



**New Public Management in the Utility Sector  
Comparative Study of Electricity in Uganda and Zambia**

**Revised Value Chain Analysis Assignment**

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## Introduction

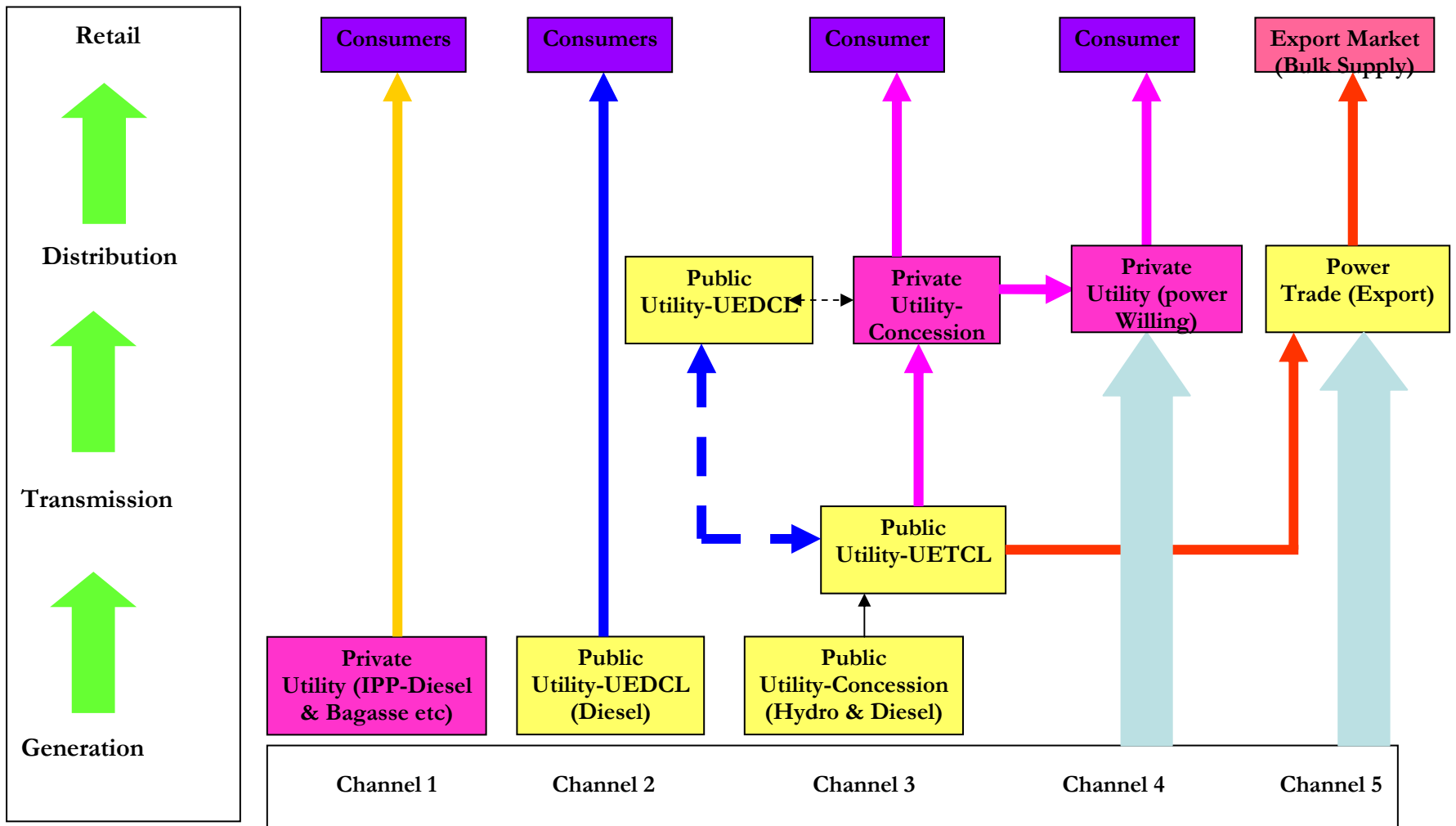
A value chain is the full range of activities that are required to bring a product or service from its conception to the final consumers. This includes activities such as design, production, marketing, distribution and support services to the final consumer. Value chains can be restricted to local markets, but do also expand globally. The Value Chain Analysis is a conceptual framework for mapping and categorising economic processes. It helps to understand how and where enterprises are positioned in economic processes. It also helps to identify new business opportunities and possible leverage points for upgrading solutions. By exploiting the upstream and downstream information flowing along the value chain, the firms may try to bypass the intermediaries creating new business models, or in other ways create improvements in its value system.

Private business activity adds value to a nation's given resources, by introducing new ideas on how best to combine them among alternative uses. Private Sector Development is increasingly acknowledged by governments, donors and development organisations as an important step towards alleviating poverty and creating viable economies. Value Chain Development is a multiple and participatory process that leads to coordinated interventions. It has the enormous advantage to bring together stakeholders from different production stages and sectors, to create a productive and innovative dialogue and to draw the attention to "Collective Competitiveness".

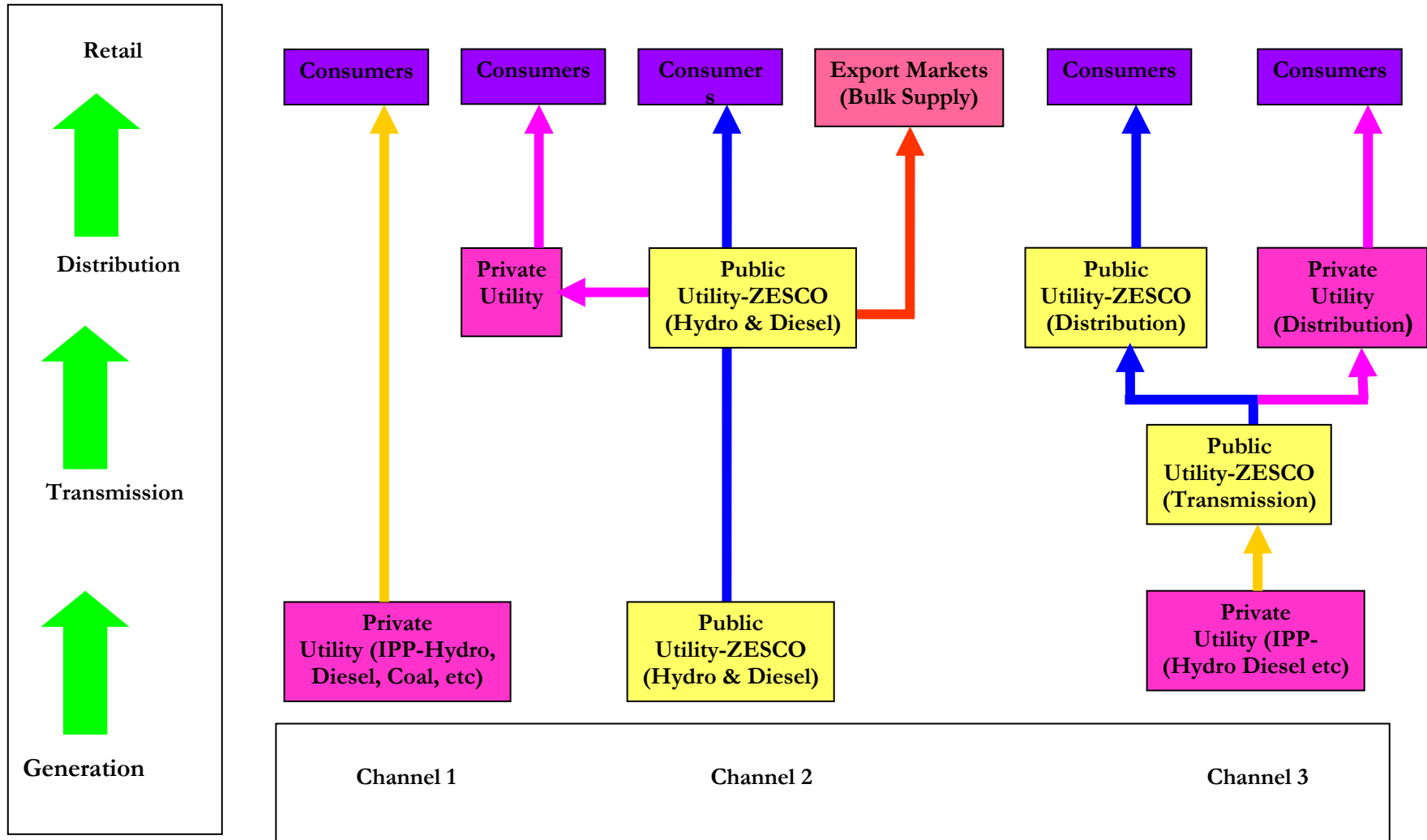
**Table 1: List of Organisations Target for Surveying or Interviewing**

No	Type of Organisation	Uganda	Zambia
1	Government Departments	Ministry of Energy and Mineral Development, Ministry of Finance, Planning and Economic Development, Privatisation Unit, Parliamentary Committee on Social Services	Same as Uganda
2	Regulators	Electricity Regulatory Authority, Rural Electrification Fund	Electricity Regulatory Board, Rural Electrification Fund
3	Public Utility Companies	Uganda Electricity Generation Company, Uganda Electricity Transmission Company, Uganda Electricity Distribution Company	Zambian Electricity Supply Corporation
4	Private Utility Companies	Umeme – Distribution), Aggreko Generation-Thermal, Bujagali and Karuma Power Projects (IPPs), West Nile Rural electrification Company, Kasese Cobalt Company, Kakira Sugar Works , Hydromax Ltd	Copper-belt Energy Corporation, Lunsemfya Hydro company, LHP (IPP) Zingamene Company Small mini-hydro run by missionaries
5	Supporting Institutions and Civil Society	Eastern African Power Pool, Uganda Industrial Research Institute, Faculty of Engineering Makerere University, International Finance Institutions, UN Agencies Donor Agencies, Environmental CSO	Southern Africa Power Pool, Technical Advisory Unit, University of Zambia International Financial, Institutions, UN Agencies Donor Agencies, Environmental CSO

### Electricity Distribution Value Chain (Uganda)



### Electricity Distribution Value Chain (Zambia)



## **The Stakeholders in the Market**

In Uganda, the following public and private companies supply electric power to the main distribution company, UMEME. These are Aggreko Generation-Thermal, ESKOM, Kasese Cobalt Company, Kakira Sugar Works, Hydromax Ltd. In Zambia, the following companies supply or receive power from ZESCO: Copper-belt Energy Corporation, Lunsemfya Hydro Company, and Zingamene Company.

## **Determinants of Values and Margins (Tariff Structure) in the Value Chain of Uganda**

In determining values and or margins, Electricity Regulatory Authority, electricity prices are set at three points in the industry:

- At the interface between generation and transmission;
- At the interface between transmission and distribution; and
- At the interface between distribution and end-user consumers

The Transmission Company acts as a single buyer of electricity supplied to the transmission network in Uganda and the sole exporter and importer of power. The prices between generation and Transmission Company are negotiated between themselves in a form of a Power Purchase Agreement, which is subject to oversight, and approval by ERA. The Transmission Company sells power to any distribution company (buyer) that is connected to the transmission network at a Bulk Supply Tariff. The Bulk power supply tariff reflects the costs of power acquisition and transmission costs.

The Transmission Company can export power at specially negotiated prices, but not below either the average or marginal cost of power purchase. The Distribution Company purchases power at the Bulk Supply Tariff and sells it to end users following an approved tariff schedule. These end-user tariffs reflect the costs of power purchase as well as the costs of distribution and retail supply.

The elements of the end user tariffs in Uganda include:

- i. Fixed standing charges (Shs per month);
- ii. Capacity (demand) charges (Shs per KVA); and
- iii. Energy or usage charge (Shs/KWh)

The fixed customer charges (per customer per month) are charges that are not a function of the customer usage during the billing period and are often used to recover costs that vary with the number of customers being served. They cover costs incurred by the licensee for providing power supply to the consumers such as metering and meter services, customer billing and customer information plus service expenses.

The energy charge is a charge per KWh of energy consumed. It is a usage charge, which is related to the amount of electricity consumed. The energy charge has a life line rate intended to make electricity services affordable to the poor or those who would otherwise be able to afford the services only with great sacrifice or not at all. Lifeline rates are lower than the true costs of supply, and are subsidised. Therefore in order to ensure that only those in need gain the benefits of the subsidy, consumption above a certain maximum level per month is priced at the cost of supply plus a small percentage required to subsidise the life line consumers. The lifeline rate is currently for the first 15kWh.

The maximum demand charging i.e. charging customer on the basis of their maximum demand in any given billing period, is used to recover capacity costs. The idea behind these charges is that the maximum usage of a customer in a billing period is a proxy for that customer's contribution to the need

to invest in capacity to cover peak demand. The number of end-user customers is categorised into five, namely; domestic, commercial, medium scale industries, large industries and street lighting.

- Domestic consumers (Code 10.1). These are customers who are metered at low voltage supply single phase and supplied at 240 volts. They include residential houses, small shops and kiosks. These customers have no time of use tariffs.
- Commercial consumers (Code 10.2/10.3). These are small commercial consumers. Electricity is supplied at three-phase voltage, with a load not exceeding 100 Amperes. They mainly include small industries such as maize mills, water pumps metered with connected load at low voltage (415 volts). These customers have time of use tariffs.
- Medium Scale Industries (Code 20). These are medium scale industries that take power at low voltage (415 volts) with a maximum demand of up to 500 kVA. This category of customers has time of use meters.
- Large Scale Industries (Code 30). They include large-scale industries taking power at a high voltage (11,000 V or 33,000 V) with a maximum demand exceeding 500 kVA but up to 10,000kVA.
- Street Lighting (Code 50). This includes electricity supply for street lighting in cities, municipalities, towns, trading centres and community centres.

### **Time Differentiation (Time of Use)**

Flat rate pricing system, regardless of the time of use creates over consumption, discourage energy efficiency and lead to leakage to other uses or consumers. To ensure efficiency in consumption, the end user tariffs are time differentiated i.e. apply different charges to usage in different time periods to reflect underlying cost differences, for those customers with time of use meters. Marginal costs of generation, transmission and high voltage distribution vary by time of day. Costs are higher in hours when load growth is likely to require additional capacity, or when high cost generators must be dispatched to meet load.

Time of use (TOU) charging improves the efficiency of price signals because the charges vary for consumption in predefined period within the billing period. However, the requirement for such complex metering if premised on the assumption that implementation of TOU charging to customers who lack the necessary metres is only cost effective if savings from load shifts from peak to off-peak periods (or reduction in peak period use) are sufficient to cover the added metering costs.

Consumption is divided into 3 periods of time; Peak, Shoulder and Off-peak.

<b>Load pattern</b>	<b>Time</b>
Peak	18:00 – 24:00 hrs
Shoulder	6:00 – 18:00 hrs
Off-peak	24:00 – 6:00 hrs

Time of use meters is currently available for code 30 (large industrial consumers); code 20 (medium industrial consumers) and some customers in code 10.2 (Commercial consumers). The strategy is to extend these to all consumers including domestic in the medium term. The limiting factor at the moment is that the cost of these meters is rather high.

### **Generation Tariffs**

The price paid to the generation companies by UETCL for bulk energy purchases depends on whether the transmission company is paying for capacity or energy. In the case of the large hydro plants

such as Kiira and Nalubaale and Bujagali, UETCL pays a capacity price. The generation capacity price is the price paid for a kW per hour. In most instances, the generation capacity price is determined annually and adjusted quarterly for changes in tested capacity, inflation and exchange rate.

The revenue requirement is made up of the following cost components, where applicable:

- The investment component;
- The operating and maintenance (O&M) component;
- The concession fee or lease component.
- Other costs such as regulatory fees and royalties.

The investment component is made up of depreciation, return on the company's capital investments and income tax. The investment component is determined in US dollars and converted to shillings at the prevailing exchange rate. The O&M component is a sum of local currency denominated element and foreign currency denominated component. The foreign currency element of O&M is converted to shillings using the prevailing exchange rate on a quarterly basis. The local element is adjusted for Uganda inflation. The O&M allowance is determined from the USD amount set in the license, and is adjusted on a quarterly basis for (a) Uganda price inflation, and (b) changes in the USD exchange rate and further adjusted by an efficiency factor to provide an incentive for increased productivity.

The concession fee component includes the lease fees paid to UEGCL by Eskom (U) Ltd under the Concession Agreement. It includes mainly debt service (both principal and interest) and administrative expenses of UEGCL.

The capacity price is adjusted quarterly for inflation, exchange rate and available capacity. The following cost elements are adjusted in response to inflation:

- The local currency component of operating and maintenance costs
- The following cost elements are adjusted in response to exchange rate:
- The foreign currency component of operating and maintenance costs;
- The investment component, comprising capital recovery charges (i.e. depreciation); Return on Investment; and Income Taxes Payable.

In the case of the thermal generation only projects that sell power to the grid, such as Aggreko (U) Ltd, UETCL pays a capacity price meant to recover the capital costs of the project and an energy charge. The energy charge has two elements: the O&M component and the fuel component. The fuel component covers the cost of fuel logistics as well as the means of plants. The fuel price is escalated periodically for changes in the international prices for fuel.

The small generation projects of less than 20 MW are supposed to be paid a feed-in tariff to be determined by UETCL based on the avoided cost principle. Currently, these projects are paid a fixed price as negotiated between them and UETCL in their power purchase agreements (PPA) and approved by ERA.

### **Bulk Supply Tariffs**

The Bulk Supply Tariff (BST) is the tariff charged by the Transmission Company to the distribution company. The BST is a per unit energy charge separated for peak, shoulder and off-peak. It is based on the revenue requirement of Transmission Company, which includes the operating and maintenance expenses (O&M), the net power purchase costs, and allowance for debt service costs. Net

power purchase costs are the total cost of power purchase from generators and imports less export revenues.

To arrive at the BST, the revenue requirement of the transmission company is divided by bulk energy sales of the transmission company. This yields the shoulder tariff, which is adjusted for a peak-weighting factor to derive the peak price. The off peak tariff is therefore derived using the residual revenue requirement. The BST is adjusted quarterly for changes in (i) purchases from generators and imports; (ii) export revenues and volumes; and (iii) sales volumes to distributors.

The following cost elements are adjusted in response to purchases from generators and exports, and sales volumes to Ugandan distributors:

- The net power purchase costs are updated quarterly to reflect the actual net costs – being the cost of purchases less the revenues from exports.
- The volumes used to calculate tariffs from costs are updated quarterly to reflect actual sales volumes (these are calculated as purchases less exports less transmission losses).

### **End-User Prices**

Uganda has one large distribution company (Umeme Ltd) which leased the assets of the formerly government owned distribution company (Uganda Electricity Distribution Company Ltd). There are some mini-grid distribution systems and one off grid generation and distribution company (West Nile Rural Electrification Company Ltd). Tariff setting follows similar principles and actual methods of tariff setting differ across the different distribution systems.

In the case of Umeme Ltd, Tariff rates for customers in each tariff category are computed to reflect the cost of electricity supply to that category. This approach is in line with modern principles of tariff determination internationally as well as the Act which calls for cost reflective tariffs. Implementation of this principle eliminates cross-subsidization of any category of customers by other categories and therefore promotes greater efficiency.

As a result, the tariff for domestic consumers is often higher than the tariff for industrial consumers. Domestic consumers who take supply at the low voltage impose higher investment and operational costs on the system than industrial consumers who are supplied at the high voltage or medium voltage. At the higher voltage, the utility is spared the investment cost in transformers and secondary lines and operational and maintenance costs will also be reduced. In addition, the unavoidable technical losses are also lower since the current flows through a smaller number of transformers and shorter line lengths on its way from generators to the customers. The consumer supplied at low voltage (secondary voltage) imposes additional investment costs, for transformers and secondary lines and the utility experiences greater technical losses.

The end-user prices are computed by implementing the following steps:

- Calculating the revenue requirement of the distribution company
- Allocating this revenue requirement to the different customer categories; and
- Converting this revenue requirement into fixed, energy and capacity tariff as appropriate for each tariff category.

The revenue requirement of the distribution company is made up of:

- Operating and maintenance costs. A portion of this is indexed to foreign exchange and the remainder is indexed to local inflation.
- Depreciation

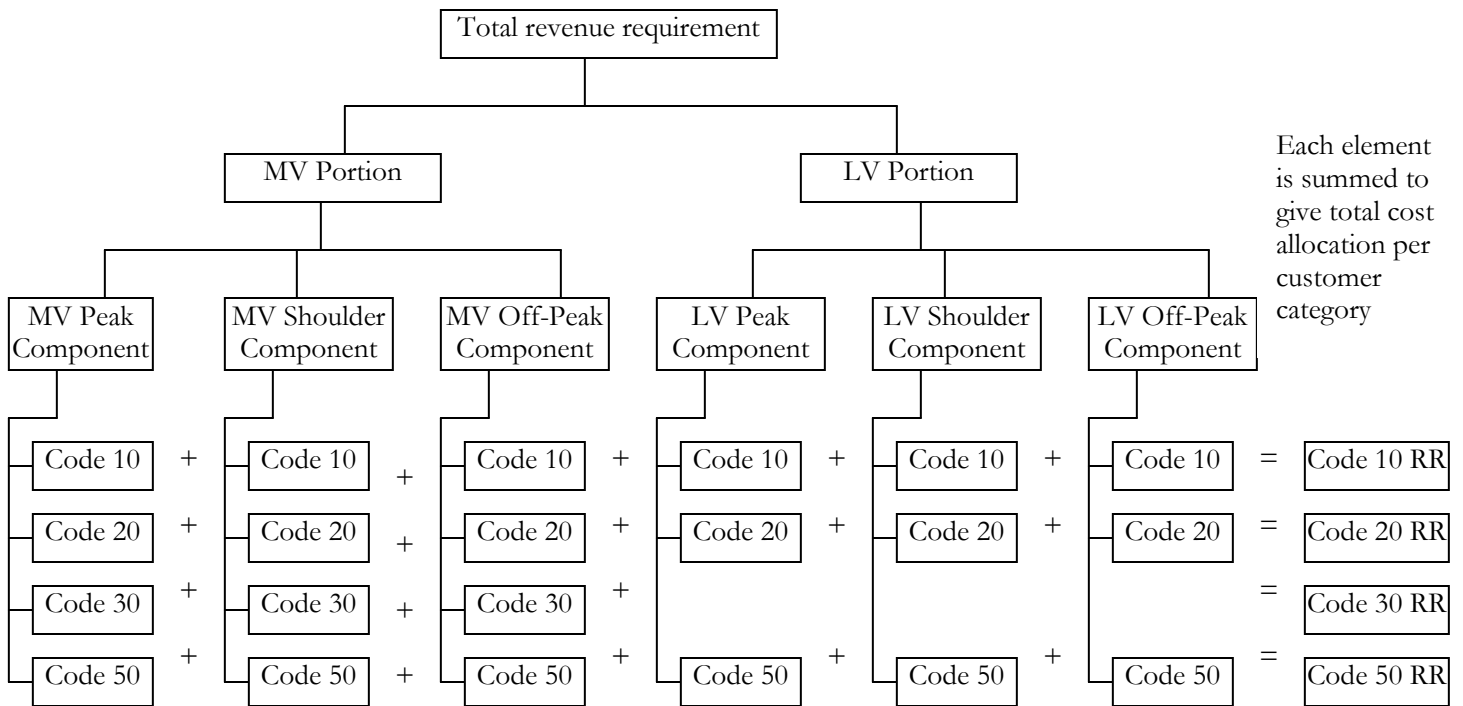
- Return on assets
- Return on working capital
- An allowance for bad debts and losses. The benchmark on these is set in the contracts in order to create an incentive for the distribution company to reduce them. Therefore, they are not fully passed over to the consumer
- Income tax.

The next step is to allocate the revenue requirement to customer categories. This is done in the following manner:

- Firstly, the total revenue requirement is split into two portions: the MV portion and the LV portion.
- Secondly, both the MV and the LV portions are then split into peak, shoulder and off-peak components.

The MV components are then allocated to customers who make use of the MV network. This allocation is done on the basis of a customer group's share of energy delivery at the MV level in each load period. The LV components are allocated in the same way. The final step is to convert this total cost allocation into a tariff for each tariff category. The energy charge may be split into different TOU charges.

### Determination of End-user Tariffs



Peak, shoulder and off-peak components allocated to customer categories in proportion to each groups share of energy load profile. The same procedure applies to MV and LV components taking account of each customer groups contribution to load at that voltage level.

*Source: ERA, 2006*

The end-user tariffs are adjusted quarterly to reflect changes in (i) the BST; (ii) the inflation rate and (iii) the exchange rate.

The following cost elements are adjusted in response to changes in the BST:

- The power supply elements of end-user tariffs are amended to reflect any changes in the BST.

The following cost elements are adjusted in response to inflation:

- The local currency component of operating and maintenance costs.

The following cost elements are adjusted in response to exchange rate:

- The foreign currency component of operating and maintenance costs;
- Return on working capital.

### **Sensitivity Factors**

The revenue requirement of the companies is sensitive to changes in: i) inflation, ii) Exchange rate, and iii) increase in fuel prices.

- Exchange rate: A number of costs are denominated in foreign currency and therefore sensitive to exchange rate movements. A significant depreciation of the Uganda shilling would cause tariffs to increase sharply even when everything else is stable.
- Fuel prices: Given the increasing share of thermal power in total energy mix, tariffs are highly sensitive to changes in fuel prices. An increase in fuel prices has a significant upward effect on energy purchase costs of the Transmission Company. These are passed through to the consumers on a quarterly basis.
- Inflation: Some of the costs that make up the revenue requirement of the companies are adjusted on a quarterly basis for changes in inflation. Therefore, increase in inflation in any given period would cause an upward movement in tariffs.

On the other hand, in Zambia the Electricity Regulatory Board (ERB) currently uses the Revenue Requirement pricing method to regulate tariffs of electricity utilities. Revenue requirement is here taken to mean the sum of all allowable costs, including a rate of return, deemed just and reasonable for the supply of electricity to customers.

- Revenue Requirement = Operating Expenses + Rate of Return x Rate Base

The Rate Base is the amount of capital or assets the utility dedicates to providing its regulated service while the rate of return is the cost of capital. Depreciation and taxes are also added to the operating Expenses.

The Revenue Requirement approach is also referred to as the Rate of Return methodology. The general principle here is that the utility is allowed to cover prudently incurred expenses and earn a reasonable return on its investment. The utility costs are therefore reviewed, and those costs deemed to be unnecessary or unreasonable are eliminated or adjusted accordingly.

Having determined an appropriate level of revenue requirement, or budget, for the utility, the ERB then works out a corresponding rate of increase to the tariff that will enable the utility to generate

the approved revenue requirement. This rate of increase is then applied by the utility on its existing tariffs.

Once a tariff is determined on the basis of the utility approved revenue requirement at the beginning of the year, the utility is free to apply to the ERB for a review under the Automatic Tariff Adjustment Formula (ATAF) in October. ATAF is only utilised to restate the approved tariff in the event of significant macroeconomic shocks such as a huge depreciation of the Zambian Kwacha or a huge rise in the level of inflation.

## **CONCLUSION**

Broadly speaking, the electricity distribution value chains in Uganda is involving a single private sector firm, UMEME who has monopoly over electricity retail, with small portion of concession to a power wheeling company and the other portion being handled by a public utility UEDCL. On the other hand, ZESCO remain the dominant public company providing the distribution and retail services. In the different channels, the values and margins are computed in very definite codes and the regulator have the final decision on what values and margins accrue from the chains in order to determine the end user price. In both countries, government interventions are common to allow affordable pricing. However, due to inadequate information readily made available by the different companies, establishing margins and values may not be possible at this material time.

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