricity subsidy (Table_4.4). Based on the calculation in section 4.4.2, the additional burden to the government is LKR 10.7 billion per year.

The researcher proposes to grant the electricity subsidy only for needy people. The best category of entitlement for the electricity subsidy is "Samurdhi" receivers who consume below 120 kWh per month. It could be offered in two groups based on the monthly income of a family unit. Current marginal income limit of Samurdhi is LKR 3,000 per month. The same income limit of Samurdhi could adopt for the electricity subsidy too.

5.2 ELECTRICITY SUBSIDY SHOULD GRADUALLY REDUCE

Statistical data shows that number of "Samurdhi" receivers are drastically reducing (Figure_2.3). Government implements variety of development projects to enhance the financial background of citizens. Parallel to those projects electricity subsidy is also proposed to be decreased. However it should not be done at once. For an example, if it is possible to reduce the subsidy by 10% twice a year, in 2020 it will come to zero. It is shown graphically in Figure_5.1.

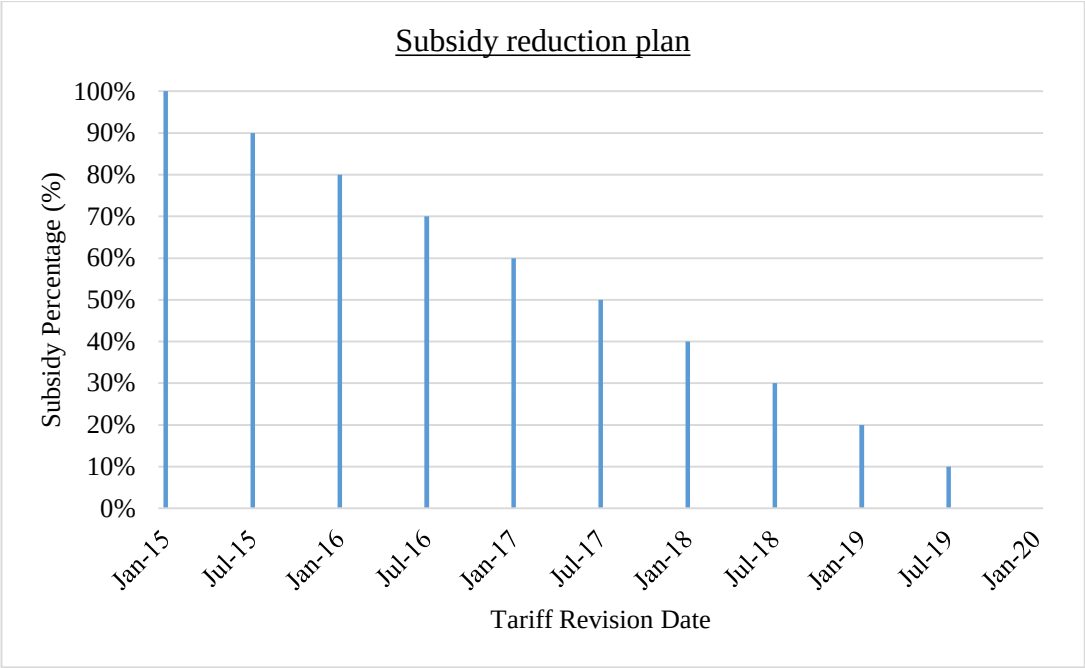


Figure_5.1: Subsidy reduction plan

5.3 MODIFICATIONS FOR TARIFF RATE FIXING METHOD

Comprehensive price equation should be introduced for the tariff fixing. It is convenient to base on the actual generation cost. Subsidy should be applied as a constant coefficient for each category.

The prices should be automatically refreshed twice for updating the actual generation cost. It is proposed to remove the subsidy for families who don't receive "Samurdhi".

It will cut down the number of subsidy receivers from 3.2 million to 1.5 million (Figure_2.3). It will improve the energy efficient equipment usage indirectly.

A new tariff equation is proposed as shown in Figure_5.2. It is based on the actual generation cost and it should be updated twice a year. Wastage factor is a variable which is also to be gradually reduce by 5% for every six months and it will come to zero in five years. If so, beyond 2020 nobody will be entitled to the subsidy on electricity. Indirectly it will reduce the taxes like VAT by remarkable value since treasury does not need to fill the difference between the revenue and the actual generation cost.

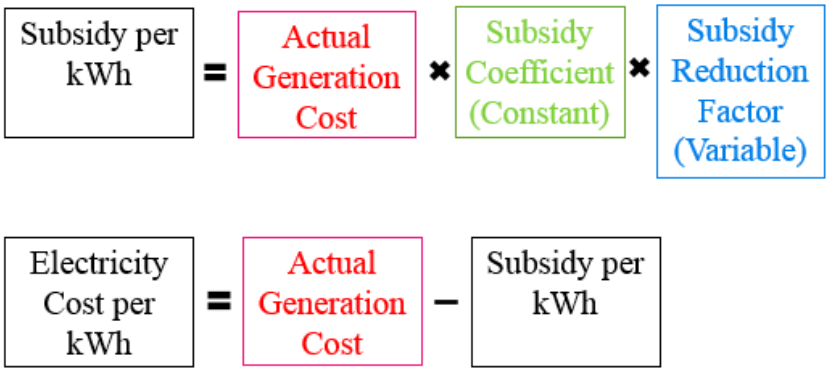


Figure_5.2: Proposed tariff equation

Sample tariff structure is shown in Table_5.10 Categories and coefficient were decided based on the concepts given in 5.1 and 5.2 with consideration of current tariff (Table_2.5) and cost of generation (Figure_2.2).

Table_5.1: Sample of proposed tariff structure

Per family income	0-30 kWh	31-60 kWh	61-90 kWh	91- 120 kWh	More than 121 kWh
Samurdhi Holders					
Below LKR 3,000	Gen. cost x (1- 0.15xR)	Gen. cost x (1- 0.3xR)	Gen. cost x (1- 0.45xR)	Gen. cost x (1-0.75xR)	Actual Gen. Cost
Above LKR 3,000	Gen. cost x (1-0.2xR)	Gen. cost x (1-0.4xR)	Gen. cost x (1-0.6xR)	Gen. cost x (1-0.9xR)	Actual Gen. Cost
Non-samurdhi Holders					
Not considered	Actual Gen. Cost	Actual Gen. Cost	Actual Gen. Cost	Actual Gen. Cost	Actual Gen. Cost x 1.5

R – Reduction factor of subsidy

5.4 DISCOURAGE ENERGY INEFFICIENT EQUIPMENT

The total number of lamps used in Sri Lanka is approximately 36 million. The annual consumption of lamps are about 26 million with incandescent lamps accounting for 50% of total lamp consumption at around 13 million. The annual consumption of CFLs is around 7 million every year and it is about 27% of total lamp consumption. Linear

fluorescent and High Intensity Discharge (HID) lamps comprise 15% and 8% respectively of the total lamp consumption [17].

It was found that subsidized consumers heavily use energy inefficient equipment. The main reason is the cheap initial cost. Those equipment are freely available in rural areas also. It is proposed to introduce a special tax to increase price of energy inefficient equipment to discourage the usage.

Import restrictions and manufacturing limitation should be introduced specially to the incandescent lamps. However it will negatively affect to the employments in incandescent industry. Hence, it is vital to support them to shift for manufacturing of CFL lamps and LED lamps. Special exception of taxes and technical support should be given them for entering to the new field. Although several initiatives are underway, most of the countries still do not have any outright ban on incandescent lamps. The main reasons for not taking such action are affordability, quality and availability of the lamps, as well as awareness amongst various users in Sri Lanka. However, Sri Lanka should try to minimize the incandescent usage at least among subsidized consumers in 2020.

5.5 INTRODUCING A SUBSIDY ON ENERGY EFFICIENT EQUIPMENT

Sri Lanka import 40% of CFL and fluorescent lamps 90% of HID lamps [17]. Several tax rebates, such as the import duty reduction and value added tax reduction on the sale of energy efficient equipment can be given to encourage energy efficient equipment. Several international funding organizations, like the World Bank and the Asian Development Bank are currently supporting energy efficiency program in most of the South Asian countries.

By the case study it was found that three number of incandescent lamps are lighted at the system peak in a subsidized household. For all 3.2 million subsidized consumers requires 9.6 million energy efficient lighting equipment. The investment for replacing incandescent lamps with CFLs would be LKR 3.8 billion and with LEDs would be LKR 5.7 billion (For the calculations the wholesale prices of high quality CFL is considered as LKR 400 and LED is considered as LKR 600). Estimated annual electricity saving would be 350 GWh and it will save LKR 6.1 billion annually from

the electricity generation. Although it is worth to give LED lamps free of charge to subsidized consumers, it is recommended to offer 60% of subsidy for CFLs and 75% subsidy for LEDs. Then it will cost about LKR 4 billion and it will save LKR 6.1 billion within a year. The net profit will be LKR 2.1 billion for the utility for the first year and afterwards it will further increase. The environmental management of hazardous waste, such as mercury disposal from CFL lamps and e-waste from LED lighting products, has been implemented successfully in Sri Lanka. Central Environmental Authority has adopted e-waste management guidelines and is in the process of finalizing mercury disposal guidelines [18].

5.6 PROMOTING HIGH QUALITY ENERGY EFFICIENT EQUIPMENT

Many initiatives for the promotion of efficient lighting have already been implemented in the BRICS countries (Brazil, Russia, India, China and South Africa) around the world. Minimum energy performance standards for CFLs have already been established and efficiency labeling is underway. In Sri Lanka, star rating for CFLs has already started. Hence currently low quality CFLs are not much available in the local market. Ranking of LEDs is still not started. Government shall take remedial actions to control the market entry of low quality LED fittings immediately. Several international funding organizations, such as the Asian Develop Bank, World Bank and Global Environment Facility have funded many of the energy efficient lighting programs.

5.7 AWARENESS PROGRAM ON ELECTRICITY CONSERVATION

During the case study it was found that “Today for Tomorrow” energy conservation program and “Earth Hour” program has highly successful during last two years. It is suggested to regain a national energy conservation awareness program with attractive television advertisement campaign for the general public. In addition professional bodies like Institution of Engineers Sri Lanka (IESL), Public Utility Commission of Sri Lanka (PUCSL) and electricity utilities can conduct comprehensive awareness seminars in schools, offices and public places on energy conservation.

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Appendix A

DATA COLLECTION FORM – 1

ELECTRICITY USAGE AMONG SUBSIDIZED CONSUMERS

1. Electricity Account No:
2. Average Electricity Consumption (kWh):
3. Monthly income:
4. Samurdhi Holder or Not: Category: Above/Below - LKR 3000
5. Number of family members:
6. Remarks:

Electricity Consumption Pattern

From	To	Incandescent Lamp					Cooking				Communication			Other	
		15 W	25 W	40 W	60 W	100 W	Rice cooker	Hot plate/ Induction cooker	Water heat	Refrigeration	TV	Radio	Other	Ironing	Water pump
6:00	7:00														
7:00	8:00														
8:00	9:00														
9:00	10:00														
10:00	11:00														
11:00	12:00														
12:00	13:00														
13:00	14:00														
14:00	15:00														
15:00	16:00														
16:00	17:00														
17:00	18:00														
18:00	19:00														
19:00	20:00														
20:00	21:00														
21:00	22:00														
22:00	23:00														

DATA COLLECTION FORM – 2
DETAILS OF RE PROJECTS

1. Name of the RE Scheme:
2. GN Division:
3. AGA Division:
4. No of beneficiaries

	Small	Medium	Large	Total
Domestic Consumers				

5. Work content

MV Lines (km)	
MV Lines (km)	

6. Total cost:
7. Per consumer cost:
8. Priority basis:

9. Details of entrepreneurs

Type	Nos.