

ELECTRICITY REGULATORY AUTHORITY

**STUDY ON SOCIAL AND ECONOMIC IMPACT OF
ELECTRICITY TARIFF CHANGES**

FINAL CONSULTANCY REPORT

SUBMITTED TO

**ELECTRICITY REGULATORY AUTHORITY
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ACRONYMS

CAIDI	-	Customer Average Interruption Duration Index
CAIFI	-	Customer Average Interruption Frequency Index
DW	-	Durbin Wastson
DW	-	Durbin Watson
EA	-	East Africa
ERA	-	Electricity Regulatory Authority
ERB	-	Electricity Regulatory Board
FDC	-	Fully Distributed Cost
GWh	-	GigaWatt hours
IEEE	-	Institution of Electrical and Electronic Engineers
LRMC	-	Long Run Marginal Costing
SADC	-	Southern Africa Development Community
SAIDI	-	Systems Average Interruption Frequency Index
SAIFI	-	Systems Average Interruption Frequency Index
SRMC	-	Short Run Marginal Costing
SWSA	-	Social Work and Social Administration
TANESCO	-	Tanzania Electric Supply Company Limited
UCPA	-	Uganda Consumers' Protection Association
UEB	-	Uganda Electricity Board
UEDCL	-	Uganda Electricity Distribution Company Limited
UETCL	-	Uganda Electricity Transmission Company Limited
Ug.Shs	-	Uganda Shillings
UMA	-	Uganda Manufacturers Association
USD	-	United States Dollar
VAT	-	Value Added Tax
WENRECO	-	West Nile Rural Electrification Company Limited

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EXECUTIVE SUMMARY

Background and Methodology

This study was commissioned by Electricity Regulatory Authority (ERA) in June 2004 to analyze the socio-economic impact of electricity tariff changes in Uganda on both urban and rural residential, commercial and industrial consumers for the years 2001, 2002 and 2003. The study was based on six purposively selected districts of Kampala, Arua, Mbarara, Masaka, Jinja, and Mbale.

A total of 735 domestic consumers/ households were selected in the urban, peri-urban and rural communities in the six districts. On the other hand, a total of 68 industrial and commercial consumers were covered in the study districts including three enterprises of Tororo Cement Factory, Muko Tea Estate and Pallisa Water Board. To supplement and verify the data collected from the study districts, key informants were interviewed in selected agencies. Focus group discussions with domestic and commercial consumers were conducted in the study districts.

Key Findings

Impacts of Changes in Tariffs on Welfare of Domestic consumers

Household expenditure serves as a proxy indicator in determining the burden that domestic consumers would feel in paying for different utilities consumed by the household. The study findings reveal that in general household expenditure consistently increased for the period 2001-2003. Increases in electricity tariffs therefore occurred at a time when domestic consumers were already experiencing increased expenditure in their household budgets.

The findings reveal that energy consumes a large portion of the rich than the poor. While the poorest 10% of the population spend 3.41% of their total expenditure on energy, the top 25% spend more than 12%. The richest 10% spend about 12.5% of their total expenditure on electricity while the poorest spend 1.32%; suggesting a positive and strong income elasticity of energy demand. The study findings further indicate that comparatively Ugandans spend less on electricity compared to other major utilities consumed by the household except for water. For instance, the richest 10% spend about 13.3% of their total expenditure on telephone as compared to 12.5% on electricity. Except for water, most of the other utilities (e.g., rent, transport) consume more of the household budgets than electricity.

The welfare loss of a 10% increase in electricity tariffs is greater for the non-poor than for the poor². It is important to note that majority of domestic consumers as revealed by the study have not sacrificed or forfeited consumption of other utilities that constitute the “welfare basket” in order to save for electricity. These include foodstuff, beverages, clothing, communication, education, medical care, footwear and transport.

Impacts of Changes in Tariffs on Industry and Commercial Consumers

Majority of the firms (91%) use electricity as the major source of energy. A quarter of all the firms/enterprises visited reported no effect of tariff increase on their performance, while in 60% of the firms it was affirmed that increase in tariffs did not affect the market prices of their final products. The study results reveal that in only less than a third (31%) of the industrial and

² The poor are defined as the lowest 25 percentile and the non-poor as those above that level.

commercial consumers were reduced profits reported, while in less than a fifth (19%) were increased production costs reported. Power outages rather than increased tariffs emerge out as the most outstanding problem faced by the industrial and commercial consumers. However, in many of the firms it was argued that a future increase such as by 10% in tariffs would increase the production costs.

From the industrial and commercial consumers survey, 7% had changed from use of electricity to use of alternative sources of energy due to reported increases in electricity tariffs. This figure shows that effects of tariff increase in industries does not override costs of other inputs hence most of the industries could still afford to operate using electricity.

Impact for Consumers for Future Relevant Changes in Tariffs

According to the study findings, elasticity of consumer welfare to changes in electricity tariffs is 0.44 in absolute terms. This implies that a unit increase in electricity tariff would reduce on average consumer's welfare by 0.44 units, holding other factors constant. The negative and low welfare elasticity of electricity demand suggests that electricity remains a necessity in consumer's welfare function and therefore alternative energy sources complement rather than substitute electricity usage.

A Comparison of Tariffs in the Region

In the East African Region, Uganda offers the highest subsidy for its poor citizens, although it offers the smallest number of units under the poors' tariff rate, compared to Kenya and Tanzania. Uganda has the lowest large industrial retail tariff but the highest medium industrial retail unit tariff in the region. On the other hand, Uganda has the lowest kVA demand tariff for medium scale industries, but has the second lowest kVA demand tariff for large-scale industries. Whereas Uganda has competitive and low tariffs for large and extra large industries, her domestic tariffs are comparatively high in the region. Domestic consumers in Uganda pay about 10 US cents per unit compared to about 2 US cents, for instance, in Malawi. In all consumer categories, the tariff rates in the SADC region are the lowest.

Price Signal, Time of Use and Alternative Sources of Consumption

The highest number of industries worked between 7a.m. and 7p.m. and for 24 hours. The current tariff levels and price signals are not high or prohibitive enough to cause a change in production hours in an attempt to accommodate the tariff increases or new price signal levels.

There was an effort to keep tariff increases for off peak consumption as low as possible to encourage industries to shift to off peak usage of electricity, but from the study findings, tariff changes did not impact on change in production hours. A look at electricity consumption of both medium and large industries shows that medium scale industrial consumers reacted to the June 2001 price increase by reducing consumption; whereas for large industrial consumers, the two price increases in June 2001 and June 2003 did not lead to adverse reactions from the consumers. Looking at it from the price signal point of view, the June 2001 increase was a suitable price signal for medium scale industrial consumers as it caused consumers to check and then reduce their consumption visibly. On the other hand a suitable price signal that would cause large industrial consumers to reduce consumption during peak hours had not been set prior to December 2003.

Changes of Tariffs and Effect on Quantity and Quality of Electricity

Reaction to tariff increases by domestic consumers was not immediate and billing data over a period of time show their consumption was not adversely affected by tariff increases. However, domestic consumers reduced use of equipment with the highest power rating.

Commercial/medium scale and small-scale industrial consumers reacted to increase in tariffs by reducing their consumption, whereas large industrial consumers did not visibly react to changes in electricity tariffs. Street lighting consumption is not affected by tariff changes.

Changes in Tariffs and the Effect on the Economy

The micro impacts on the households and the firms have been analyzed, however lack of an up to-date and comprehensive input-output table or social accounting matrix for the country cannot allow for the quantification of the macro-economic impacts. Therefore, no quantification of the impact on prices and a change in composition of aggregate output, and impact of reduced subsidies on government expenditures and revenues is attempted.

Though many firms use electricity in their production process and it contributes a big proportion of the total costs, the structure of the Ugandan economy is not so much electricity intensive. As a result, therefore not much of such increases can be transmitted to higher prices. Lastly are the effects of higher tariffs and reduced government subsidies on government expenditures and revenues.

Tariff Changes and Optimum use of Electricity Resources in Uganda

The household survey reveals that majority of domestic consumers (78%) had adopted energy saving measures to minimize the amount of electricity consumed. In the year 2001, less than a half (44%) of the domestic consumers adopted energy saving measures to minimize the effect of increase in electricity tariffs. However in the years 2002 and 2003, the number of domestic consumers that adopted energy saving measures to minimize impact of increase in electricity tariffs dropped to 26% and 30%, respectively. Particular energy saving strategies adopted to cope with increased electricity tariffs, reported highest was the use of energy saving bulbs.

Majority of industrial/commercial consumers (75%; n=51) had adopted energy saving initiatives to minimize the amount of electricity consumed. Use of energy saving lighting was adopted by majority (90%) of industrial/commercial consumers. Good housekeeping measures such as switching off machinery and lights not in use was adopted by 47% of the industrial/commercial consumers, followed by regular maintenance of electrical equipment. However, measures such as power factor correction, which would save on reactive power demanded had a low rating of 14%, with only 7 out of 51 industries/commercial firms using power factor correction. Off peak electricity usage is also not a popular energy saving strategy.

Low usage of Power factor correction was investigated further with results showing that only 23 industries knew what their power factor was. Of these, the highest frequency (7) had a power factor of 0.90, followed by 5 industries, which had a power factor of 0.99, which is very good. The accuracy of the figure given is questionable and for purposed of this analysis we can note that about 5 industries had a power factor between 0.90 and 0.99; thus 5 out of 23 industries that know their power factors endeavor to maintain it at a high value. The highest rated incentive for installation of power factor correction equipment was reduction of electricity consumption.

Slightly over a third of the industrial/commercial consumers (34%) had installed time-of-use meters. Six industries, which is the highest number of those with time-use meters, installed them in the year 2004. Apparently, most industrial/commercial consumers had not installed time-of-use meters due to lack of knowledge (49%), while slightly less than a fifth indicated no benefits were envisaged in installing time-of-use meters.

Lifeline Subsidy

Up to 5% of households sampled spend Ug. Shs 5,000 and below monthly on electricity in 2001 and 2002. In 2003, this number dropped to 2.6% of households sampled. Only up to 9% of the sampled domestic consumers had dwellings that would consume power within the lifeline subsidy. This implies that the percentage of households that qualify for lifeline subsidy rate is lower than 9% of those sampled due to high usage rate of electric irons and hotplates. Therefore, the current lifeline subsidy provision does not provide for the target group; the very poor who have access to electricity, and hence does not have any socio-economic justification to maintain it unless the number of units under the lifeline subsidy are increased. The consequences of this, however, will be to increase the tariff in order to recover the increased number of units under the lifeline subsidy loses.

Effects of Tariffs in Rural Areas

Although over 80% of the total population of Uganda resides in rural areas, only 2% of rural households have access to electricity. Nationally, less than 4.5% of the population of 24 m is connected to the power grid system. Despite the fact that many people in the rural areas are willing to pay for electricity; increasing tariffs affect their budgetary outlays most.

Conclusion

The study findings have revealed that the electricity tariff is not as high to impact on the welfare of domestic consumers as compared to expenditure on other household utilities. Categories affected by the increases in tariffs are mainly the urban rich, implying that increased or increasing tariffs will have a progressive impact. Although domestic consumers report the burden of increased electricity tariffs, they have not directly sacrificed or forfeited consumption of other welfare household items. Instead of forfeiting or sacrificing the above mentioned welfare items, domestic consumers adopt complementary, but not substitution strategies such as using charcoal, wood fuel, gas and limiting the use of electrical appliances. These complementary strategies might not necessarily be cheaper than electricity, but the system of pre-paid payment unlike for electricity does not make the consumer feel a burden.

Suggestions

The whole outcry about high electricity tariffs appears to have flourished due to UEDCL's public image problem among consumers of different categories. This image problem emanates from inaccurate and estimated billing even when meters are installed, untimely billing, delayed updating of customer account, disconnection of consumers on delivery of an accumulated bill without prior warning and failure to enforce bill collection, which is left to accumulate. UEDCL has to address these problems, coupled with sensitization of the consumers about the tariff and the billing system. Specifically, UEDCL has to do the following:

- Meter all premises connected to electricity
- Read all Meters accurately and timely
- Provide Meter reading function with logistics
- Monitor performance of Meter readers

- Reflect all payments
- Avail customer accounts information to all districts
- Ensure security of measuring instruments
- Check customer-staff collusion and complacency
- Pre-paid Metering

Although the findings reveal no significant impact of tariffs on the welfare of consumer and industrial performance, particular vulnerable groups (rural poor) need to be assisted especially in meeting the initial capital/costs to connect to the grid.

In order to keep track of how the network is performing (quality and quantity), it is important that the reliability indices are reported to ERA by the utility companies so as to be measured against international standards. This would be a check on how the company is performing and justify tariff increases with improved network reliability. Industries would be cheated if they were made to pay high kVA tariffs for instance yet the machine is lying idle half the time due to power outages.

1.0 INTRODUCTION

1.1 Background to the Study

The Electricity Regulatory Authority (ERA) was established by the Electricity Act 1999 as an independent statutory body responsible for regulating the electricity industry in Uganda. The policy organ of ERA is the Authority. Functions of the ERA as listed in Section 11 of the “The Electricity Act, 1999, include, among others, to establish a tariff structure and to investigate tariff charges, whether or not a specific complaint has been made for a tariff adjustment, and approve rates of charges and conditions of electricity services provided by transmission and distribution companies.

The Authority first approved an end-user electricity tariff in 2001 after the unbundling of the vertically integrated Uganda Electricity Board (UEB) into three independent companies. This was the first tariff adjustment in eight years, the last having been carried out by UEB in 1993. Since then, the Authority has been approving tariffs adjustments annually. Sometimes these tariffs have actually dropped and at other times, they have gone up depending on the revenue requirements approved for the utility companies in a particular year. Tariff increases were effected in June 2001, September 2002, June 2003 and January 2004. See Appendix 7 for tariff structure 2001-2003.

Section 76 of “The Electricity Act, 1999” stipulates that tariff structure shall take into account licensee’s total revenue covering all reasonable costs and offering a reasonable rate of return. Tariff structure should be in accordance with the principles of tariff calculations, and methodology and procedures of tariff calculation should be approved by ERA. “The Electricity (Tariff Code) Regulation, 2003” (Statutory Instrument 2003; No. 23) stipulates that tariffs shall be based on accurate cost information, reflecting short term variation in costs imposed on the system by the time of use, seasonal factors, consumer load profile, voltage levels and other similar factors. The regulation also stipulates that the tariff shall reflect true cost of the service provided and set clear price signals to the consumers.

Prior to 1st June 2001, the Long-Run Marginal Costing (LRMC) system was used to calculate the tariff structure. LRMC took into account changes in costs resulting from additions to capacity to serve incremental load increases i.e. capital expenditure. In accordance with Section 76 of “The Electricity Act, 1999” and Regulation “The Electricity (Tariff Code) Regulation, 2003”, as cited above, the tariff structure was changed in June 2001 so that customers were charged for costs imposed on the system and for operational costs incurred in delivering the service. This tariff structure is based on the Short-Run Marginal Costing system (SRMC).

Irrespective of whether the tariffs drop or increase, they are bound to have an effect on the consuming population or industrial enterprises. Often the consumers will tend to resent the increase in tariff. In the absence of an empirical investigation, it becomes exceedingly difficult for policy-makers and other relevant authorities to set rational tariff levels that would not have adverse impact on the welfare of domestic consumers, commercial and industrial consumers. It is against this background that ERA commissioned the Department of Social Work and Social Administration (SWSA) of Makerere University to carry out an assessment of the actual social and economic impact of tariff adjustments for the years 2001, 2002 and 2003. This report

therefore contains the findings of the study that was conducted between June and September 2004.

1.2 Scope and Objective of the Study

The overall objective of the study was to analyze the impact of electricity tariff changes on both urban and rural residential, commercial and industrial consumers as well as developing relevant socio-economic indicators that are precursors of adverse electricity tariffs. The specific objectives are contained in the scope of work as defined in the terms of reference shown in Appendix 10. The specific objectives included:

- To investigate the impact of changes in tariffs for the years 2001, 2002, and 2003 regarding welfare of consumers and consequences for industry.
- To investigate the impact for industry and consumers for future relevant changes in tariffs
- To carry out a comparison of tariffs in the region and the trend of their changes in absolute terms
- To investigate the level of price signal in time of use tariffs that can lead to changes to off-peak hours consumption and/or alternative sources of consumption, and whether the current price signals in the electricity tariff structure as a tool for demand side management is effective
- To analyze the effect on quantity and quality of electricity consumed/produced with changes in tariffs and the effect on the economy
- To investigate whether the tariff changes have led to optimum use of electricity resources in Uganda
- Investigate whether the current socio-economic provisions are appropriate and have an impact on tariff changes i.e., lifeline subsidy
- To investigate the effect of tariffs in rural areas, and the ability of rural customers to pay
- Develop a set of indicators for assessing the economic and social effects of changes in electricity tariffs and specify social and economic aspects most vulnerable to electricity tariffs.

1.3 Study Methodology

This study set to verify social and economic impacts of electricity tariff changes in Uganda based on six purposively selected districts of Kampala, Arua, Mbarara, Masaka, Jinja, and Mbale. The six districts are the leading consumers of electricity both at the household, industrial and commercial level. Countrywide, all these consumers put together by end of 2003 totaled 244,245 (UEDCL, 2003). See Appendix 6. In addition to the consumers, key informants were selected from key organizations/agencies as participants in this study.

Domestic consumers³

A total of 735 electricity-consuming households were selected in six districts. Districts were stratified into three sub-strata; urban, peri-urban and rural for selection of a sample of electricity consuming households. The sample size (n) was scientifically determined using the formula below:

³ Electricity supply to residences, small shops, kiosks, etc metered at 1-phase (240V)

$$n = \frac{z_{\alpha/2}^2 p(1-p)}{d^2}$$

- where p is the estimated proportion of households connected to electricity.
- d is the maximum amount of error committed during sampling
- Z is the value of the normal distribution
- α is the level of significance.

Using the optimum value of p i.e., 0.5 and the amount of error, d=0.04,

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.04)^2} = 600.25$$

Using the above formula, the overall sample size was 600 consuming households in six districts selected with 95 percent level of confidence to ensure that the maximum amount of error in the estimation of p does not exceed 0.04. However, this was administratively adjusted by a factor of 22.5% so as to capture a larger sample of 735 electricity-consuming households, and draw appropriate proportionate district samples. The sample size of domestic customers per district was proportionately determined after obtaining the figures from UEDCL before actual fieldwork starts. See Table 1.

Industrial⁴ and Commercial⁵ Consumers

Industrial consumers comprised of large and medium consumers, while commercial consumers included hotels/restaurant, places of entertainment, milling machines, workshops, hospitals, schools and local artisans. A total of 68 enterprises were covered in six study districts including three enterprises of Tororo Cement Factory, Muko Tea Estate and Pallisa Water Board. See Table 1. The sample had been anticipated to be approximately 100, but due to unforeseen challenges this was not possible. See 1.6.

⁴ Refers to both medium scale industries (MSI) and large scale industries (LSI). MSI refers to electricity supplies at low voltage (415V) with a Maximum Demand up to 500kVA. LSI refers to electricity supply at High Voltage (11kV & 33kV) with a Maximum Demand exceeding 500 kVA

⁵ Also referred to as Small Scale industries—relate to electricity supplied at 3-phase (415V) with a load not exceeding 100 Amperes

Table 1: Sample distribution of domestic, industrial and commercial consumers

District	Category of Consumer Domestic (N=735) Industrial and Commercial (N=68)	Total Sample (n)	
		%	N
Mbarara	Domestic	13.6	100
	Industrial and Commercial	14.7	10
Masaka	Domestic	18.5	136
	Industrial and Commercial	13.2	9
Kampala	Domestic	29.5	217
	Industrial and Commercial	32.4	22
Jinja	Domestic	17.7	130
	Industrial and Commercial	11.8	8
Mbale	Domestic	11.8	87
	Industrial and Commercial	11.2	8
Arua	Domestic	8.8	65
	Industrial and Commercial	13.2	9
Total	Domestic	100.0	735
	Industrial and Commercial	100.0	65 ⁶

Key Informants and other stakeholders

Key informants comprised of officials at ERA, Uganda Electricity Distribution Company Limited (UEDCL), West Nile Rural Electrification Company (WENRECO), Ministry of Energy and Mineral Development, Ministry of Finance, Planning and Economic Development - Utility Reform Unit and Privatization Unit, Rural Electrification Agency, Uganda Manufacturers Association, Uganda Consumers' Protection Association and Members of Parliament.

Data Collection Methods

Both primary and secondary data were collected to address the objectives of this study. Primary data were collected using a set of tools administered to domestic consumers and industrial/commercial consumers, while secondary data was collected from relevant organizations.

Domestic consumer questionnaire

A structured domestic consumer questionnaire as shown in Appendix 1 was used to obtain information on a number of variables including household expenditure in general and on selected welfare needs. Attempts were made to assess household expenditure on electricity since 2001, and possible sacrifices made on household welfare so as to pay electricity bills. Other aspects examined were the coping mechanisms adopted by households vis-à-vis increased electricity tariffs, and the implications this has on the consuming households. The questionnaire helped to capture the domestic consumer's daily consumption pattern over the years by capturing various loads in the household, which helped in constructing a load curve at household level. It also captured people's perception of load shedding and their concerns on billing.

Industrial and commercial questionnaire

⁶ Total sample of industrial and commercial was 68 enterprises, for 3 were deliberately picked outside the six study districts; Tororo Cement factory, Muko Tea Estate and Pallisa Water Board.

For industrial and commercial consumers, a structured questionnaire was used to capture expenditure on electricity over the years, production costs as a result of increased tariffs, and the relationship between increases in electricity tariffs and production level/output. The impact on prices was captured and used to determine the impact on demand for final goods. Quantity and quality of electricity supply from the industrial/commercial consumer point of view was also captured. See Appendix 2.

Focus group discussion (FGD) guide

The FGD guide was used to capture the perceptions of the consumers on changes in tariffs and try to understand level of community mobilization to appreciate the increases in tariffs, and perceptions on tolerable price for electricity. See Appendix 3.

Key informant guides

The key informants guide was used to elicit data on the envisaged impact of increases on electricity tariffs on the welfare of the population and production level of firms/industries. See Appendix 4.

Secondary data checklists

Using secondary data checklists, data were obtained from the Ministry of Energy and Mineral Development, ERA, Uganda Electricity Distribution Company Limited (UEDCL) and Uganda Electricity Transmission Company Limited (UETCL) and WENRECO (West Nile Rural Electrification Company Limited).

1.4 Data Management and Analysis

All data from domestic/households, industrial and commercial were entered into the computer using EPI-INFO software and further analysis was carried out using the Statistical Package for the Social Scientist (SPSS) and E-views Version 3.1 Econometric Package.

In this study, several approaches to analyze welfare impacts were used such as compensating/equivalent variation method. Household expenditure, but not income levels were used to measure household welfare. As a first step, the study sample was divided into quintiles (expenditure groups).

Quantity of power was analyzed at the household level using four parameters; installed power, simultaneity coefficient, peak use factor and demand factor. Installed power was obtained from the sum of every appliance in use. Simultaneity coefficient, peak use factor and demand factor were calculated from household data. See Appendix 5 for details.

The quality of power supply was analyzed by reliability indices calculated from power outages data obtained from UEDCL. The reliability indices, which were calculated included System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), Customer Average Interruption Frequency Index (CAIFI) and Customer Average Interruption Duration Index (CAIDI).

1.5 Literature Review

Many countries in sub-Saharan Africa have embarked on power sector reforms without adequate attention being paid to the tariff question. Such reforms, have often led to massive financial

losses because the controlled retail tariffs could not cover the costs of purchasing power on the wholesale market – where prices were changing freely (Mangwengwende, 2002). In Uganda, the power sector reform process is still ongoing and lessons from other countries that have already implemented these reforms could be useful for Uganda as well.

In most developing countries, electricity for long was treated as a public good and the tariffs set by the state, did not cover costs and were much higher for industrial consumers than for households and other final consumers. The impact of these wide restrictions on the energy sector is widely discussed in the literature (See for example Wallich, 1997, Kenedy, 1999). The results of these empirical investigations showed that the price distortions set wrong incentives for the allocation of energy resources and also seemed to protect wrong targets. In most cases, high-income households benefited most from electricity subsidies as they consumed more electricity and their income elasticities were substantially higher (Freund and Wallich, 1997).

Although tariffs have been increasing in Uganda since 2001, there is still no clear empirical indication of the effects on the welfare of households, and impact on industries. It is expected that tariff increases may have significant negative social and economic effects with implications on household welfare and varying impacts on other consumers. In this study, welfare is defined as the sum of consumer surplus and producer surplus. Expenditure levels of households are used to proxy their welfare status as information on income is difficult to obtain. The effect of a tariff change on welfare is assumed to improve if there is a move from an inefficient tariff to a more efficient tariff. Therefore the main objective of the energy providers is to maximize welfare by choosing efficient energy pricing systems, subject to the costs of electricity supply.

There are several pricing schemes used in the literature to develop the optimum best prices for consumers. These include prices based on marginal costs, prices based on the Ramsey pricing, optimal Coasian two-part tariffs and those based on the fully distributed cost pricing (FDC) (Kopsakangas-Savolainen, 2003). The most commonly used pricing system in developing countries is the marginal cost pricing. This approach is seen to maximize social welfare but may violate the revenue requirements of developing countries. However, Laffont and Tirole (1994) argue that it is still the most efficient pricing system. They show that by setting prices efficiently, a social planner can thus maximize welfare, which can then be distributed as society wishes. The other methods fulfill the requirement of breaking even and can be reviewed in the literature. These approaches have been used in Finland and Ukraine to determine the effects of tariff changes on welfare. In Finland, the results show that changing the pricing system to the marginal costing method would result in significant welfare improvement.

In Uganda, a Social Impact Assessment Report (2001) prepared for the Utility Reform Unit shows that it is justified to increase tariffs on electricity. This study showed that the majority of the consumers would be able to absorb the envisaged tariff increases and that tariff increases will not be great enough to create sustained resistance. The study also showed that the immediate imperative of achieving higher growth as a co-producer of long-term human and socio economic development mandates higher electricity prices and concluded that “higher tariffs are the ‘investment’ required to ensure more equitable and fair access to electricity. However, some methodological issues emerge from their analysis.

The study uses tolerance price of electricity and the percentage of household expenditure methods to determine the effects of tariff changes. Limited information on rural households was used and

therefore their impacts were not critically assessed. Also, dividing the expenditure groups into only three categories provided for generalizations as far as the income group is concerned. A more robust approach would be to divide the expenditure groups into several categories such as quintiles or deciles and further disaggregate them into socio-economic groups such as farmers, public servants, private employees and self-employed groups. Further in order to better analyze the electricity consumption patterns within each group, different levels of consumption per adult equivalent have to be analyzed.

In many developing countries, adjusting prices for public services is very difficult because they tend to be politically unfeasible (Freund and Wallich 1995). As a result, there is still massive under pricing with lots of government subsidies. However, there are a number of reasons; first is the fear of the direct impact on the overall price level, which will be a function of the structure of the economy and its energy intensity. The increase in household energy can increase social impact even if price increases. In other countries, they lack the management capacity to handle increasing cash flows after the transition (Freund and Wallich 1997).

1.6 Study Limitations and Challenges

One of the major challenges encountered in this study was collecting data from industrial and commercial consumers and some of the key informants from selected agencies or organizations. Relevant officials in industries often declined to participate in the study unless permission was obtained from their superiors, some of who were not available during the entire period of the study. In isolated cases there was outright refusal even after locating responsible officers. The alleged heavy schedule on the part of some key informants made it difficult to make appointments within the allotted time for this study.

The other critical challenge was obtaining comparison of tariff rates for different countries due to the following reasons:

- Different countries set prices differently, with different policy objectives. For example, in some countries, in order to encourage rural electrification they have different rates in rural areas as compared to those in the urban areas. In others, they charge low tariffs for different quantities consumed.
- Some countries classify their customers in two broad categories; industrial and residential, while others have many classes; small-commercial, industrial, social services, residential etc. This complicated the comparison between and among countries.
- Differences in the purchasing power of the different currencies, for example, a dollar in South Africa purchases more than the same dollar in Uganda.
- Lack of consistent data especially over the years for all countries. Uganda is one of the few countries that have comfortably posted their tariff rates on their website in the region. Many other countries do not have this information, or where it exists, is not consistent.

STUDY RESULTS

2.0 IMPACTS OF CHANGES IN TARIFFS ON WELFARE OF DOMESTIC CONSUMERS

2.1 Socio-economic Characteristics of the Household Consumers

The socio-economic and demographic characteristics of the household consumers provide the context for appreciating the study findings on the impact of electricity tariffs on the welfare of the consumers. The relevant characteristics of the household respondents in this study as shown in Table 2.

Table 2: Socio-economic and demographic characteristics of sampled households

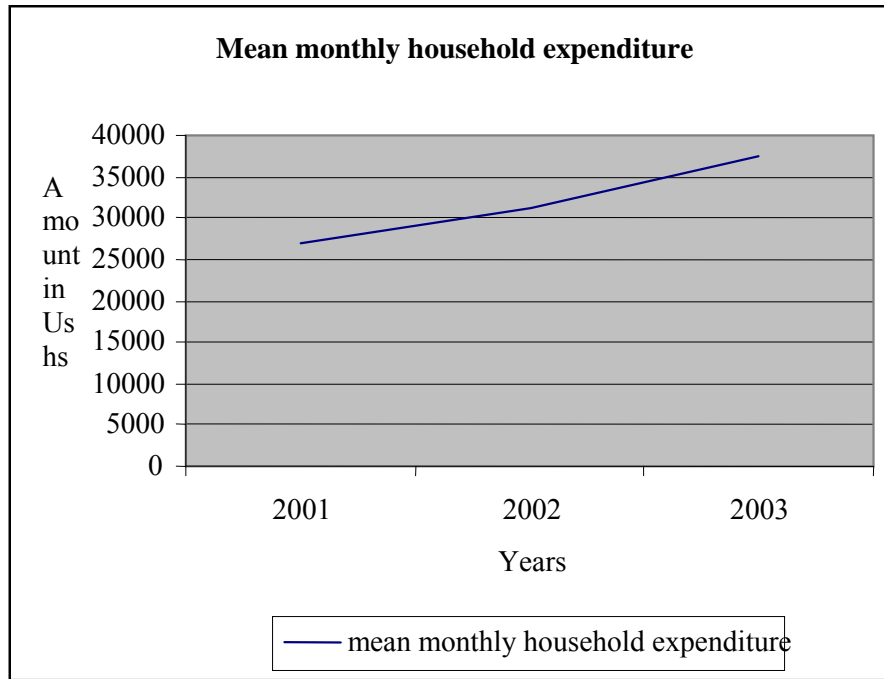
Characteristics (N=735)	Respondents	
	%	N
Location		
Urban	70.1	515
Peri-urban	15.1	111
Rural	14.8	109
Respondents Status		
Head of the household	56.0	408
Spouse	44.0	327
Household Headship		
Male headed	77.0	566
Female headed	22.3	164
Child headed	0.7	5
Main Occupation of the Household Head		
Peasant farmer	7.3	54
Government employed	28.7	211
Non-government formal employment	16.5	121
Petty trading	7.6	56
Commercial/business	29.3	215
Others	10.6	78
Household Size		
1-3 people	12.5	92
4-6 people	49.1	361
7-9 people	25.7	189
10 + people	12.7	93

In the Table above, it is clear that majority of household respondents/households (70.1%) were located in urban areas. Over a half (56.0%) of the household respondents were heads, while less than a half were spouses. Therefore for reliability and validity of data, the study captured household members who either controlled the household budget or were knowledgeable about the household expenditure on electricity and other utilities consumed by the household. Majority of the households (77%) were male headed and with less than a tenth of all heads engaged in peasantry farming as their main occupation, and hence a source of income. The study findings are consistent with the prevailing situation that there are very few households in Uganda who depend on peasantry farming that consume electricity. Most of the households captured in this study had four members or above, and hence implying sufficient level of utility consumption/expenditure, keeping other factors constant.

2.2 General Household Expenditure

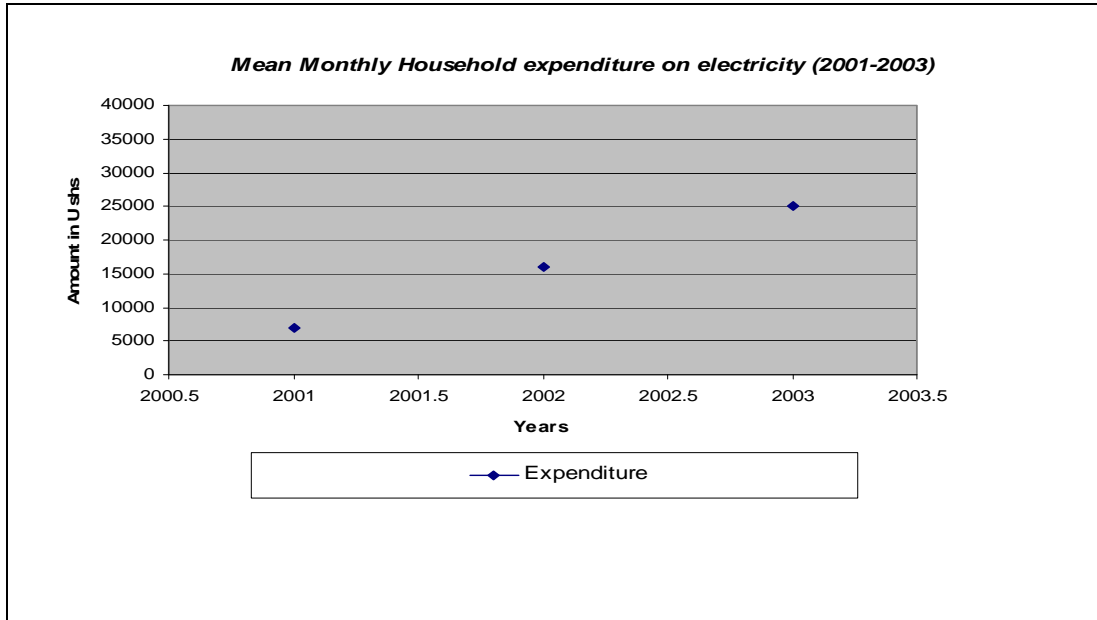
Household expenditure serves as a proxy indicator in determining the burden that domestic consumers would feel in paying for different utilities consumed by the household. The study findings reveal that in general household expenditure consistently increased for the period 2001-2003 as shown in Figure 1.

Figure 1: Trends in mean household expenditure over the years 2001-2003



Source: Household Data.

Figure 1 reveals that increases in electricity tariffs occurred at a time when domestic consumers were already experiencing increased expenditure in their household budgets on other items such as food, health care, school, rent, communication, entertainment/leisure, rent/housing etc. In such a situation, the increase in electricity tariff was bound to be met with a hostile reaction as households were already being burdened by expenditure on other welfare needs. Also see Figure 2 for household expenditure on electricity.

Figure 2: Mean monthly household expenditure on electricity (2001-2003)

Source: Household Data

It is clear in Figure 2 that household expenditures on electricity consistently increased between 2001-2003. This could partly be explained by the increase in tariffs or more use of electrical appliances as owned by households. See Appendix 8 for electrical equipment/appliance owned by sampled households and regularity of use.

2.3 Impact of Electricity Tariffs on Household Welfare

In analyzing the impact of electricity tariffs on household welfare, a broad question guided the investigation—who spends more on electricity. An attempt was made to identify which socio-economic category of the population spent more on electricity in comparison with other types of energy. Table 3 categorizes the domestic consumers captured in this study in terms of their economic ranking, which is cross-tabulated with expenditure on different types of energy.

Table 3: Household energy expenditure on different sources of energy by economic class

Percentiles	Electricity %	Paraffin %	Firewood %	Solar %	Gas %	Bio-gas %	Charcoal %	Candle %	Total Energy %
P10 (poorest)	1.32	0.2	0.29	0	0.68	0	0.72	0.07	3.28
P25	2.41	0.35	0.71	0	1.05	0	1.2	0.13	5.85
P50	4.13	0.66	1.58	0	1.45	1.03	2.06	0.23	11.14
P75	6.82	1.26	3.14	0.15	2.48	2.9	3.37	0.39	20.51
P90 (richest)	12.49	2.27	5.9	0.57	3.72	3.52	5.07	0.76	34.30

Source: Household Survey

From Table 3, the study reveals that electricity consumption takes the bulk of the non-poor's household total energy expenditure than the poor. While the poorest 10% of the population spent 3.28% of their total expenditure on energy, the top 25% spent about 7% on electricity and more than 20% on energy as a whole. In particular, the richest 10% spent about 12.5% of their total energy expenditure on electricity while the poorest spent 1.32%. So not only did the better off spend a larger absolute amount on energy and electricity in particular than the poor, but energy also consumed a larger proportion of their expenditure. This suggests a positive and strong income elasticity of energy demand. It is also probable that it could be as a result of the high expenditure on electricity that even the rich are diversifying the use of different energy sources.

2.4 Comparison of Expenditure on Utilities as a Percentage of Total Expenditure

In analyzing further the impact of increased electricity tariffs on the welfare of the domestic consumers, an attempt was made to analyze the proportion of expenditure on electricity vis-à-vis expenditure on other utilities consumed by the household. The findings are presented in Table 4.

Table 4: Household expenditure on electricity as a proportion of total expenditure for different utilities

Percentiles	Electricity %	Telephone %	Transport %	Water %	Rent %
p10 (Poorest)	1.32	1.62	1.28	0.55	6.94
p25	2.41	2.68	2.99	0.93	11.44
p50	4.13	4.7	5.67	1.66	18.98
p75	6.82	8.06	11.28	2.73	28.83
p90 (richest)	12.49	13.27	16.43	4.96	39.03

Source: Household Survey

Table 4 reveals that comparatively Ugandans spend less on electricity compared to other major utilities consumed by the household except for water. For instance, Ugandans are spending more on telephone than they do spend on electricity. From the survey information, the richest 10% spend about 13.3% of their total expenditure on telephone as compared to 12.5% on electricity. This situation is consistent for all expenditure groups. Transport and rent are also burdensome to the population, consuming a much larger share of expenditure for all the different expenditure categories, than electricity. Except water, where substantial subsidies still remain, most of the other utilities consume more of the household budgets than electricity.

2.5 Rising Energy Prices—Who Loses and by How Much?

The impact of direct effects on the consumption and welfare of the households as a result of increased electricity tariffs depend on the share of energy in the total household budget and its substitutability with other fuels and other goods. The lack of elasticity of demand of electricity requires making particular assumptions on the elasticity in a given range from zero (perfectly inelastic) to negative one. This is a reasonable range as electricity is considered to be a necessity good by at least those who consume it. Therefore, surplus1 represents the consumer surplus loss as a percentage of total expenditure assuming an elasticity of zero, surplus2 elasticity of negative 0.5 and surplus3 with an elasticity of negative one. Similarly when the impact on household expenditure is being analyzed, the same elasticity range for expd1, expd2 and expd3 is assumed (See Tables 5 and 6).

Table 5: Effects on household budget of increasing electricity prices by 10%

Percentiles	Surplus1 %	Surplus2 %	Surplus3 %
P10(poorest)	0.13	0.13	0.13
P25	0.24	0.23	0.23
P50	0.41	0.40	0.40
P75	0.68	0.67	0.65
P90(richest)	1.25	1.22	1.19

According to Table 5, the welfare loss of a 10% increase in electricity prices is greater for the non-poor than for the poor⁷. Assuming zero elasticity, the poor's welfare declines by 0.4 percent while that of the richest percentile declines by 1.25 percent. For all the consumers taken together, the welfare loss is between 0.13 to 1.25 percent of their total budget, depending on the assumed elasticity. The more elastic is demand the less the welfare loss. In areas where substitute energy sources are almost non-existent, the welfare loss is greatest.

Table 6: Effects on socio-economic group of increasing electricity prices by 10%

Social economic group/occupation	Surplus1 %	Surplus2 %	Surplus3 %
None	0.66	0.65	0.63
Farming	0.78	0.76	0.74
Petty trade	0.61	0.60	0.58
Commercial	0.62	0.60	0.59
Salary	0.54	0.53	0.51
Total	0.61	0.59	0.58

In terms of socio-economic groups and occupation, farmers are hurt most by a 10% increase in household electricity prices. With a zero price elasticity of demand, their welfare drops by about 0.78% of the total budget compared to 0.54% for salaried earners. Those who do not have major and consistent sources of income represented by "none" in Table 6 are also significantly hurt. This explains the poor who are actually hurt by the increase and who are a big political force especially in the urban areas.

Apart from capturing impact on loss in consumer surplus as a percentage of total expenditure, the study also captured the impact on actual household budgets. See Table 7.

⁷ We define the poor as the lowest 25 percentile and the non-poor as those above that level.

Table 7: Change in actual expenditures on electricity for a 10% price increase

Percentiles	Expd1 %	Expd2 %	Expd3 %
P10 (poorest)	0.13	0.06	-0.12
P25	0.24	0.11	-0.07
P50	0.41	0.19	-0.04
P75	0.68	0.31	-0.02
P90 (richest)	1.25	0.56	-0.01
Location			
Urban	0.61	0.27	-0.06
Peri-urban	0.53	0.24	-0.05
Rural	0.78	0.35	-0.08

Tables 7 and 8 reveal the increase (or decrease) in actual household spending due to tariff rise. The positive change shows an increase in spending on electricity while a negative change shows a reduction in expenditure. For the scenario where the price elasticity is negative one or greater, the simulations show that there is a “positive effect” on household spending. This means that households reduce their budget outlays when the tariffs are increased. On the other hand, if the price elasticity is 0.5 or less, then, households spend more after the tariff change than before. The budgetary impact of rising electricity prices is again felt more by the richest group and according to location; the impact is felt more in rural households that consume electricity. Amongst the different socio-economic groups, higher energy prices affect the farmers most, increasing their electricity expenditure by 0.78%. See Table 8.

Table 8: Change in actual expenditures on electricity for a 10 % price increase

Social economic/ occupation group	Expd1 %	Expd2 %	Expd3 %
None	0.66	0.3	-0.07
Farming	0.78	0.35	-0.08
Petty trade	0.61	0.28	-0.06
Commercial	0.62	0.28	-0.06
Salary	0.54	0.24	-0.05
Total	0.61	0.27	-0.06

2.6 Domestic Consumers’ Substitution to Alternative Sources/Forms of Energy

One of the proxy indicators regarding the impact of electricity tariffs on the welfare of domestic consumer is to analyze whether the increase in tariffs triggered household to use alternative sources/forms of energy. Tables 9 and 10 present the levels of usage of alternative sources of energy prior and after the increase in electricity tariffs.

Table 9: Alternative sources of energy in use prior and after increase in electricity tariffs

Alternative Source of Energy	Use of alternative source prior and after tariff increase				
	Usage/Purpose	Prior (Before 2001)		After (After 2001)	
		(n=735)	%	(n=735)	%
Dry Cells	Lighting	165	22	62	8
Dry Cells	Other uses	155	21	53	7
Charcoal	Cooking	609	83	259	35
Charcoal	Other uses	26	3	5	0.7
Gas	Cooking	69	9	30	4
Gas	Lighting	25	3	4	0.5
Kerosene	Cooking	204	28	82	11
Kerosene	Lighting	505	69	174	24
Kerosene	Other uses	4	0.5	1	0.1
Solar Energy	Cooking	4	0.5	1	0.1
Solar Energy	Lighting	14	2	8	1
Solar Energy	Other uses	2	0.3	0	0
Firewood	Cooking	148	20	1	0.1
Other Sources of Energy	Cooking	20	3	1	0.1
Other Sources of Energy	Lighting	151	21	1	0.1
Other Sources of Energy	Other Uses	5	0.7	1	0.1

It is noted in Table 9 that on the onset of tariff increase in 2001 domestic consumers were already using alternative sources such as charcoal for cooking and kerosene for lighting as an alternative to electricity. The usage of alternative sources of energy can therefore not be attributed to increase in tariffs per se that took effect in June 2001. This, however, does not rule out the fact for complementing electricity between 2001-2003. For, a shift in the usage of dry cells, charcoal and kerosene in 2001 is evident in Table 10. The households that shifted to use of gas, solar energy, firewood, diesel and petrol between 2001-2003 was very minimal, except for charcoal and dry cells.

Table 10: Years households shifted to use of alternative sources of energy

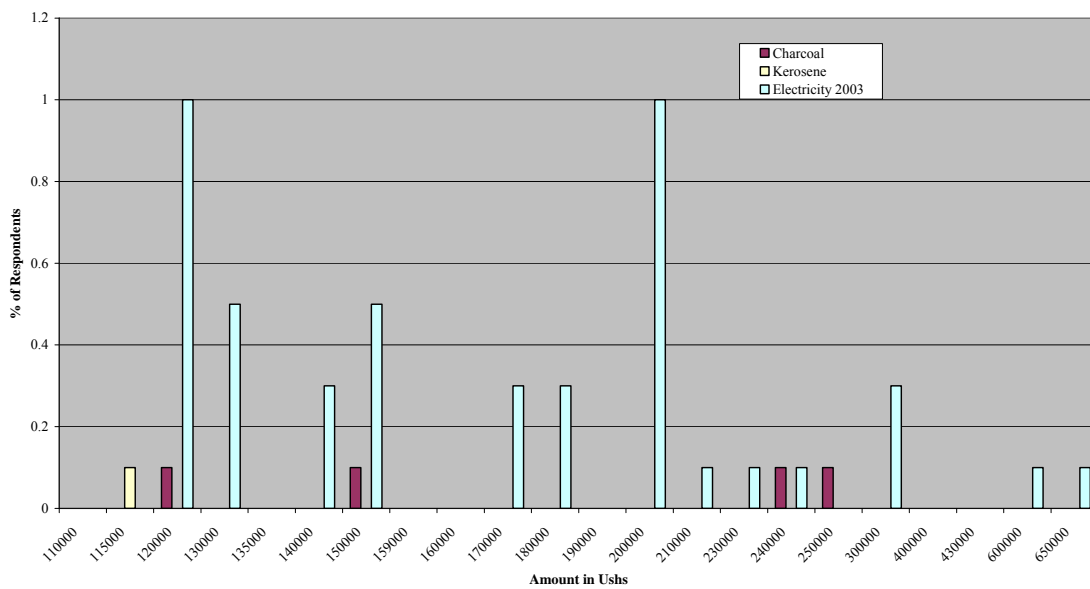
Alternative Source of Energy Shifted to	Respondents that shifted to use of alternative source of energy in given year					
	Year 2001		Year 2002		Year 2003	
	No.	%	No.	%	No.	%
Dry cells (n=634)	59	8	12	2	30	4
Charcoal (n=264)	154	21	60	8	50	7
Gas (n=32)	13	2	4	0.5	15	2
Kerosene (n=191)	109	15	41	6	41	6
Solar energy (n=7)	1	0.1	2	0.3	4	0.5
Firewood (n=2)	0	0.0	1	0.1	1	0.1
Diesel (n=2)	0	0.0	0	0.0	2	0.3
Petrol (n=1)	0	0.0	1	0.1	0	0.0

2.7 Expenditure on Alternative Sources of Energy

A positive pattern between the rich and the poor with regard to expenditure on electricity vis-à-vis alternative sources of energy is revealed in this study. It is clear that household, which spent less than 5000/= per month on different energy forms, spent the highest on kerosene and wood

fuel. For households, which spent between Ug.shs 5000-20000/= on energy sources, majority households spent it on charcoal, but also expenditure on electricity in this category starts rising. For households, which spent between Ug. Shs 20,000-50,000/= as well as those spending over 50,000/=, electricity consumes the largest share of the household budget on energy followed by charcoal. Households spending over 100,000/= on energy, spent it mainly on electricity and in a few isolated cases spent it on charcoal and kerosene. See Figure 3. As earlier observed, increased electricity tariffs are felt by those who spend much on electricity i.e., the very rich, but not the very poor.

Figure 3: Average monthly expenditure of 100,000/=+ on alternative sources of energy compared to electricity



Source: Household Survey

It has to be noted that very few households sampled used gas as an alternative source of energy. In households where gas is used, the expenditure is on average Ug.shs 25,000-30,000/= a month. Use of alternative sources of energy (charcoal, firewood) as a cultural preference was a reason reported by only 3% of the domestic consumers. This is contrary to the belief that majority of domestic consumers use such sources of energy to keep up cultural practices like cooking food the traditional way. Convenience of alternative source of energy and security of supply for instance, use of gas because it will always be available as opposed to electricity, which is subject to load shedding, was given as a reason by 23% and 20% of the respondents respectively.

2.8 Perceptions of Consumers and Key Informants on Electricity Tariffs and Billing System

The quantitative findings reveal that electricity tariffs are not high as compared to other utilities consumed by households except for water. The problem seems to be more of people's perceptions and attitude, lack of knowledge between a tariff and the bill coupled with the inefficiencies of UEDCL and WENRECO billing systems. Thus to counteract the outcry of high electricity tariffs, the issue of attitude and perception change on the part of the consumers has got to be addressed

and at the same time UEDCL and WENRECO have to address itself the current billing system. Below we present people's voices and the knowledge regarding the billing system to possibly serve as a basis for developing information campaigns by UEDCL and WENRECO.

All key informants especially in the sampled six districts were of the view that electricity bills were a big burden.

I have been moving around many parts of the country, even when on a different mission, people keep pleading, "please help, the power tariffs are chocking us", the tariff is unaffordable (Member of Parliament).

Over the last 2-3 years, selling charcoal and firewood has become a lucrative business here. Every year now many people are getting licenses from the Municipal council to trade in charcoal and firewood, which is also becoming like "a boda boda" business" (Deputy Town Clerk, Mbarara)

In a few instances, key informants although acknowledging that the tariffs were high, were quick to observe that lack of knowledge about the whole billing system by UEDCL and the inaccuracies therein were largely responsible for the perceived impact. From the household survey, 43% of the respondents did not understand the whole billing process. An equal percentage of household consumers surveyed also felt that the electricity bill does not reflect their actual power consumption, i.e. it is too high compared to the time of use of appliances. See Tables 11.

Table 11: Aspects of electricity bill not understood by domestic consumers

Aspects of Electricity Bill Not Understood by Domestic Consumers*	n=384	%
Whole process	166	43
Cost per unit	105	27
Meter reading	53	14
Computation of VAT (Value Added Tax)	40	10
The many components of the bill	13	3
Other aspects not understood	20	5

* *Multiple Responses Allowed*

Most domestic consumers observed that they often received wrong bills due to UEDCL's internal inefficiencies and the use of estimated readings. See Table 12.

Table 12: Why Electricity Bill does not reflect actual Power Consumption for Household Consumers

Why Electricity Bill does not reflect actual power consumption*	(n=429)	%
Bill high compared to time of use of appliances	189	44
Bill always estimated	83	19
New meters are too fast	18	4
UEDCL has internal inefficiencies	36	8
General perception that UEDCL are cheats	64	15
Other reasons	26	6

* *Multiple Responses Allowed*

About a fifth of the surveyed households (19%) were receiving estimated bills. Problems with the billing system were acknowledged by informants at UEDCL:

When estimates are made the bills issued are a bit higher than actual consumption. Between January and April 2004 there was a problem with the billing system, which has currently been sorted out (Ag. General Manager Technical & Customer Services, UEDCL).

To overcome the problem of the billing system, most of the key informants interviewed (except for UEDCL) suggested pre-paid billing as a way to manage electricity expenditure on the consumer side. The electricity utility companies have investigated the option of pre-paid billing and although they agree that it is a good option for areas not prone to power theft from illegal connections and meter bypassing, the companies maintain that the venture is not viable because of the high capital expenditure involved.

Pre-paid billing involves high capital expenditure and a communication link. It is not currently feasible and is regarded as a long-term investment. 100% pre-paid billing would not be suitable, for example Tanzania adopted the system but does not have 100% pre-paid billing and Kenya does not have any pre-paid billing at all (Ag. General Manager Technical & Customer Services, UEDCL)

Lack of information to the consumers regarding the tariffs was sighted as a reason why tariffs in the energy sector were greatly felt by the consumers.

Some of the negative observations made about the energy sector, and electricity tariffs in particular, are from people who are not well informed. People should be taught, for instance, how to read meters. Some get bills, which they cannot understand or are merely estimates (Commissioner of Energy, Ministry of Energy and Mineral Development)

The little information that is available, the way it is disseminated and packaged could be a source of negative sentiments on the part of domestic consumers.

You are selling your product, but at the same time you are telling me on how not to over consume it because I will pay high prices or that I consume it at certain hours when the prices are down! You see these fellows at UEDCL are ashamed... they know that their prices are high and hence telling us when to switch on water heaters, security lights, buying energy savers etc! (Deputy Town Clerk—Masaka)

A key informant at Uganda Consumers' Protection Association also noted lack of consumer education or the manner it is disseminated, and the agency responsible for disseminating information as key factors in influencing consumers' sentiments and attitudes.

Consumers lack information about tariffs and bills. When UEDCL instead of neutral ERA provides information to the consumers on how to reduce the power costs by instituting energy saving measures, it runs the risk of being suspected about its intentions (Executive Director, UCPA)

Key informants in the private sector pointed out the inefficiencies of the distributing company that result in poor quality of service which triggers negative sentiments on the part of the consumers.

*The question is, how long will electricity Distribution Company remain inefficient? There is a problem of poor accountability of power by the distributor; if you lose say 30-40% of it, you cannot break-even, even if it were any business. The distributor needs to curtail her losses so that there is enough power to sell even at a lower unit cost (**Executive Director, Uganda manufacturers Association**)*

2.9 Conclusion

The study findings have revealed that the electricity tariff is not as high to impact on the welfare of domestic consumers as compared to expenditure on other household utilities. Categories affected by the increases in tariffs are mainly the urban rich, implying that increased or increasing tariffs will have a progressive impact, and as a result this presents a scenario of income redistribution if resources could be channeled to provide electricity to as many people as possible. However, particular vulnerable groups who include rural poor need to be assisted where increased tariffs could affect their welfare.

Although domestic consumers report the burden of increased electricity tariffs, they have not directly sacrificed or forfeited consumption of other welfare household items such as selected food stuffs and beverages, communication, leisure, entertainment, medical care, school etc. Instead of forfeiting or sacrificing the above mentioned welfare items, domestic consumers adopt complementary strategies such as using charcoal, wood fuel, gas and limiting the use of electrical appliances that consume a lot of power. These complementary strategies might not necessarily be cheaper than electricity, but the system of pre-paid payment unlike for electricity does not make the consumer feel a burden. This appears to be exacerbated by what key informants referred to as “*lack of culture in this country for paying for services we have consumed*” (**Commissioner, Ministry of Energy and Mineral Development and Executive Director, UCPA**)

The complementary strategies if used excessively could have a potential impact on the welfare of the consumer, albeit, largely indirect as well as psychological comfort (e.g., using charcoal, kerosene oil and wood fuel).

3.0 IMPACTS OF CHANGES IN TARIFFS ON INDUSTRY AND COMMERCIAL ENTERPRISES

3.1 Industrial and Commercial Enterprises Scale of Operation

A total of 68 industries/firms were covered by the study; slightly over a tenth (12%) were large enterprises, over a fifth (22%) were medium sized, while 66% were commercial/small-scale industries. About 70% of the firms had been established before the year 2001, and hence they experienced both electricity price regimes (prior and after tariff increases) and the remaining 30% were new entrants after tariff changes.

3.2 Impact of Changes in Tariffs on Industry Over the Period 2001-2003

Majority of the firms reached (91%) use electricity as the major source of energy, and hence it would be assumed that they feel a great impact of tariff increases. However, the study results reveal that only less than a third (31%) reported reduced profits, while less than a fifth (19%) reported increased production costs. See Table 12.

Table 12: Increases in tariffs and impact on the performance of firms

Impact	Reporting firms			
	Yes		No	
	%	n	%	(n)
Reduced profits	30.9	21	69.1	47
Increased production costs	19.1	13	80.1	55
Reduced output	2.9	2	97.1	66
No effect	25.0	17	75.0	51
Others	1.47	1	98.53	67

It has to be noted that a quarter of all the firms/enterprises visited reported no effect of tariff increase on their performance, while in 60% of the firms it was affirmed that increase in tariffs did not affect the market prices of their final products. The response to such a question would of course depend on the type of good in question. This, however, shows that the impact on market prices is not that significant. Given that only a few firms reported increases in prices (10%), the impact on the macro economy would not be expected to be significant as a result of increase in electricity tariffs. These findings are corroborated by the views of key informants in the private sector.

I think the very big consumers; the bulk users of power, have been taken care of nicely in the new tariff structure, so I think tariff is not a problem (Chairman, Uganda Manufacturers Association—UMA)

However, for small and medium commercial consumers are not greatly benefiting from the tariff regime as their counterparts; the large industrial consumers as a key informant observed:

As a country we should be interested in offering lower tariffs especially to small and medium scale producers/industrialists because in this specific sector, we are not doing enough (Chairman, UMA)

On the whole, increase in electricity tariffs as a factor affecting industries was only reported in almost a third of all the enterprises, and mostly commercial consumers. See Table 13.

Table 13: Major problems faced by the firms

Major problems	Reporting firms			
	Yes		No	
	%	(n)	%	(n)
High electricity tariff	32.4	22	67.6	46
Load shedding	52.9	36	47.1	32
Poor transport system	7.4	5	92.6	63
Technical problems	23.5	16	76.5	52
Competition	11.8	8	88.2	60
Finances	23.5	16	76.5	52

Power outages rather than increased tariffs emerge out as the most outstanding problem faced by the industrial and commercial consumers as regards electricity. This is discussed in detail in Section 7.

Although majority of industrial consumers did not consider tariffs as a big problem, a future increase such as by 10% in tariffs would increase the production costs, and 96% of the firms were strongly opposed to further increases in tariffs. Many argued that this would impact on their competitiveness in the region. Some firms (11%) indicated that the opportunity cost of further increases in electricity tariffs would be labor reduction (human resource time) and wage reductions in order to take into account future increases.

Key informants at UEDCL corroborated the views of industrial consumers about the tariffs. For instance, on the issue of KVA billing for industries, a key informant observed that industries were paying much less now. Before the change in tariffs, KVA was billed at Ushs 10,000. Now for the first 2000kVA, the industry pays Ushs 3300/=, above that it pays Ushs 3000/= for each KVA. This is a much better rate for most industries.

3.3 Industrial/Commercial Use of Alternatives Sources of Energy

From the industrial and commercial consumers survey, less than a tenth (7%) reported to have changed from use of electricity to use of alternative sources of energy due to reported increases in electricity tariffs. This figure shows that effects of tariff increase in industries does not override costs of other inputs hence most of the industries could still afford to operate using electricity. See Table 14.

Table 14: Sources of Energy in use by Industries/Commercial Institutions

Sources of Energy*	(n=68)	%
Gas	10	15
Furnace fuel	8	12
Firewood	10	15
Diesel	25	37
Petrol	12	17
Electricity	62	91
Other sources of energy	4	6

* Multiple Responses Allowed

Less than a half (44%) of the industrial/commercial consumers reported the major reason for change in average monthly electricity consumption as electricity tariff changes.

3.4 The Billing System

Like their counter-part, the domestic consumers, industrial and commercial respondents noted difficulties with the billing system as shown in Table 15.

Table 15: Aspects of Electricity Bill not understood by Industrial and Commercial Consumers

Aspects of Electricity Bill Not Understood by Industrial & Commercial Consumers*	(n=28)	%
Calculation of cost per unit	8	29
Meter reading	8	29
Whole billing process	15	54
Balance carried forward	3	11

* *Multiple Responses Allowed*

The highest number of respondents in industrial and commercial enterprises (54%) did not understand the whole billing process, while 41% were of the view that electricity bills do not reflect their actual consumption.

3.5 Conclusion

The study findings have not revealed any apparent impact on industries and commercial enterprises as a result of the increase in electricity tariffs. This, however, does not mean that industrial and commercial consumers have no problems with UEDCL. They, for instance, cite billing inefficiencies as a major problem.

4.0 IMPACT FOR CONSUMERS AND INDUSTRY FOR FUTURE RELEVANT CHANGES IN TARIFFS AND IMPACT ON ECONOMY

4.1 Impact for Consumers for Future Relevant Changes in Tariffs

The analysis to investigate the implication of change in electricity tariff structures on consumers and industry was done in two stages. This was based on the objective function the dual tend to maximize. Whereas consumers maximize welfare for maximum satisfaction, industrialists maximize output in order to maximize profits in the event that prices are market determined.

To investigate the impact of changes in electricity tariffs on consumer's welfare, a simple regression model was used. The model involved consumer's welfare as a dependent variable and consumer's expenditures on charcoal, electricity and firewood as explanatory variables. It also included a random term to capture the other factors that infringe on consumer's welfare but not captured in the model. Consumer's welfare was proxied by expenses on food items, rent, water, health and education. These are assumed to reflect the basic needs of individual households and hence a measure of individual households welfare. Accordingly, the following equation was estimated

$$(1) \quad Lw_{el} = \beta_0 + \beta_1 Lcha + \beta_2 Lele + \beta_3 Lfw + \beta_4 Lpar + u_i$$

Where,

Lwel	=	log of welfare
Lcha	=	log of charcoal
Lele	=	Log of electricity
Lfw	=	log of fire wood
Lpar	=	log of paraffin, and
u_i	=	iid $\sim N(0, \delta^2)$

From equation (2), β_3 and β_4 are expected to bear positive signs while β_1 and β_2 are expected to bear negative signs.

Table 16: Estimation Results of Equation 1 on LWEL

Variable	Coefficient	t statistic
C	1.001982	2.585986**
LCHA	-0.058041	-2.857544*
LELE	-0.437737	3.680616*
LFW	0.294517	3.186216*
LPAR	0.514431	3.186216*

Adj R-squared = 0.9001, F-statistics = 1443.897 (0.000000), DW = 1.8089, N = 30.

Notes *, **, *** implies significance at the 1%, 5% and 10% levels of significance respectively.

Source: Computed from the Household Data.

At a 1% level of significance, the log of charcoal, log of electricity, log of firewood and log of paraffin are significant and bear the hypothesized signs. The high value of Adjusted R-squared implies that the variables included in the model explain 90 percent of the variations in the consumer's welfare. This implies that only 10 percent of the variations in consumer's welfare remain unexplained. The F-statistics value of 1443.897 with a probability of 0.000000 implies

that the model is highly significant and refutes the null hypothesis that all the right hand variables except for the constant are insignificant. The high value of DW statistic refutes the possibility of serial correlation presence in the model.

4.1.1 Impact for Consumer's for Future Relevant Changes in Electricity Tariffs

According to the study results, elasticity of consumer welfare to changes in electricity tariffs is 0.44 in absolute terms. This implies that a unit change in electricity tariff would change on average consumer's welfare by 0.44 units, holding other factors constant. The negative and low welfare elasticity of electricity demand suggests that electricity remains a necessity in consumer's welfare function and therefore alternative energy sources complement rather than substitute electricity usage.

4.1.2 Impact for Industry for Future Relevant Changes in Electricity Tariffs

To investigate the impact of changes in electricity tariffs on industry's production, a simple regression model has to be used. The model would involve industrial output as a dependent variable and industry's expenditures on capital inputs and labour as dependent variables. Expenditures on electricity would then be captured under capital input. It would also include a random term to capture the other factors that affect industrial output, but not captured in the model. The impact for industry for future relevant changes in electricity tariffs could not be estimated due to lack of data on industrial output, which could not allow for estimation of the model. Therefore, no quantification of the impact of changes in electricity tariffs on industrial production is attempted. Potential respondents from industries covered by this study kept promising to provide the required data, but after several "call-backs" and reminders without success, the exercise was called off.

4.2 Changes in Tariffs and the Effect on the Economy

The micro impacts on the households and the firms have been analyzed, however lack of an up-to-date and comprehensive input-output table or social accounting matrix for the country cannot allow for the quantification of the macro-economic impacts. Therefore, no quantification of the impact on prices and a change in composition of aggregate output, and impact of reduced subsidies on government expenditures and revenues is attempted.

However, from the theoretical point of view, the impact of increase in the electricity tariffs on the economy has two paths; the micro and macro impacts. At a micro level, that is, household's level, increase in electricity tariffs like any other tariff directly affects household's budget. Principally, increment in electricity tariffs calls for household's resource re-allocation as these increments generate new needs in an attempt to manage the increased expenses on electricity without straining the available resources. These range from investing in alternative sources of energy to adoption of coping strategies that entail non-use or low consumption of electricity whose adoption/ implementation calls for resource re-allocation. It is therefore not surprising that, though not direct, a few households in this study claimed to have sacrificed on the consumption of other welfare household items in order to meet increased electricity tariffs. At wider level, if households substitute for electricity with charcoal it has a further long-term environmental implication.

At a macro-level, electricity being an input in the production process, firm's output is directly affected by increment in electricity tariffs. Increment in electricity tariffs increases the costs of

production. As result, firms reduce their production, resulting in shortages on the output market. The result of this shortage is a rise in prices for consumable goods and services, which turns out to be a burden to consumers/households who finally bear the burden of production shifts. This reduces their consumer's surplus and consequently the welfare of all market participants. The extent to which the burden of increased electricity tariff is born by the consumer depends on the type of the goods produced and their respective elasticities of demand. A situation where elasticity of demand of the produced good is elastic, market prices of consumable goods would not increase, but instead, the producers bear the burden of increased electricity tariff. In this case, it is the profit of the producers that reduce. However, though many firms use electricity in their production process, the structure of the Ugandan economy is not so much electricity intensive. As a result, therefore not much of such increases can be transmitted to higher prices.

5.0 A COMPARISON OF TARIFFS IN THE REGION

5.1 Tariff Comparison in the East African Region

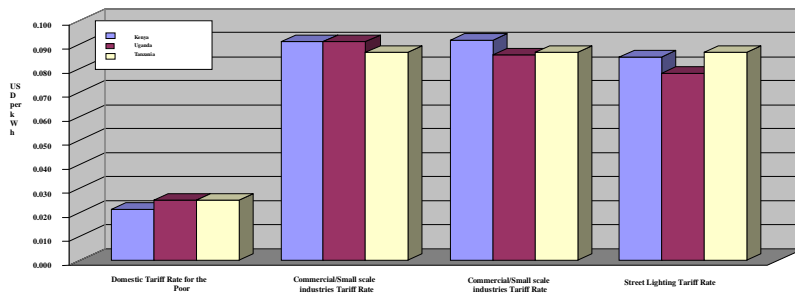
Tariff comparison in the East African region was done for Kenya, Uganda and Tanzania, within the scope of the study from 2001 to 2003. Within this period, Tanzania Electricity Supply Company Limited (TANESCO) last changed tariffs in April 2003, Electricity Regulatory Board (ERB) of Kenya last changed tariffs on 29th May 2000, and ERA of Uganda last changed tariffs on 30th June 2003. Tariff rates as of 1st June 2003 for the three countries were compared. It has to be noted that Uganda and Tanzania changed tariffs in 2004, which is outside the scope of this study. See Table 17 for tariff structure categories in the three countries.

Table 17: Tariff structure categories in the EA Region

Kenya	Tanzania	Uganda
Domestic	Poverty tariff	Domestic
Small Commercial & Industrial	General Use	Commercial
Medium Irrigation, Medium Commercial & Industrial	Low Voltage Supply	Medium Industrial
Large Commercial & Industrial	High Voltage Supply	Large Industrial
Interruptible Off-peak Supplies		
Street Lighting		Street Lighting

Kenyan and Tanzania tariff structures do not cater for off peak usage. There are no incentives for off peak consumption of electricity, unlike in Uganda where off peak tariff rates are lower for medium and large industrial users. See Figure 4.

Figure 4: Regional comparison of domestic and commercial tariff rates

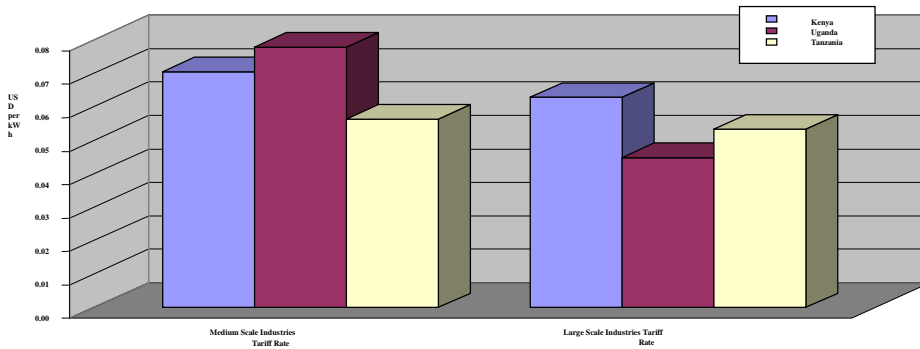


The first three bars in Figure 4 indicate the tariff catering for the poor in the three countries. Uganda has the highest tariff rate that caters for the poor i.e., lifeline subsidy, which means that Uganda offers the highest subsidy for its poor. Tanzania has a poverty rate, which caters for the first 100kWh, whereas Kenya caters for poor consumers with a provision for the first 50kWh and Uganda's lifeline subsidy rate caters for the first 15kWh. Although from Figure 4, Uganda has the highest tariff rate for the poor, it offers the smallest number of units under the poor's tariff rate, compared to the other two East African countries. Tanzania has a penalty charge for high domestic usage, which is the same as the general usage (equivalent of commercial usage in Uganda). This penalty is not there for Uganda and Kenya.

Kenya progressively increases tariffs as usage increases and has four levels under domestic usage. The comparison for similar domestic categories shows that Uganda has the lowest domestic, street lighting and commercial tariffs in the region. See Figure 4.

Kenyan industrial users are very large and hence consume a lot of power and at very high voltages beyond the large industrial enterprises of Tanzania and Uganda; hence in addition to medium industrial consumers, the regional comparison is restricted to large industrial users up to 33kV and 5GWh. See Figure 5.

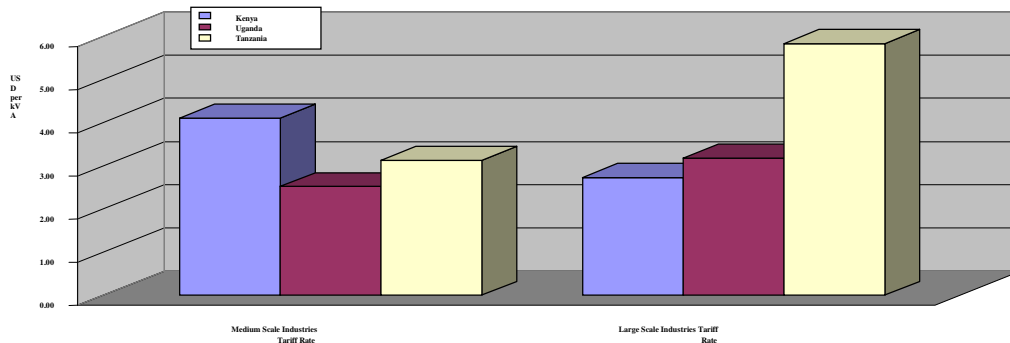
Figure 5: Regional comparison of medium and large-scale industrial tariff rates



It should be noted further that Kenya also has a categories for medium irrigation and interruptible off peak supply consumers which have no equivalent in Tanzania and Uganda and hence no comparison has been made for this category. From figure 5, Uganda has the lowest large industrial retail tariff but the highest medium industrial retail unit tariff in the region. This strengthens the findings in Figure 12, section 7.4.2 that commercial, small scale and medium scale consumers in Uganda visibly reacted to tariff increase in June 2003 especially.

A large portion of industrial electricity bills is from kVA demand charges, hence a comparison of kVA demand charge tariff for the three countries, has been presented in Figure 6. Uganda has the lowest kVA demand tariff for medium scale industries but has the second lowest kVA demand tariff for large-scale industries.

Figure 6: Regional comparison of KVA demand charges



5.2 Tariff Comparison Between EA and SADC

Apart from comparing tariffs in the East African region, an attempt was made to carry out a comparison between countries in the EA region and those in SADC. With the exception of South Africa, all the other countries are quite comparable in terms of per capita income between the range of 240 and 360, except for Malawi at 160 USD, and inflation rate in single digit figures except for Zambia and Kenya in two digits. Zimbabwe on the other hand has a very high inflation rate. See Table 18.

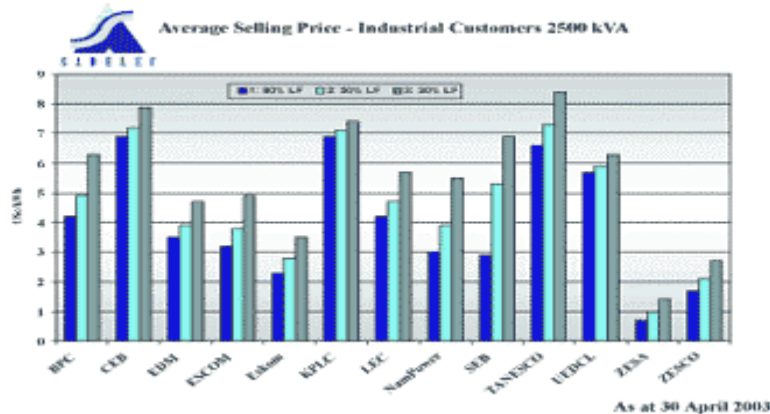
Table 18: Shows the per capita incomes and inflation rates in the countries being compared

	Uganda	Kenya	Tanzania	Malawi	Zimbabwe	Zambia	South Africa
GNP/CAPITA	240	360	290	160	587	330	2600
CPI inflation	5.9	12.4	5.3	5.0	420	18	5.8

Source: African Development Report 2004

Figure 7 illustrates electricity prices expressed at the exchange rates as of 30th April 2003, that industrial consumers could pay for a 2,500kVA load for three different load factors. Uganda has competitive and low tariffs for the large and extra-large industries, but her domestic tariffs are comparatively high in the region. Domestic consumers in Uganda are required to pay about 10 US cents per unit compared to about 2 US cents in Malawi. In all consumer categories, the tariff rates in the SADC region are the lowest. This could be explained by the presence of a more efficient producer and distributor (ESKOM - South Africa) of electricity in the region.

Figure 7: Average Selling Price—Industrial Customers 2500 KVA



Source: Espinheira Tino (2003)

With regard to fixed monthly charges, Uganda has among the lowest, while Kenya and Zambia have the highest especially for the industrial sectors (extra large and large industries). Malawi and Tanzania equally have competitive monthly charges.

It has to be noted that industrial and commercial enterprises are the major consumers of electricity and therefore industrialist in the private sector take a keen interest in the comparison of tariffs in the region so as to compete fairly in the market. Key informants in this study were quick to compare with the tariffs in South Africa, which are lower.

Industrialists are very conscious of power tariffs in the region because they need to compete fairly...they compare the power rates and say...goods from S. Africa produced at power rate of 2-3 cents and Uganda's at 7 cents are going to the same regional market; how are you going to compete? (UMA Executive Director)

5.3 Conclusion

From the regional comparison of tariffs, Uganda has the lowest retail tariff rates for all but medium industrial consumers. Uganda's monthly service charges for all categories of consumers are also the lowest in the region. It should also be noted that the kVA demand charge for Kenya's large industrial sector is lower than Uganda's for the equivalent sector.

6.0 PRICE SIGNAL, TIME OF USE AND ALTERNATIVE SOURCES OF CONSUMPTION

6.1 Price Signal in Time of Use Tariffs for Changes to off-Peak Hours of Electricity Consumption

The study investigated the level of price signal in time of use tariffs that can lead to changes to off-peak hours consumption. The study findings as shown in Table 19 indicate that the highest number of industries worked between 7a.m and 7p.m and for 24hours. Both these periods were each reported for 29% of the industries visited for the year 2001.

Table 19: Production Hours of Industries and Commercial Enterprises

Production Hours	Year 2001		Year 2002		Year 2003	
	N=51	%	n=58	%	n=65	%
7a.m.-7p.m.	15	29	15	26	15	23
8a.m.-5p.m.	8	16	10	17	11	17
7a.m.-7a.m.	15	29	17	29	19	29
Other hours	13	26	16	28	20	31

In the year 2002 the number of industrial consumers working outside stipulated hours rose from 26% to 28%, which is viewed as a slight increase. However, there was a drop from year 2001 to year 2002 and 2003 for industries working between 7a.m and 7p.m. On the contrary, there was an increase in production outside normal hours from year 2001 to year 2003. The change in production was due to reduction in production hours, cost cutting measures and tariff changes. Changes in electricity tariffs were, however, not a major reason for change in production hours.

The current tariff levels and price signals are not high or prohibitive enough to cause a change in production hours, in an attempt to accommodate the tariff increases or new price signal levels. This could be attributed to the fact that production expenses are not largely or only dependent on electricity input. From the study findings, change in production hours was attributed to reduction in production levels by 12% of the 68 industrial and commercial consumers.

For medium scale industries the retail cost of off peak consumption is 48% lower than retail cost of normal consumption hours. For large industries the retail cost of off peak consumption is 37% lower than retail cost of normal consumption hours. Further still the tariff increase from June 2001 to June 2003 for medium scale industries for normal consumption hours was 48% and that for off peak consumption was 48%.

Similarly tariff increase from June 2001 to June 2003 for large industries for normal consumption hours was 28% and that for off peak consumption was 12%. There was an effort to keep tariff increases for off peak consumption as low as possible to encourage industries to shift to off peak usage of electricity, but from the study findings, tariff changes did not impact on change in production hours. But a look at electricity consumption of both medium and large industries in Section 7.0 shows that medium scale industrial consumers reacted to the June 2001 price increase by reducing consumption; whereas for large industrial consumers, the two price increases in June 2001 and June 2003 did not lead to adverse reactions from the consumers. Looking at it from the price signal point of view, the June 2001 increase was a suitable price signal for medium scale industrial consumers as it caused consumers to check and then reduce their consumption visibly.

On the other hand a suitable price signal that would cause large industrial consumers to reduce consumption during peak hours had not been set prior to December 2003. Note that the January 2004 tariff changes have not been analysed since these fall outside the scope of this study and the time frame is too short for their impact to be felt.

Prior to December 2003, there were no price signals for commercial/small scale industrial consumers. These have been introduced with the time-of-use meters effective January 2004. Time-of use meters have been in use effective January 2004, a period that falls outside the scope of this study. They have not been in use long enough for their impact to be felt.

Domestic consumers pose the greatest strain on the network during peak hours from 7p.m. to 10p.m. This has been established from the consumer end point by developing a load curve from consumer responses (See Section 7.0). However there are no price signals for domestic consumers. Setting price signals would necessitate installation of time-of-use meters, a capital expenditure that has to be investigated to established viability and whether it will reduce demand during peak hours and reduce the need for load shedding as generation capacity is increased in the long term.

6.2 Price Signal in Time of Use Tariffs for Changes to Alternative Sources of Energy Consumption

From the industrial and commercial enterprises survey, 5 (7%) out of 67 industries/commercial firms sampled had changed from use of electricity to use of alternative sources of energy due to increases in electricity tariffs. This is a small percentage implying that the effects of tariff increase in industries does not override costs of other inputs hence most of the industries could still afford to operate using electricity. Thus the price signals set between June 2001 and June 2003 for industrial consumers peak electricity usage were not prohibitive enough to cause industrial consumers to shift to alternative sources of energy.

6.3 Conclusion

In conclusion, for medium and large scale consumers, a suitable price signal would be a retail unit tariff rate for peak consumption, equal or greater than that set during June 2001 tariff increases. This was of Ug.shs171.6 per kWh for medium industrial consumers at peak consumption hours and Ug.Shs104.4 for large industries' peak consumption. However the price signal level should be adjusted to cater for inflation. June 2001 tariff increase has been selected as a reference for setting price signals because according to UEDCL data (Figure 12 section 7.4.2), medium industrial consumers visibly reacted to this tariff increase by reducing consumption. Clearly, the current industrial tariff levels for normal consumption hours are not high or prohibitive enough to cause a change in production hours or change to alternative sources of energy, in an attempt to accommodate the tariff increase or new price signal levels. This could be attributed to the fact that production expenses are not largely or only dependent on electricity input.

7.0 CHANGES OF TARIFFS AND EFFECT ON QUANTITY AND QUALITY OF ELECTRICITY CONSUMED/PRODUCED

7.1 Security of Electricity Supply and Load Shedding

Analysis of security of supply will help put in context available electricity supply. From January 2001 to June 2002, total installed generation capacity in Uganda was 263MW. Nalubaale power station has an installed capacity of 180MW; Kiira power station had an installed generation capacity of 80MW until June 2002 when this was increased to 120MW. Maziba installed generation capacity is 1MW and thermal installed generation capacity is 2MW. From June 2002, to-date total installed generation capacity has remained at 303MW, yet demand growth rate for upcountry substations is 4%, and that of Kampala and Entebbe is 7.4%. The national demand growth rate is 8% (Source: UETCL, June 2004). Accordingly, demand does not much supply, while at the same time demand growth rate is high yet installed capacity has not increased, necessitating load shedding. Installed capacity was only beefed up at Kiira power station by 40MW in June 2002.

Load shedding is a major issue facing the electricity industry in Uganda. Throughout the survey respondents complained about load shedding, and indeed majority-lacked knowledge on the rationale behind load shedding. Slightly over a third of the domestic consumers (35%) reportedly knew the rationale behind load shedding. See Table 20.

Table 20: Reasons for load shedding

Reason for Load Shedding*		
	n=257	%
Cope with high demand for power	153	60
Repair power lines/generators	33	13
Have surplus for export	25	10
Other reasons for load shedding	26	10
Limit amount of electricity	21	8
Save power processing industrial plants	19	7

* *Multiple Responses Allowed*

Whereas a large percentage of the household respondents knew the reasons for load shedding, a quarter of the respondents (25%) attribute load shedding to the need for surplus power for export and industries. Majority of both household and industrial/commercial respondents did not see any justification for load shedding; 66% and 78% respectively. The reasons given by the industrial and commercial consumers for load shedding included coping with demand for power (60%) and repair/maintaining of power lines/generators (38%).

On the level of awareness on measures that can lead to reduction of load shedding, and practices that can be adopted, domestic and industrial/commercial consumers exhibited varied knowledge. For instance, majority of domestic consumers (73%) reported switching off lights not in use as a measure, and of these 81% were adopting the practice. See Table 21.

Table 21: Level of awareness and practices adopted to reduce load shedding by domestic consumers

Measures	Level of awareness (n=257)		Households adopting the practice (n=64)	
	(n)	%	(n)	%
Use of water heaters between 2p.m. and 5p.m.	44	17	1	2
Ironing between 2p.m. and 5p.m.	64	25	4	6
Use of energy saving bulbs	168	65	26	41
Switching off lights not in use	188	73	52	81
No idea	19	7	6	9
Other methods for reducing load shedding	38	15	5	8

In Table 21 it can be noted that of the domestic consumers with knowledge on the measures that can reduce load shedding, a big proportion (65%) reported use of energy saving bulbs, although only 41% had adopted the practice due to high costs. It is worthy noting that awareness of use of water heaters and ironing between 2.00p.m and 5.00p.m as a measure to reduce need for load shedding was low and practiced by very few households.

In relation to industrial/commercial consumers and measures adopted that can reduce load shedding, it is noted that use of time of use meters had not picked up, although in less than a half of the enterprises' respondents (45%) were aware of their usefulness in reducing the need for load shedding. Respondents were instead reporting in big numbers measures such as use of energy saving bulbs and switching off lights not in use, which were at the same time being adopted. However, production during off peak hours is really what would reduce the need for load shedding, although this was reported in less than a half (48%) of the industrial/commercial enterprises. See Table 22

Table 22: Level of awareness and practices adopted to reduce load shedding by industrial/commercial consumers

Measures	Level of awareness (n=40)		Industries/Commercial adopting the practice (n=40)	
	(n)	%	40	%
Time of use meters	18	45	10	25
Production during off-peak hours	19	48	8	20
Use of energy saving bulbs	29	73	23	58
Switching off lights not in use	26	65	24	60
Power factor correction	12	30	2	5
Other practices	3	8	1	3
Do not know	1	3	9	23

Industrial and commercial consumers have not yet recognized that production during off-peak hours can aid demand management and reduce need for load shedding. This could be attributed to the fact that industries found in demarcated industrial areas are not affected by load shedding.

7.2 Reliability of Electricity Supply

7.2.1 Reliability Indices

Reliability indices have been calculated from power outage data obtained from UEDCL. Reliability indices have been calculated for each of five selected districts⁸ at the 11kV and 33kV feeder level. See also Appendix 5. The data does not include power outages due to load shedding; as load shedding is a planned power outage that is communicated to the consumers prior to its occurrence. These have been compared where possible with those of Mozambique, another African country and with the IEEE (Institution of Electrical & Electronic Engineers, USA) standards. There is a concern of the accuracy of the data presented by UEDCL, for there is no clear match between the district feeder numbers from UEDCL and the feeder names from UETCL, yet the power outage data were obtained from SCADA information from UETCL and number of customers per feeder was obtained from UEDCL data. For purposes of this study, however, attempts have been made to match the data together with personnel from UEDCL, but the figures should be taken as indicative only.

Table 23: Reliability Indices

Reliability Index	Kampala			Jinja			Masaka			Mbale			Mbarara			IEEE Standard 1366	Mozambique
	'01	'02	'03	'01	'02	'03	'01	'02	'03	'01	'02	'03	'01	'02	'03	1998	1999-2001
SAIFI (frequency)	6.0	6.0	9.0	0.91	1.2	3.0	1.9	2.5	4.1	11.6	15.6	11.7	9.2	10.4	8.4	0.90 – 1.45	60-75
SAIDI (hours)	12	10	24	4	9	19	9	13	17	237	76	32	32	29	26	0.89 – 2.30	30 - 50
CAIFI (frequency)	166	158	236	11	14	35	21	28	45	136	177	132	105	119	97	-	-
CAIDI (hours)	1.9	1.6	2.6	4.7	7.5	6.3	4.8	5.3	4.2	20.5	4.9	2.7	3.5	2.8	3.1	-	0.5 – 0.78

SAIFI (System Average Interruption Frequency Index) gives information on average frequency of sustained interruption per customer served in the given area. Although the SAIFI indices for selected districts in Uganda (Table 23) are not as high as Mozambique's network's SAIFI they are still much higher than the IEEE standard set. Only Jinja district registered a SAIFI lower than IEEE standard in 2001 and 2002.

SAIDI (System Average Interruption Duration Index) measures the total duration of interruptions in hours. SAIDI for all selected districts is very high, way above the standard set by IEEE (Table 23). However SAIDI for selected districts in Uganda are lower than SAIDI for Mozambique.

CAIFI (Customer Average Interruption Frequency Index) gives information on average frequency of sustained interruption per customer interrupted in the given area; each customer is counted only once regardless of the number of times he experiences interruption. It is not a commonly used index hence the IEEE standard and Mozambique value is not given in Table 23.

CAIDI measures the average repair time, i.e. the time it takes to restore power after an interruption. The Mozambique network had a CAIDI ranging from 0.5 – 0.78 hours, which is way below CAIDI in selected districts of Uganda. Restoration time after an interruption is quite

⁸ Reliability indices for Arua were not calculated due to unreliable data.

high in the selected districts of Uganda. CAIDI is not a commonly used index hence the IEEE standard is not given in Table 23.

From the reliability indices above, it will be seen that the UEDCL network experiences frequent power outages coupled with high restoration time outside the industry norm as set by IEEE standard. However, it is recognized that this is an old network, with new loads connected to old transformers and prone to overloading coupled with aged cables, switching and protection gear, hence the comparison was made with another African country, Mozambique. Although the frequency of interruptions is not as high as that of Mozambique, the restoration time is much lower.

7.2.2 Power Outages

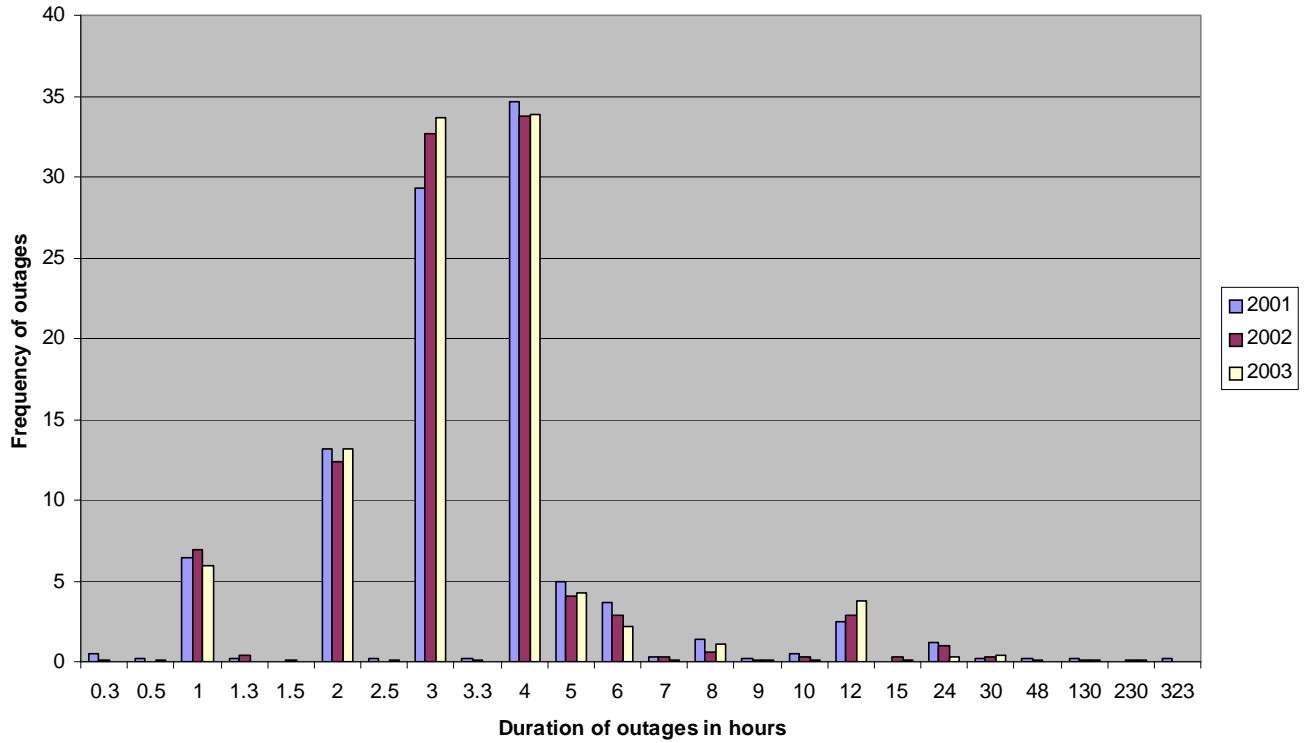
In addition to calculation of reliability indices using data from UEDCL, consumers were asked to report on own experience with power outages. See Table 24. Most power outages occurred once in two days for domestic consumers from 2001 to 2003; and for industrial and commercial consumers once in two days in 2003, which is a high frequency that confirms the high SAIFI values in Table 23. According to the survey, occurrence and frequency of power outages does not differ much when moving from 2001 to 2003. See Table 24.

Table 24: Frequency of power outages by consumer category

Frequency of outages	Year and consumer category					
	2001		2002		2003	
	Domestic (n=654) %	Ind/Com (n=49) %	Domestic (n=654) %	Ind/Com (n=59) %	Domestic (n=654) %	Ind/Com (n=63) %
Daily	31	8	29	7	216	3
Once in two days	35	31	34	29	237	35
Once a week	20	33	22	34	141	29
Rarely	14	29	15	31	120	33
Never	0.5	0.0	0.6	0.0	9	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

The biggest number of consumers reported power outages as occurring once in two days. The results of the household survey indicate that occurrence and frequency of power outages did not differ much between 2001 and 2003. Household consumers rated three-four hours as the highest duration of power outages (Figure 8).

Figure 8: Duration of outages at the domestic consumption level



Industrial and commercial consumers reported two–four hours duration of power outages highest. See Table 25.

Table 25: Duration of Power Outages from Industrial and Commercial Survey

Duration of Outage	Year 2001	Year 2002	Year 2003
	(n=47) %	(n=56) %	(n=60) %
1	15	13	18
2	28	23	13
3	21	25	35
4	26	29	22
5	6	5	7
6	2	2	2
8	2	4	3

It should be noted that power outages due to causes other than load shedding are masked by the high degree of load shedding for domestic consumers and they might not feel the impact of the unreliable network. See also Table 26.

Table 26: Causes of Power Outages

Cause of Power Outage*	Domestic consumers		Industrial/commercial consumers	
	N=735	%	n=68	%
Load shedding	579	80	60	88
Electric fault on power line	141	19	46	68
Transformer problem	107	15	16	24
Disconnection due to non-payment of bills	53	7	6	9
Repairs undertaken by utility company	107	15	32	47
Natural disasters	96	13	18	27
Other reasons	87	12	3	4

* *Multiple Responses Allowed*

Since load shedding was rated as the highest cause of power outages for both domestic and industrial/commercial consumers, the survey results cannot be compared to SAIFI and CAIDI indices derived earlier which do not take load shedding into consideration.

7.2.3 Voltage Fluctuations

Table 27 shows the frequency of voltage fluctuations from 2001 to 2003 for both the domestic consumers and the industrial/commercial consumers. Frequency of voltage fluctuations did not vary between 2001 and 2003. Voltage fluctuations were rare as shown in the Table 27.

Table 27: Frequency of voltage fluctuations

Frequency of voltage fluctuation	Year and consumer category					
	2001		2002		2003	
	Domestic (n=660) %	Ind/Com (n=52) %	Domestic (n=697) %	Ind/Com (n=60) %	Domestic (n=725) %	Ind/Com (n=65) %
Daily	22	10	19	12	19	9
Once in two days	14	17	15	17	12	9
Once a week	14	6	16	5	12	12
Once a month	10	10	9	12	9	14
Rarely	34	42	35	43	39	43
Never	6	15	5	12	8	12
Others	0.6	0.0	0.4	0.0	0.4	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

7.2.4 Power Surges

Table 28 shows the frequency of power surges between 2001 and 2003. Like fluctuating voltage, power surges were also rare for both the domestic and industrial/commercial consumers.

Table 28: Frequency of power surges by category of consumer

Frequency of power surges	Year and consumer category					
	2001		2002		2003	
	Domestic (n=655) %	Ind/Com (n=20) %	Domestic (n=693) %	Ind/Com (n=57) %	Domestic (n=724) %	Ind/Com (n=61) %
Daily	8	4	7	7	9	3
Once in two days	13	17	13	16	8	10
Once a week	10	10	10	9	8	10
Once a month	10	8	9	9	12	8
Rarely	45	40	46	39	47	49
Never	13	21	14	21	17	20
Others	0.3	0.0	0.1	0.0	0.1	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

The danger with power surges is the loss of household and industrial/commercial electrical equipment. In this study, 42% of the domestic consumers indicated that they had lost household equipment due to power surges. Likewise 54% of the industries/commercial enterprises covered by the study had lost machinery due to power surges. Further, 53% industries and commercial enterprises had experienced machinery downtime due to power surges or low voltages. This would imply that machinery was lying idle due to low voltage or lost as a result of power surges and hence increased cost of production.

7.3 Backup Sources of Energy

Given the insufficiency of electricity both in terms of quantity and quality, consumers resort to backup sources of energy to supplement inadequate and unreliable electricity supply. The findings of the study reveal that majority of domestic consumers (84%) were using kerosene oil as a backup, while almost a half of the industrial/commercial consumers were using diesel. See Table 29.

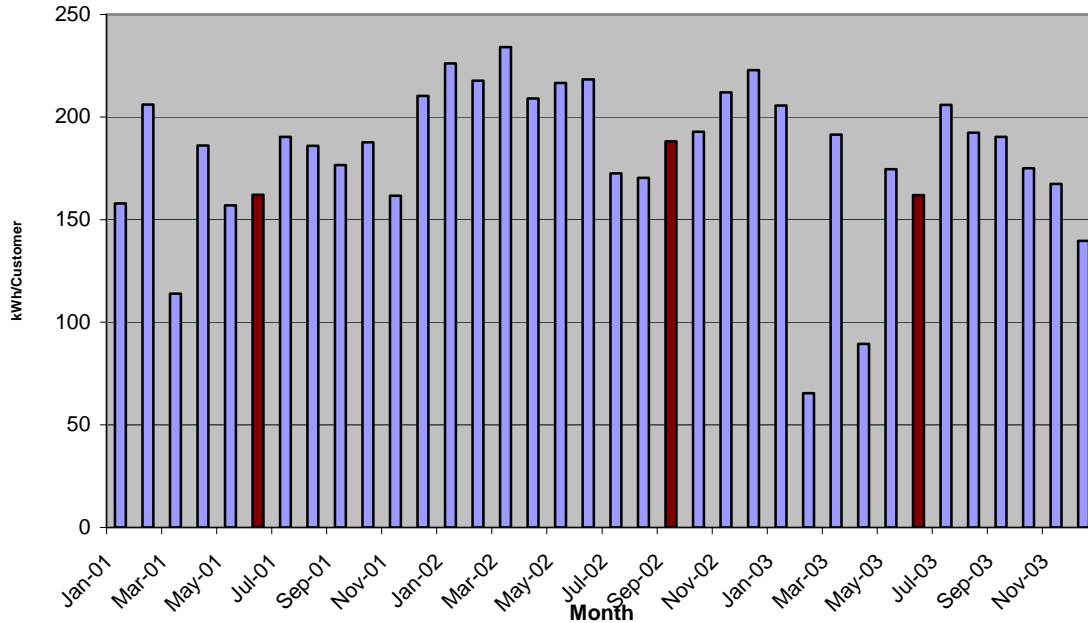
Table 29: Usage of backup sources of energy by consumer category

Backup Source of Energy		
Domestic Consumers	n=735	%
Dry cells	271	37
Car battery	17	2
Kerosene	616	84
Candles	338	46
Diesel	12	2
Charcoal	451	61
Gas	52	7
Petrol	12	2
Solar energy	15	2
Firewood	120	16
Other sources of energy	42	6
Industrial/Commercial Consumers	(n=68)	%
Batteries	3	4
Diesel	33	49
Gas	4	6
Furnace fuel	0	0
Petrol	12	18
Solar Energy	0	0
Firewood	2	3
No backup source of energy	19	28

7.4 Average Monthly Electricity Consumption with Changes in Tariffs

7.4.1 Domestic Consumption

From the household survey, majority (79%) of domestic consumers reported changes in their monthly bill electricity consumption, which they attributed to changes in tariffs. Almost a fifth (19%) attributed the changes to variations in equipment used. An attempt was made to verify the responses by carrying out an analysis of UEDCL billing data of the months of June 2001, September 2002 and June 2003 when tariff increases were effected. See Figure 9.

Figure 9: Electricity Billed to Domestic Consumers⁹

Source: UEDCL, 2001 -2003

After June 2001 tariff increase, electricity consumption increased and then decreased till March 2002 after which a downward trend in consumption is evident. After the tariff increase in September 2002, the decrease in consumption occurred four months later, starting in December 2003. However consumption peaks up again in July 2003, and after July 2003 a steady decrease in electricity consumption occurred.

It is clear that the reaction to tariff increases by domestic consumers was not immediate. After June 2001 increase in tariffs, consumers did not react adversely and consumption went up and down in the subsequent months hence the tariff increase did not impact much on the domestic consumers. However after the tariff increase in September 2002, there are signs of domestic consumer reduction of consumption four months later; however this was not sustained as consumption peaked in July 2003. Again domestic electricity consumption was not adversely affected by the increase in tariffs in September 2002. After the tariff increase in June 2003, consumers steadily reduced consumption; this particular tariff increase affected consumers and caused them to decrease electricity consumption.

Examining the details of power installed in sampled districts, Table 30 shows that households sampled registered high simultaneity coefficient. This implies that over 95% of the electrical

⁹Billing data from Arua was available for only July 2003, August 2003, and from January 2004 to April 2004, which is out of the research scope. The 2003 data was insufficient to analyse quantity of electricity consumed in Arua, hence this has not been included in this section.

equipment installed is actually being used, implying that tariffs have not forced people to abandon use of appliances. Simultaneity coefficient increased from 0.94 to 0.97 between 2001 and 2003, thus households were increasingly using installed electrical equipment. Peak usage factor was 0.37 in 2001, which translates to a peak usage length of about 9 hours a day. This implies on average the households sampled were using power for about 9 hours in a day.

Demand factor was 0.43 in 2001, which indicates that on average the households sampled were well equipped with electrical equipment of a wide range that is normally not operated at the same time. It should be noted that demand factor decreases as number of electrical equipment in the household increases. Households with very little electrical equipment will have a high demand factor as at a certain point in the day; they will operate every piece of equipment likely to use electricity.

Table 30: Analysis of Power Installed in Households

	2001	2002	2003
Power in Use	1,525,794 kW	1,600,106 kW	1,667,309 kW
Power installed	1,628,936 kW	1,667,309 kW	1,716,935 kW
Simultaneity Coefficient	0.94	0.96	0.97
Peak usage factor	0.37	0.38	0.39
Demand factor	0.43	0.46	0.45

However, although over 95% of installed equipment was in use, regularity of use was low for equipment with high power rating as shown in Table 31.

Table 31: Reduction in Use of Electrical Equipment

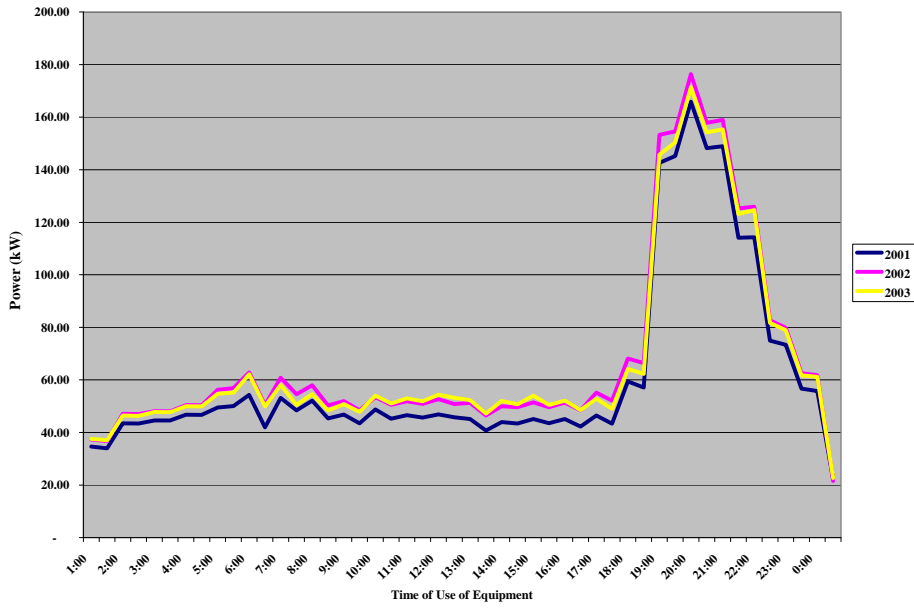
Equipment	Equipment Rating	2001		2002		2003	
			%		%		%
Electric Cooker/ oven	5Kw	53 (n=139)	38	60 (n=141)	43	86 (n=145)	59
Hot plate	2kW	50 (n=107)	47	8 (n=61)	54	70 (n=117)	60
Water Heater	1.5Kw	20 (n=87)	23	27 (n=95)	28	43 (n=101)	43
Electric kettle	2.2Kw	69 (n=246)	28	95 (n=270)	35	125 (n=283)	44

Domestic consumers reduced use of equipment with the highest power rating. Notable was the electric cooker and hotplate where by 2003, 60% of the hotplates and electric cookers owned were largely irregularly used.

7.4.1.1 Daily load curves

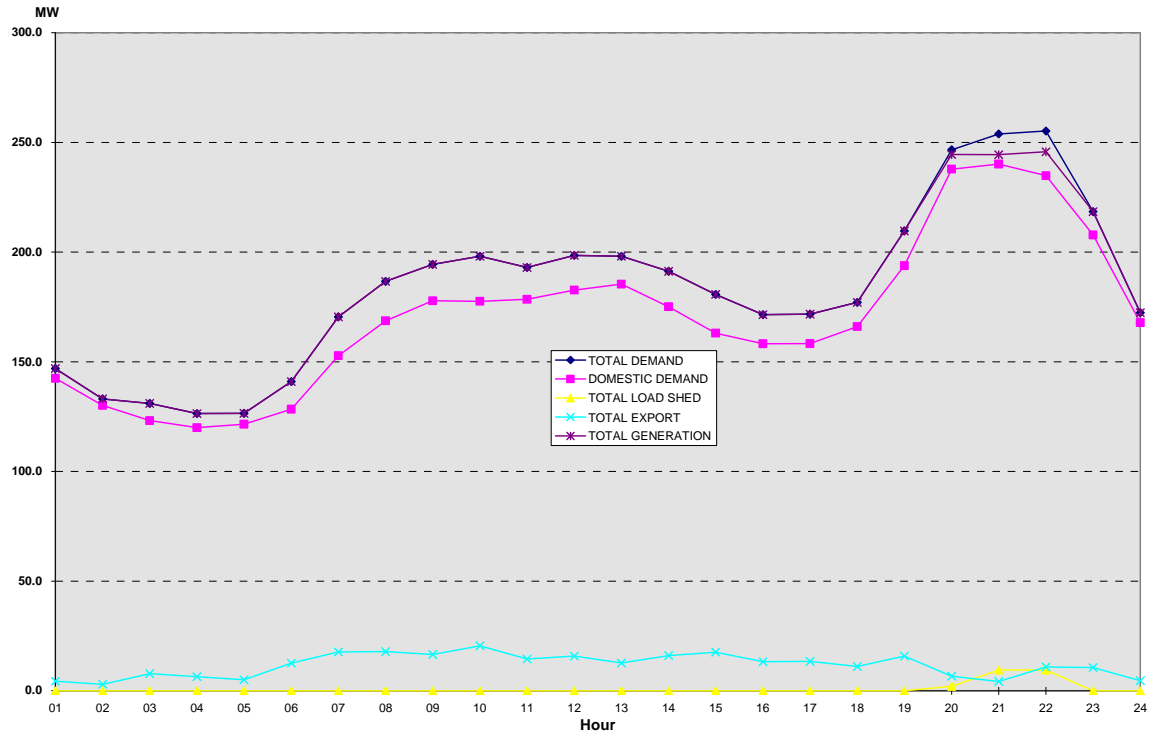
The household load curve was constructed from data on time of use of electrical equipment as obtained from the household questionnaire. See Figure 10. An assumption was made that all appliances operate at maximum power.

Figure 10: Household load Curve 2004



Source: Household Survey

The daily load curve shows that peak usage of electricity occurs between 1900hours and 2300hours. This is confirmed by the similar trend for the national load curves in Figure 11 and those in Appendix 9.

Figure 11: Daily National Load Curve for December 2001

Source: UETCL, December 2001

7.4.1.2 Status of household electrical installations

High power consumption can be attributed to system losses at low voltage distribution level. The household installations were inspected, and the findings generally revealed that installations were in good condition with wires enclosed in the meter boxes and main switches. See Tables 32 and 33.

Table 32: Status of Electrical Installations in Meter Box

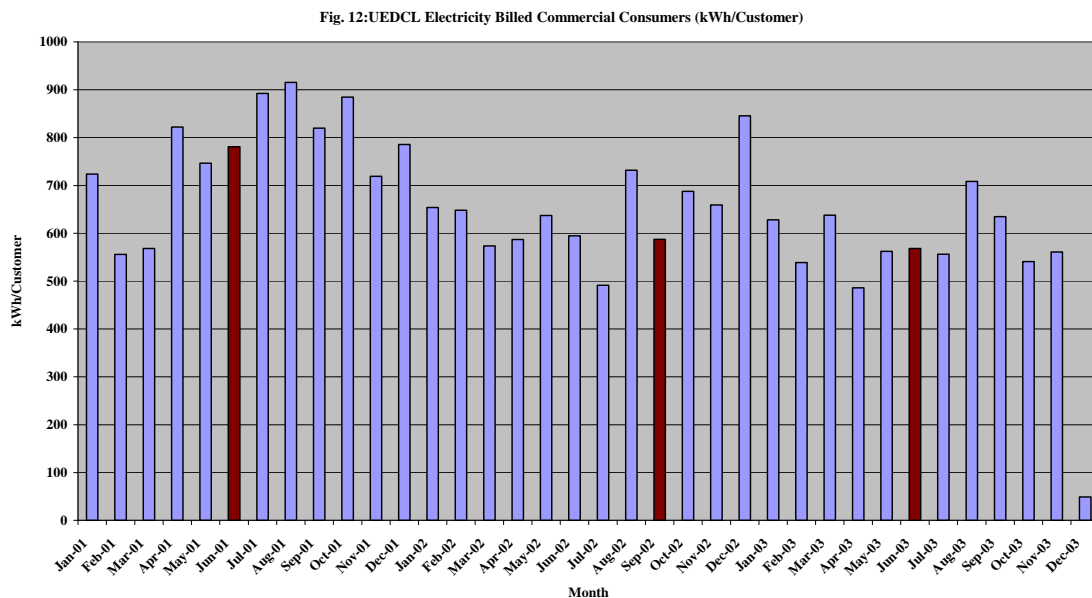
Status of Electrical Installations in Meter Box	n=735	%
All wiring enclosed in meter box	606	82
Wiring tied with insulation tape	128	17
Wiring intact with no insulation tape	179	24
Wires hanging outside meter box	61	8
Bare wires evident	103	14
No meter box	44	6
Circuit breaker in place	295	40
No circuit breaker, uses wires	126	17

Table 33: Status of Electrical Installations in Main Switch

Status of Electrical Installations in Main Switch	n=735	%
All wiring enclosed in main switch	647	88
Wiring tied with insulation tape	87	12
Wiring intact with no insulation tape	182	25
Wires hanging outside main switch	36	5
Bare wires evident	15	2
No main switch	35	5

7.4.2 Electricity consumption by industrial/commercial consumers as a result of tariff increase

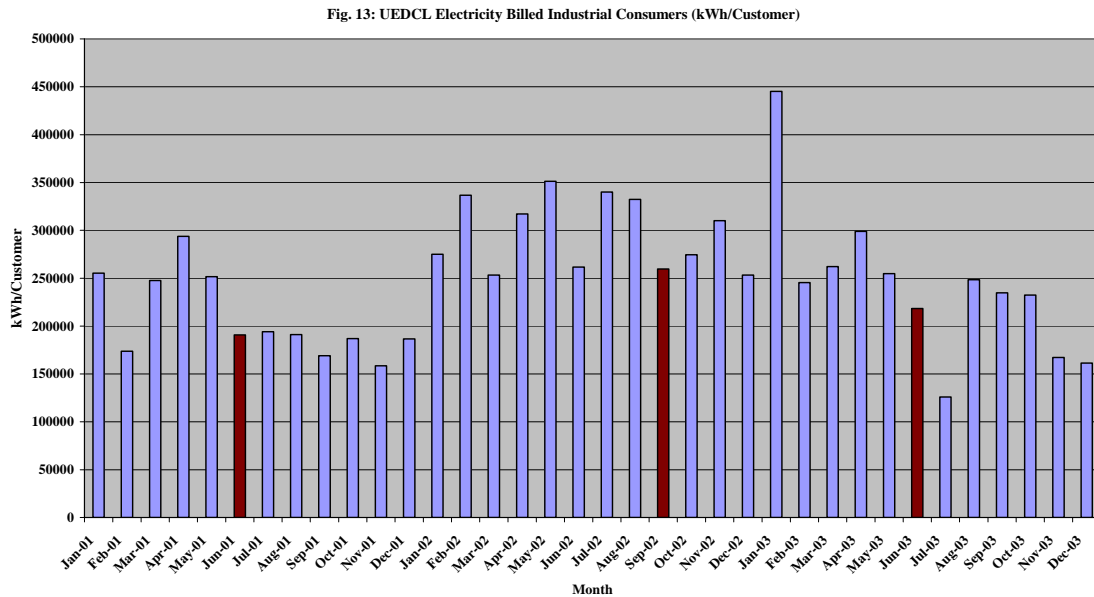
Figure 11 shows trend of commercial consumers from January 2001 to December 2003. It is revealed in this study that consumption increased slightly after the June 2001 tariff increase, and after August 2001, consumption started decreasing steadily up to July 2002. See Figure 12. The increase in retail tariff was extremely high (about 129%) for low voltage commercial consumers. There was a peak in August 2002 followed by a deep in September 2004, the month when tariffs were decreased by about 11%. However, electricity consumption went on decreasing, as was the trend prior to September 2002, except for a peak in December 2002. The second tariff increase was in June 2003 after which a peak in consumption is registered in August 2003 and thereafter a steady decrease up to November 2003. December 2003 consumption is very low and can be explained by other reasons other than high electricity tariffs. Commercial/medium scale industrial consumers reacted to increase in tariffs by reducing their consumption. The impact of increase in tariffs is felt one to two months after the increase had been effected, after which a downward trend in consumption is noticeable.



Source: UEDCL, 2001-2003

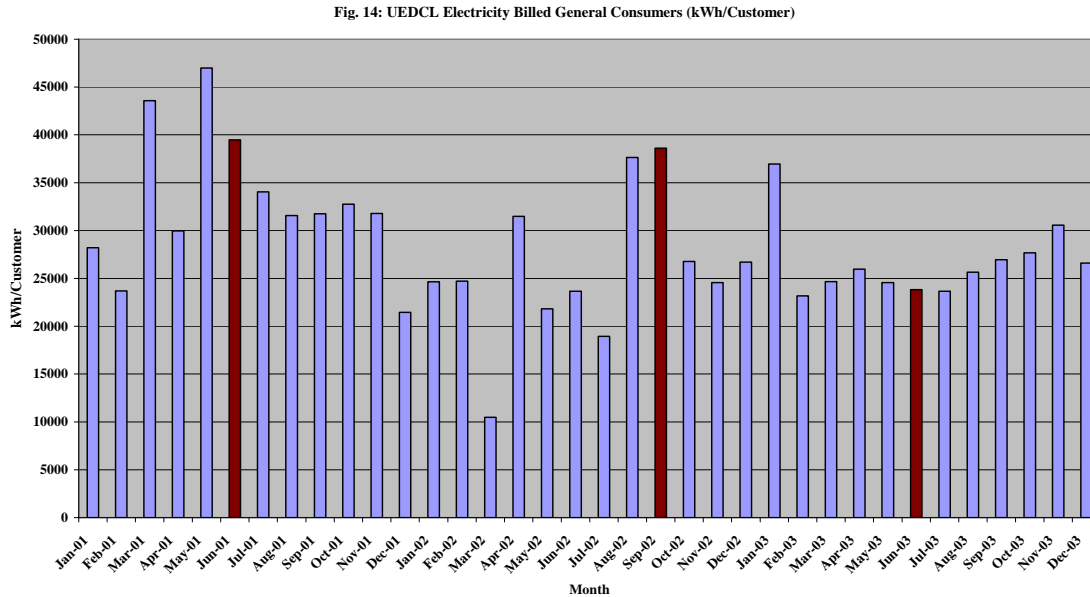
Unlike the commercial consumers, large industrial consumers did not visibly react to changes in electricity tariffs as shown in Figure 13. After the June 2001 tariff increase, their electricity

consumption remained more or else constant and even increased in February 2002, where it remained more or less constant again up to September 2002, where we see a visible decrease in consumption. Apart from the peak in consumption in January 2003, consumption varied little between September 2002 and May 2003. There was a decrease in consumption after June 2003 decrease in electricity tariffs, after which a large increase occurred, followed by a downward trend for three months and finally the consumption evens out up to December 2003. This shows that large industrial consumers did not adjust their consumption with changes in tariffs.



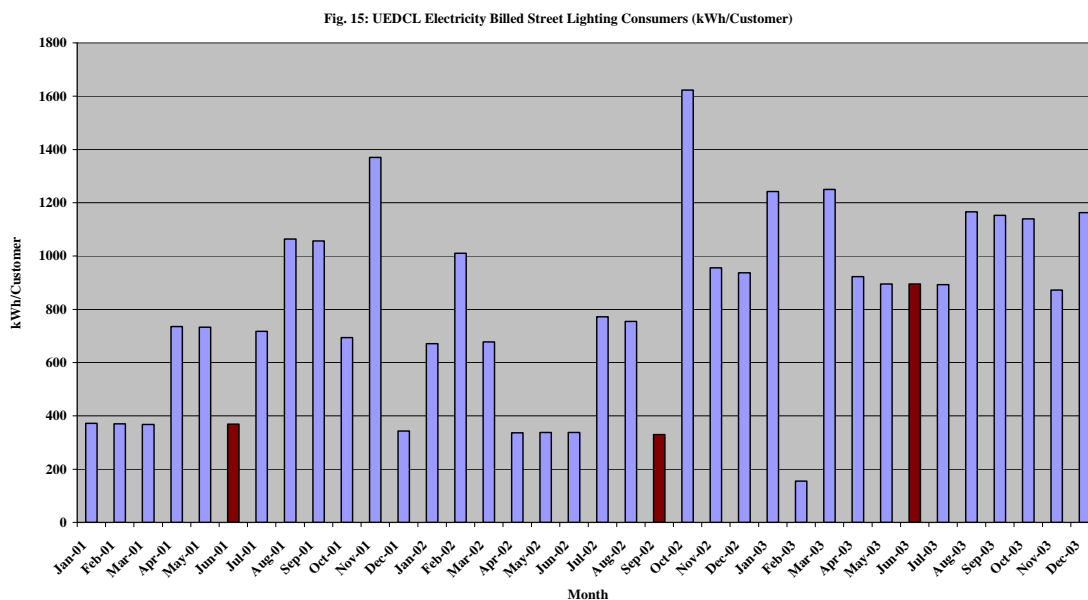
Source: UEDCL, June 2004

Small-scale industrial consumers unlike the large industrial consumers reacted to large changes in electricity tariffs. From Figure 13, after the large (65%) June 2003 tariff increase, there was a general downward trend in electricity consumption up to July 2002 (except for the peak in April 2002). There was a noticeable peak in August and September 2002; prior to the 11% September 2002 tariff decrease. However, after the tariff decrease in September 2002, electricity consumption tended to even out except for a peak in January 2003. In June 2003, there was a slight tariff increase of about 1.2%, which resulted in no noticeable reaction by the small-scale consumers. Instead, the consumption was increasing slowly and steadily from July 2003 to November 2003, with a slight decrease in December 2003, all of which can be attributed to other factors other than tariff increase.



Source: UEDCL, June 2004

Apart from commercial and large industrial consumers, the study investigated the consumption by municipal and town councils in relation to street lighting. Street lighting consumption unlike in other cases is not affected by tariff changes. See Figure 14. For, after the June 2001 tariff increase, street lighting consumption varied with no clear increasing or decreasing trend. This followed with the September 2002 decrease in tariffs; again there was variation in electricity consumption, but no clear downward or upward trend. It was only after the June 2003 increment that the electricity consumption tended to remain constant except for the month of November 2003, where consumption deeps slightly. However, this cannot be a basis for establishing a reaction to tariff changes, hence the conclusion that street lighting electricity consumption is not dependant on electricity tariff changes.



Source: UEDCL, June 2004

7.4.2.1 Conditions of industrial electrical equipment

High power consumption can equally be attributed to system losses at low voltage distribution level and poor servicing of electrical installations. The industrial and commercial electrical installations were inspected to examine their conditions. The results of the inspection revealed that in general the installations were in good condition with wires enclosed in the meter boxes and main switches. See Table 34 and 35.

Table 34: Status of Electrical Installations in Meter Box

Status of Electrical Installations in Meter Box	(n=735)	%	(n=68)	%
All wiring enclosed in meter box	606	82	50	74
Wiring tied with insulation tape	128	17	25	37
Wiring intact with no insulation tape	179	24	28	41
Wires hanging outside meter box	61	8	13	19
Bare wires evident	103	14	9	13
No meter box	44	6	2	3
Circuit breaker in place	295	40	48	71
No circuit breaker, uses wires	126	17	8	12

Table 35: Status of Electrical Installations in Main Switch

Status of Electrical Installations in Main Switch*	N	%	n	%
All wiring enclosed in main switch	647	88	53	78
Wiring tied with insulation tape	87	12	12	18
Wiring intact with no insulation tape	182	25	30	44
Wires hanging outside main switch	36	5	7	10
Bare wires evident	15	2	5	7
No main switch (main switchboard)	35	5	3	4

* *Multiple Responses Allowed*

Apart from inspecting the status of electrical installations, the study analyzed servicing of electrical installations. The findings revealed a mix among servicing electrical installations in-house by an Engineer, an Electrician and contracting an Electrician to do the job. See Table 36.

Table 36: Responsibilities for Servicing of Electrical Installations

Responsibilities for Servicing Electrical Installations *	(n=59)	%
Electrical Contractor Company	6	10
In-house Engineer	20	34
In-house Electrician	20	34
Electrician Contracted	21	36
Other servicing arrangements	0	0

* *Multiple Responses Allowed*

Most firms do not contract companies to service their installation. This is an indication that servicing of electrical installations is not entrusted to a licensed company that would be subject to verification of standards of work. It is left to in-house engineers or electricians whose capabilities are dependent on training and qualification requirements of the industry or commercial enterprise and whose standard of work is set by the industry or commercial enterprise itself. There is no follow up on standards of work and check on acceptable standard of electrical installations that would ensure no losses in electricity and therefore optimum costs incurred on electricity usage. Of the 59 industrial and commercial consumers, only 9 registered a decrease in electricity consumption and electricity monthly cost after servicing electrical equipment. In less than a half of the industrial/commercial consumers (n=27) did not register any change in electricity consumption as a result of servicing their equipment and 18 had no idea no whether there was a change or not.

7.4.3 Electricity Consumption of Street Lighting

After presentation of the inception report by the consultant, the client (ERA) asked the client to investigate the aspect of street lighting, although it has no bearing on social and economic impact on the consumer. Municipal and town councils pay for street lighting, and hence people who benefit from street lighting do not directly pay for it and cannot therefore feel the impact of increase in electricity tariffs regarding increase in street lighting bills.

Data were obtained for four major municipalities (Jinja, Mbarara, Masaka, Mbale), partial for Kampala, and none for Arua. From the data available for the four municipalities, it can be noted in Table 37 that expenditure on street lighting ranges from 2% (Mbarara) to 13% (Mbale) of the total expenditure of the municipal councils.

Table 37: Expenditure on Street Lighting

Municipality	Total Monthly Revenue	Monthly Street Lighting Cost	% Expenditure on Street Lighting
Jinja Municipality	Ushs 75,000,000	Ushs 8,000,000	11%
Mbale Municipality	Ushs 45,000,000	Ushs 6,000,000	13%
Mbarara Municipality	Ushs 63,000,000	Ushs 1,200,000	2%
Arua Municipality	-	-	-
Masaka Municipality	Ushs 20,833,330	Ushs 1,466,660	7%
Kampala City Council	Not available	Ushs 45,000,000	-

Source: Municipality Informants

Kampala street lighting costs on average Ug.shs 45,000,000 monthly, but this was not compared to the monthly expenditure, as the consultant could not access figures. For Arua, total monthly collection and expenditure on street lighting were not accessed. In all situations, however, it can be noted that street lighting does not constitute a significant expense for municipal and town councils, as key informants seemed to indicate. Like in domestic consumption, the problem could be that of poor billing system by UEDCL that fuels consumer's negative attitude and perception. Again for street lighting, it could also be to lack of prioritization of street lighting by respective councils. For Arua, even in the absence of data on monthly collections and expenditure on street lighting, it has to be noted that streetlights in Arua are switched on for just a few hours (< 5 hrs), which would make the cost even much lower, the inconveniences caused to the public notwithstanding.

7.5 Conclusion

Amidst increased electricity tariffs, load shedding is a major issue with quite a number of consumers not understanding the rationale for load shedding. Unless generation capacity can be increased, to reduce incidence of load shedding, household consumers will still feel cheated by the high electricity tariffs. In addition, reliability of the UEDCL electricity distribution network is generally lower than the industry norm; which affects industrial consumers more than domestic consumers. Tariff increases have not been backed by improved network reliability. This has led to majority of domestic and industrial/commercial consumers shifting to use of kerosene and diesel respectively as alternative sources of electricity. From UEDCL billing data, increases in tariffs did not impact greatly on quantity of electricity consumed by domestic and large industrial consumers; whereas medium and small-scale industrial consumers decreased quantity of electricity consumed as a result of tariff increases.

8.0 TARIFF CHANGES AND OPTIMUM USE OF ELECTRICITY RESOURCES IN UGANDA

8.1 Energy Saving Measures

8.1.1 Domestic consumers

The household survey reveals that a number of domestic consumers had adopted energy saving measures to minimize the amount of electricity consumed. In the year 2001, less than a half (44%) of the domestic consumers adopted energy saving measures to minimize the effect of increase in electricity tariffs. However in the years 2002 and 2003, the number of domestic consumers that adopted energy saving measures to minimize impact of increase in electricity tariffs dropped to 26% and 30%, respectively. See Table 38.

Table 38: Energy Saving Strategies by Households to Cope with Increased Electricity Tariffs

Energy Saving Strategies by Households	n=568	%
Reduced number of bulbs	150	26
Reduced amount of time security lights are on	130	23
Used energy saving bulbs	232	41
Use of alternative sources of energy	439	77
Other energy saving strategies	297	52

Table 38 shows particular energy saving strategies adopted to cope with increased electricity tariffs, reported highest was the use of energy saving bulbs. The largest number of domestic consumers adopted or learnt of the energy saving strategies from colleagues as opposed to the information disseminated by UEDCL and WENRECO. The utility companies campaigns on energy saving benefited only 39% of the domestic consumers.

8.1.2 Industrial/commercial consumers

Majority of industrial/commercial consumers (75%; n=51) had adopted energy saving initiatives to minimize the amount of electricity consumed. Energy saving initiatives used in industries and commercial enterprises are shown Table 39.

Table 39: Energy Saving Strategies by Industries and Commercial Consumers to Cope with Increased Electricity Tariffs

Energy Saving Strategies by Industries and Commercial Consumers	n=51	%
Energy saving lighting	46	90
Off peak electricity usage	13	26
Power factor correction	7	14
Good housekeeping	24	47
Reduced use of electrical equipment	15	29
Regular maintenance of electrical equipment	23	45
Other energy saving initiatives	1	2

Use of energy saving lighting was adopted by majority (90%) of industrial/commercial consumers. Good housekeeping measures such as switching off machinery and lights not in use was adopted by 47% of the industrial/commercial consumers, followed by regular maintenance of electrical equipment. However, measures such as power factor correction, which would save on reactive power demanded had a low rating of 14%, with only 7 out of 51 industries/commercial

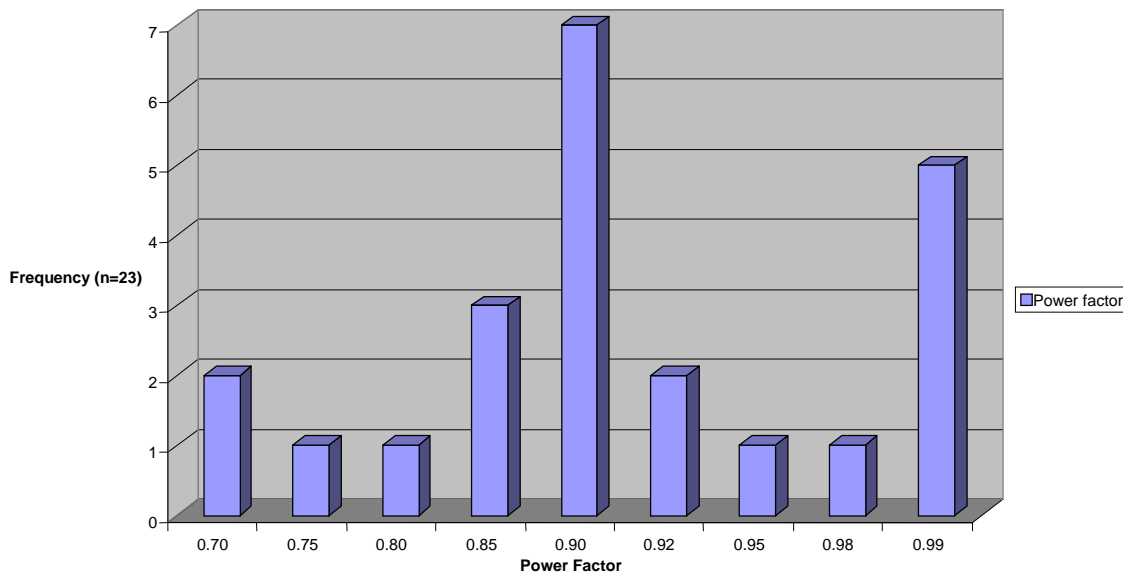
firms using power factor correction. It will be noted that industries and commercial enterprises prefer to use no cost and low cost energy saving strategies.

Most firms visited had not changed their production time despite efforts to reduce off peak rates for manufacturers. Only 4.4% reported a change in working time due to increases in electricity tariffs, in order to take advantage of the off peak rates. Other reasons given for change of working hours, though not very common are reductions in output and other cost cutting measures. The policy implication from this section is that incentives given to these firms to produce during the off peak hours are not optimal to cause the change in working hours

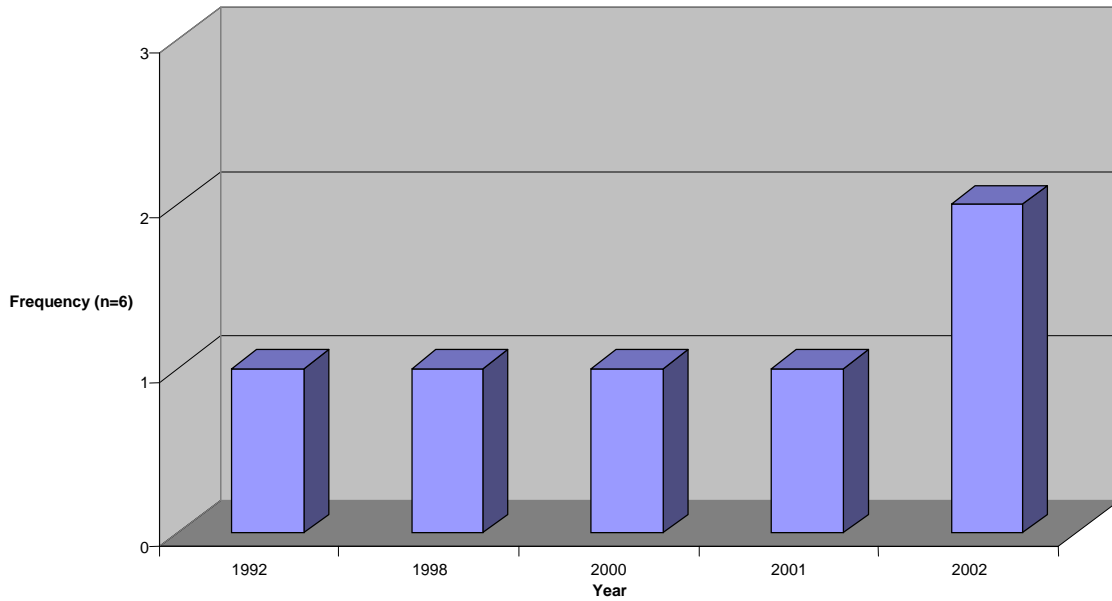
8.2 Power Factor Correction

Low usage of Power factor correction was investigated further with results showing that only 23 industries knew what their power factor was. Of these, the highest frequency (7) had a power factor of 0.90, followed by 5 industries, which had a power factor of 0.99, which is very good. The accuracy of the figure given is questionable and for purposes of this analysis we can note that about 5 industries had a power factor between 0.90 and 0.99; thus 5 out of 23 industries that know their power factors endeavor to maintain it at a high value. See Figure 16.

Fig. 16: Power Factor of Industries



Further probing showed that nine out of 61 industrial and commercial enterprises that responded had installed power factor correction equipment, but not necessarily as an energy saving initiative. Only in six industrial/commercial firms was the year (2002) given in which the power factor correction equipment was installed. See Figure 17.

Fig. 17: Year Power Factor Correction Equipment was Installed in Industries sample

The highest rated incentive for installation of power factor correction equipment was reduction of electricity consumption.

8.3 Conclusion

There has been an effort by consumers to institute energy saving measures to counter high electricity costs. However, consumers tend to institute low cost energy saving measures involving good house keeping as opposed to high cost measures such as power factor correction equipment. The price signal for off peak electricity consumption by industries does not encourage users to shift to off peak hours.

9.0 LIFELINE SUBSIDY

9.1 Concept of lifeline subsidy

In this study, lifeline subsidy is perceived as a socio-economic provision (safety net) to cushion the very poor against high electricity tariffs. It refers to cost per unit of electricity that will allow people in the poorest income bracket to consume electricity. For the domestic consumer to be within the lifeline subsidy rate of the first 15kWh, one should consume an average of 500Wh per day. This is equivalent to having two ordinary 60W filament bulbs powered for 4 hours per day and one portable radio powered for about 10hours per day.

9.2 Is the Lifeline Subsidy an Appropriate Socio-economic Provision?

Prior to 1st June 2001, the lifeline subsidy rate had one level that was set at Ug.shs.20 for the first 30 units. The second level set at Ug.shs. 70 for 21 to 200 units was the price reflecting the actual cost, and finally Ug.shs 100 for Units above 200 which is above the price reflecting the actual cost, was intended to recover the revenue lost as a result of the subsidy. In June 2001, the lifeline subsidy tariff level was increased to Ug.shs 50 for the first 30units, which was maintained even with the September 2002 tariff increase. For domestic consumers above the lifeline subsidy rate, units above 30kWh were charged at Ug.shs 189.8 in June 2001, and this was decreased to Ug.shs 168 in September 2002.

In June 2003, the lifeline subsidy rate was Ug.shs 50 each for the first 15kWh. Any unit above 15kW hours was charged at Ug.shs 170. This decreased the number of domestic consumers under the lifeline subsidy tariff. Until June 2003, the first 30kwh of electricity consumed by the domestic customers was billed at Ug. Shs 50 per kWh, which totals up to Ug.shs 2,925 including service charge and VAT (Value Added Tax). This was the lifeline subsidy set for the very poor households. This represented 13% of total consumers countrywide. In June 2003, the lifeline subsidy was reduced to Ug. shs 50 per kWh for the first 15kWh, totaling up to Ug. shs 2,047.5 including service charge and VAT, which reduced the number of domestic consumers under the lifeline subsidy rate. For instance from Table 40, only 5% of total domestic consumers in Kampala were under the lifeline subsidy rate

Table 40: Consumers under the lifeline subsidy from the districts sampled.

Consumers under Lifeline Subsidy	Arua	Jinja	Kampala	Mbale	Masaka	Mbarara
Jan 01 to May 03	8,772	32,042	269,810	24,223	54,390	28,571
% of Total Consumers	0.16	0.60	5.05	0.45	1.02	0.53
June 03 to May 04		8,397	39,280	3,700	13,052	3,493
% of Total Consumers		0.32	1.49	0.14	0.50	0.13

Source: UEDCL, June 2004

From average monthly electricity expenditure data (Table 40), up to 5% of households sampled spent Ug. Shs 5,000 and below monthly on electricity in 2001 and 2002. In 2003, this number dropped to 2.6% of households sampled.

Table 41: Average monthly electricity expenditure below Ug.shs 3,000/= for Households Sampled

Year 2001 (n=735)			Year 2002 (n=735)			Year 2003 (n=735)		
Amount (Ug.shs)	(n)	%	Amount (Ug.shs)	(n)	%	Amount (Ug.shs)	n	%
1,000	1	0.2	1,200	1	0.2	1,000	1	0.1
1,500	3	0.5	2,000	8	1.2	1,200	2	0.3
2,000	9	1.5	2500	11	1.7	2,000	5	0.7
2500	12	1.9	3000	30	4.6	2,500	10	1.4
3000	32	5.2				3,000	18	2.6

Only up to 9% of the sampled domestic consumers had dwellings that would consume power within the lifeline subsidy. This assumes that there were no hotplates, electric kettles and electric irons in use in these dwellings. Hotplate ownership was low at an average of 15% for the three years, whereas the electric iron usage rate was high at an average of 79% for the three years, of households visited and the usage rate of electric kettles was moderate at an average of 37% for the three years. This implies that the percentage of households that qualify for lifeline subsidy rate is lower than 9% of those sampled because of the high usage rate of electric irons.

9.3 Conclusion

From the above findings, it becomes clear that the current lifeline subsidy provision does not offer much for the target consumer group; the very poor, as clearly seen that only 9% of sampled households were able to consume power below the lifeline subsidy rate. Yet the tariff structure caters for the provision of recovering what is lost in the subsidy from the cost of the other units above the subsidy; hence people are paying more than they should for electricity, to cover a lifeline subsidy rate that does not even benefit the target group. In light of the study findings, either of the two scenarios can be adopted; (i) scrap the lifeline subsidy and charge electricity at true cost, or (ii) increase the number of units under the lifeline subsidy. The consequences of the latter (i.e., ii) will be the increase in the tariff to recover the increased number of units under the lifeline subsidy loses.

10.0 EFFECTS OF TARIFFS IN RURAL AREAS

10.1 Consumption of electricity in Rural Uganda

The study was extended to rural locations with electricity so as to analyze the effects of electricity tariffs on rural areas, and the ability of rural consumers to pay. Although over 80% of the total population of Uganda resides in rural areas, only 2% of rural households have access to electricity. Nationally, less than 4.5% of the population of 24 million is connected to the power grid system.

10.2 Willingness to Pay Tariffs in Rural Areas

In this study rural consumers were mainly those served by WENRECO, although the study covered also a big number of rural consumers in Masaka who constitute 60% of the total consumers in the district (**UEDCL District Manager, Masaka**). Regarding willingness to pay for electricity if tariffs increased by 15% percent, majority (70%) expressed willingness. It has to be noted, however, that this willingness was qualified in terms of having an improved service delivery. Thus, the high willingness to pay (the average maximum of all respondents) could emanate from two possible explanations. First, the costs rural consumers incur due to poor/unreliable electricity supply weigh more than the contribution (15% increment in electricity tariffs) the consumer would make to have electricity supply improved or installed. Second, in comparing the costs of acceptance to have improved electricity supply to the value of alternative energy sources, it is possible that the value (cost) of alternative sources of energy is more than the costs incurred for improved electricity supply¹⁰. This has two implications: first, electricity could be a big necessity for rural consumers especially commercial ones and second, rural consumers encounter difficulties to substitute certain services provided by electricity.

10.3 Affordability to Pay for Power in Rural Areas

Despite the fact that many people in the rural areas are willing to pay for improved electricity supply; initial costs to have power installed affect the budgetary outlays of most domestic consumers. Cases were cited in Masaka and Mbarara where power lines had been extended to peri-urban areas and rural areas near town in the last two years, but people were failing to meet the initial costs of getting connected, and yet accordingly had made appeals to political leaders that they needed electricity. The policy implication here is that as the country embarks on the policy of rural electrification big subsidies will have to be provided to aid the potential rural consumers meet the initial costs of installation, without which this could hamper efforts of rural electrification. However, through the Rural Electrification Program (a ten year program funded by the World Bank) where subsidies are channeled towards the capital investment, it will attract more rural consumers getting connected (**Commissioner, Energy**).

In the current situation, what is emerging out in this study is that increases in tariffs in rural areas are affecting small enterprise than the domestic consumer as one informant observed.

¹⁰ These depend on the nature of the economic activity a rural household is involved in. For example, among others, grinding mill projects, welding activities, and recreation facilities.

For small scale, mainly rural enterprises, government has to find a mechanism of supporting them; they have not reached break-even point to sustain the costs on their own from the market (Executive Director, UMA)

For the domestic consumers, tariffs have no impact on their welfare and seem not to be much of their concern, (the effects are minimal on consumers welfare). The major issue, therefore, is not of high tariffs, but rather of improved electricity supply. A case of WENRECO below succinctly puts the picture in perspective.

10.4 Case Study of Rural Electrification: WENRECO

On 1st April 2003, WENRECO took over UEDCL operations in Arua district. This was at a time when power supply operations were in a poor state as the generator sets were due for servicing and were frequently breaking down. Load shedding was rampant and large areas of Arua did not have electrical power. There are four synchronised generator sets of total capacity 1.23MW. However their output is less due to inefficiency. A new generator was being installed at the time of this study. The new generator has a capacity of 1.5MW.

Currently power is switched on from 7.30p.m. to 10.30p.m. Previously power was switched on from 7p.m. to 11p.m. Duration of power supply has been reduced because of insufficient fuel. According to the Operations Manager, the network is not characterized by many faults, however power outages are attributed to storms during the rainy season. Power reliability could not be quantified using reliability indices, as was the case for the other districts selected due to insufficient power outage data. Load shedding is currently carried out once a week, which was reported to an improvement as it used to be more frequent in the past.

On taking over the Arua operations, WENRECO mapped the area and located areas that require electricity. There are currently about 400 applicants wishing to be connected to the electricity grid. However new connections cannot be effected until the new generator set is up and running.

The billing process in Arua has not been streamlined. When the company began operations, it instituted billing software that crashed within 3 months of operation. Currently another billing software is under test, which started in March 2004. There were numerous billing complaints when the previous software was in use. Major complaints were that bills were wrong and payments were not posted.

Consumers in Arua like in other places often encounter difficulties to pay especially when the bills accumulate. At the time of this study, WENRECO had disconnected 10 – 20% of consumers that had failed to pay. Institutions such as the Prisons, UPDF and the Police were reported to be the biggest power defaulters, and yet it is difficult to disconnect them. The Police, for instance, at the time of this study had not paid its electricity bill since WENRECO took over operations in April 2003.

WENRECO charges the same tariffs as UEDCL, but accordingly incurs heavy expenses on operations and maintenance. On average, domestic consumers pay between Ug. shs 1,900-12,000 per month, which in total is inadequate to cover the operation and overhead costs. The

Operations Manager estimated that they were spending about Ug. shs 45,000,000 on fuel per month, while the monthly collections were about Ug.shs 12,000,000.

11.0 INDICATORS FOR ASSESSING THE ECONOMIC AND SOCIAL EFFECTS OF CHANGES IN ELECTRICITY TARIFFS

11.1 Socio-economic Indicators

A set of indicators has been derived from the study findings as per consumer category to enable continued assessment of economic and social effects of changes in electricity tariffs. Attempted is the means of verification of the indicators.

11.1.1 Indicators for domestic consumers

Finding 1

Use of complementary or back-up sources of energy is increasing due to inefficiency in electricity supply coupled with load shedding and increased tariffs

Indicator 1

- Percentage of households using complementary sources of energy (i.e., increased use of alternative sources of energy e.g., charcoal, gas, wood fuel, kerosene etc)

Means of Verification 1

- Household Survey, Key Informant Interviews and Focus Group Discussions

Finding 2

Expenditures on electricity consumption constitute the bulk of total energy expenditure. This is the case for all socio-economic classes of households, that is, the poor and non-poor. Increased expenditure on electricity in relation to expenses on other energy sources is attributed to increased electricity tariffs.

Indicator 2

- Proportion of electricity expenditure in the household budget—trend of expenditure on electricity vis-à-vis alternative energy sources

Means of Verification 2

- Household Survey, Key Informant Interviews and Focus Group Discussions

Finding 3

Increased electricity tariffs can potentially affect the welfare of the consumers. However, in the Ugandan context, the impact is so negligible to lead into substitution for electricity use. Alternative energy sources to electricity only complement, but do not substitute for electricity use.

Indicator 3

- Degree of responsiveness of consumers welfare to changes in electricity tariffs, holding other factors constant i.e., the welfare elasticity to changes in electricity tariffs should be inelastic

Means of Verification 3

- Household Survey, Key Informant Interviews and Focus Group Discussions

Finding 4

There has been a change in electricity consumption habits as consumers adopt energy saving measures such as increased use energy saving bulbs, minimizing the use of high power consuming electricity appliances etc.

Indicator 4

- Percentage of households adopting/practicing energy saving measures (e.g., energy saving bulbs)—change in electricity consumption habits.

Means of Verification 4

- Household Survey, Key Informant Interviews and Focus Group Discussions

Finding 5

Cases were cited in Masaka and Mbarara where power lines had been extended to peri-urban areas and rural areas near town in the last two years, but people were failing to meet the costs of getting connected.

Indicator 5

- Number of rural households getting connected to an existing line

Means of Verification 5

- Household Survey in rural areas with access to the national grid, Secondary Sources, Key Informant Interviews and Focus Group Discussions

Finding 6

Qualitative data revealed the ever-increasing number of domestic consumers getting disconnected and at the same time taking long to get reconnected especially the urban poor.

Indicator 6

- Increased household disconnections
- Number of households failing to meet reconnection costs.

Means of Verification 6

- Trends in illegal connections—stealing of power (by passing meter)

11.1.2 Indicators for commercial and industrial consumers**Finding 7**

Effective monitoring of time-of-use meters started in January 2004, which was outside the scope of this work.

Indicator 7

- Percentage of industrial consumers shifting to time-of-use meters

Means of Verification 7

- Secondary data from electricity utility companies

Finding 8

Although the study findings do not reveal any changes in electricity consumption during off-peak hours, in future this could be possible and therefore could be monitored.

Indicator 8

- Number of industries/commercial enterprises changing of production hours to off peak hours

Means of Verification 8

- Secondary data from Electricity Utility Companies

Finding 9

A few industrial and commercial consumers reported increased costs partly as a result of increase in electricity tariffs and prices

Indicator 9

- Number reporting increased costs of production due to electricity tariffs

Means of Verification 9

- Industrial and commercial consumer survey and key informant interviews

Finding 10

Increased production costs and reduction in profit margin depend on the nature of elasticity of demand of the good that is produced.

Indicator 10

- Percentage of industries attributing reduction of output to tariff changes
- Percentage of industrial/commercial consumers reporting profit margin reduction to changes in tariffs

Means of Verification 10

- Industrial and commercial consumer survey and key informant interviews

11.2 Social and Economic Aspects Vulnerable to Electricity Tariffs

As indicated in the previous discussions, this study did not reveal adverse socio-economic impact on different categories of consumers (domestic and industrial/commercial) as a result of increases in tariffs. Although the study findings do not point to social and economic aspects vulnerable to electricity tariffs, some impressions from the theoretical point of view emerge out. For instance, at the domestic level, if tariffs are tremendously increased, household expenditure on electricity is bound to increase. In order to cope, households resort to complementary and alternative sources, which are pre-paid, and hence the burden is not very much felt. This, however, has got inconveniences and could as well end up more costly to the domestic consumer.

With regard to industrial consumers, on contrary, the industrialists except for commercial consumers regard the tariffs as fair. However, if tariffs are too high, industrialists can experience rises in costs of production.

12.0 CONCLUSIONS, CHALLENGES AND SUGGESTIONS

12.1 Conclusion

In drawing the conclusions emerging out of the study findings, some pertinent questions can be posed; did the tariff increases between 2001-2003 have adverse socio-economic effects on consumers? Are the tariffs too high to be afforded or are tariffs a problem?

The quantitative results of this study reveal that electricity tariff is not high to the extent of making it unaffordable by majority Ugandans irrespective of their socio-economic status. The industrial consumers (large) are generally not burdened by the tariffs, but the small and medium commercial consumers do feel the burden. The findings reveal that for the domestic and industrial consumer, it is more of an attitude/perception problem, which is exacerbated by inherent problems within UEDCL including the billing system and quality of power supply rather than the increased tariffs per se.

The perceived burden is felt partly due to the billing system i.e., a monthly bill after one has consumed the product, which is not all enticing/motivating to pay as it shocks the income of the consumer unlike in a pre-paid system. This is glaringly clear in the analysis of the major complaints of the consumers, which rotate around huge unexplained bills, irregular billing, estimates when meters exist, not being billed at all, inaccurate meter readings, failure to reflect payments made on bills, late or no receiving of bills and disconnections on date of bill delivery.

Nevertheless, consumers belonging to high income bracket experience more the burden of increases in tariffs than the poor, and hence increased tariffs have a progressive impact, which could translate into income redistribution if resources could be channeled to provide electricity to as many people as possible. Further, this implies that subsidies in form of low tariffs would constitute a significant leakage to the non-poor, which would represent a major fiscal cost.

The results of the study do not point to major welfare sacrifices made by consumers to meet increased tariffs. In situations where sacrifices could possibly have been made, instead consumers have adopted coping strategies that entail non-use of electricity or low consumption of electricity. The coping strategies adopted have a potential impact on the welfare of the consumer, albeit, largely indirect as well as psychological comfort of the consumer.

For the industrial consumers, power outages rather than increase in tariffs is big problem affecting the productivity of the industrial enterprises. This increases costs of production through loss of production time. Firms also incur higher costs of alternative energy source (Diesel) when there is power outage. Firms have also not changed their production time to take advantage of the off peak rates, implying that the price signal for time of use is not effective.

Regarding the effect of the tariff on rural areas, it is not the increase in tariffs per se for those who are already connected, but rather improved electricity supply such as the case in Arua. The consumption levels in Arua are so low due to unreliable power for the consumer to feel the burden of the tariff. On the other hand, the major point of concern to majority of potential rural consumers is the initial cost incurred (meter, wires/wiring, poles, upfront deposit etc) to access electricity except for those consumers that at the same time use electricity for commercial

purposes. This initial cost has a potential to affect government efforts aimed at rural electrification.

12.2 Suggestions

The whole outcry about high electricity tariffs has flourished due to UEDCL's public image problem among consumers of different categories. This image problem emanates from inaccurate and estimated billing even when meters are installed, untimely billing, delayed updating of customer account, disconnection of consumers on delivery of an accumulated bill without prior warning and failure to enforce bill collection, which is left to accumulate. UEDCL has to address these problems, coupled with sensitization of the consumers about the tariff and the billing system. Specifically, UEDCL has to do the following:

- Meter all premises connected to electricity
- Read all Meters accurately and timely
- Provide Meter reading function with logistics
- Monitor performance of Meter readers
- Reflect all payments
- Avail customer accounts information to all districts
- Ensure security of measuring instruments
- Check customer-staff collusion and complacency
- Pre-paid Metering

Although the findings reveal no significant impact on the welfare of consumer and industrial performance, particular vulnerable groups (rural poor and the farmers) need to be assisted especially in meeting the initial capital/costs to connect to the grid. Reducing or abolishing taxes on such materials, sourcing for cheaper alternatives by the relevant institutions and popularizing such materials to the private sector among others, could help. Reliability of the network should be improved by overhauling areas prone to power outages as a result of faults and bush clearing.

At the industrial/commercial level, the major problem is power outages. The small commercial consumers feel the burden of increases in tariffs. It could help to subsidize or have special rates for such small commercial consumers to help them cut on the costs of production.

Reliability of electricity supply is measured by internationally recognized reliability indices. In order to keep track of how the network is performing, it is important that these indices are reported to ERA by the utility companies so as to be measured against international standards. This would be a check on how the company is performing and justify tariff increases with improved network reliability. Industries would be cheated if they were made to pay high kVA tariffs for instance yet the machine is lying idle half the time due to power outages.

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