

**NATIONAL ELECTRIFICATION FORUM**

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**WORKING GROUP: FINANCE AND TARIFFS**

**Electrification financing and tariffs:  
International literature review**

by

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## Executive Summary

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This report has reviewed international experience in pricing, financing and financial management in electrification programmes. Relevant conclusions are:

- The ability of electricity utilities to maintain and expand electricity services is severely prejudiced if their financial viability is undermined through inappropriate pricing, financing and financial management policies.
- Electricity pricing and financing should be undertaken within an integrated energy planning framework which establishes overall development goals and balances policy objectives between different economic and energy sectors.
- Economic efficiency is not the only criteria to be applied in deriving prices for domestic electricity consumers. Equity considerations and the financial viability of the utility have often taken precedence.
- Price regulation should be transparent and arms-length and should not result in the viability of the utility being undermined.
- Tariff levels should, as far as possible, attempt to achieve overall cost recovery for the household sector as a whole.
- Appropriate price signals (eg time-of-use tariffs) should be passed on to those consumers capable of adjusting their load patterns.
- To achieve greater equity and access, tariff structures should allow for low connection fees.
- External subsidies may be required for the lowest income categories as well as for rural electrification.
- Where the possibility of external subsidies is constrained, cross-subsidies may be affected through uniform tariffs applicable to high and low level consumers and to urban and rural areas.
- To minimise distortions in pricing signals, subsidies should first be applied to capital costs of connection, rather than to energy charges through the tariff.
- Governments have a key role to play in facilitating the flow of private capital to electrification programmes, as well as making available concessionary finance from the fiscus where this is required.
- Electricity utilities must maintain financial viability by ensuring that average prices more than cover their average costs. This will improve their self-financing ratio and the willingness of private capital, either to invest directly or to provide loans.
- Utilities must be able to attract private capital as it is unlikely and probably undesirable that utilities will be able to finance all their investment from internally-generated funds and since external sources of finance from government and foreign donors is generally insufficient.
- Rural electrification will, in many cases, compromise the financial viability of utilities and so concessionary finance will be required for such projects if they are desirable for economic, social or political reasons.
- Financing is required to overcome the barriers to entry posed not only by high connection costs, but also by expensive electric appliances.
- Current cost accounting methods are recommended, especially in inflationary environments, although the most commonly used approach is historical cost accounting.
- The debt to equity ratio, the self-financing ratio and especially the interest coverage ratio are three useful measures to monitor financial performance of utilities, although 'desirable' ratios depend on utilities' specific circumstances.

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## 1. Introduction

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This report was commissioned by the National Electrification Forum (NELF). It is a review of international experience in electricity pricing, funding and financial management. The purpose of the report is to assess how these issues have affected electrification programmes in developing countries and to draw conclusions which will assist NELF in establishing appropriate electricity pricing and financing policies for South Africa. A successful electrification programme which enables widened access to electricity is ultimately dependent on the creation and maintenance of a financially viable electricity distribution industry. Financial viability is, in turn, crucially dependent on appropriate pricing and financing policies and financial management practices. The report is based on an extensive review of international literature.

The review of electricity pricing commences with a discussion on pricing policies, the principles of economic efficiency and marginal cost-based prices. Some of the difficulties of this approach are highlighted, and additional, often more pressing, pricing objectives are noted, including the imperative of prices which will allow financial viability and prices which will achieve greater equity. Actual practice in developing countries is then examined with regard to tariff *levels* and *structures*. Tariff levels are compared with long run marginal costs, generally being much lower in developing countries. The tariff structures discussed include inclining block, single flat rate, two-part, unmetered and time-of-use tariffs. The question of subsidies is raised as well as the problems of implementing equitable life-line tariffs.

The section on financing examines sources of finance and mechanisms for financing. Sources include private savings of end-users, government grant finance from the fiscus, foreign borrowings, utility self-financing, private loan and equity investments, cross-subsidies, taxes and levies from other consumers, foreign donors and international lending agencies such as the World Bank. Financing mechanisms discussed include special electrification funds, electricity cooperatives and the special case of rural electrification agencies.

The final section reviews international financial management practices with regard to accounting, revenue and debt policies. Current cost accounting methods are favoured in theory, although historical cost accounting is most commonly used in practice. No cases where fund accounting is used were discovered. A review of revenue policies involves examination of rate of return on assets and equity, while debt policies involve parameters such as self-financing, debt-equity and interest cover ratios. The importance of transparency in financial management is highlighted.

Finally, conclusions are drawn regarding success factors for electricity pricing, financing, and financial management practices in developing countries.

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## 2. Electricity pricing

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### 2.1 Introduction

This section of the report covers the literature review conducted around the subject of the pricing of electricity for domestic consumers. The objective of the review was to gain insights into international experience with pricing for large-scale electrification programmes.

The subject of pricing has attracted a huge amount of attention in the international literature. Unfortunately much of the material is concerned with pricing for bulk consumers and is confined to the context of industrialised countries. Nonetheless a great deal of work has been done on energy pricing for developing countries, especially within the framework of integrated energy planning. This section covers the following particular topics:

- pricing principles;
- the practice of pricing in developing countries; and
- key success factors for electricity pricing and domestic pricing in particular.

### 2.2 Pricing principles

A great deal of the literature on electricity pricing for developing countries has been either written, or influenced, by the prolific Mohan Munasinghe. Starting in the late 1970s Munasinghe has played a central role in promoting the use of marginal cost based tariffs, mainly from a World Bank platform (Munasinghe 1980, 1981, 1983, 1984, 1988, 1990, 1992). A dominant theme in Munasinghe's writings has been the concept of *integrated energy planning*<sup>1</sup>. Although the pricing methodologies proposed by Munasinghe have been revised and improved over the years the basic concept of deriving electricity prices within the context of the energy sector and the country's general economic and development goals remains.

#### 2.2.1 Marginal cost-based pricing

The starting point of the pricing approach advocated by Munasinghe and others is a belief that social welfare will be not maximised unless electricity prices are based on the *marginal costs* of supply, defined as the net change in total supply cost resulting from an incremental change in output. This theory assumes that in an economy comprising efficient markets, prices based on marginal costs will automatically balance supply capacity with system demand.

A number of studies have criticised strict adherence to marginal cost-based pricing. Besant-Jones (1992:195) concedes that this approach is rather theoretical

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See 'An integrated framework for energy pricing in developing countries,' (Munasinghe 1980) for a useful introduction.

and is difficult to implement. Some additional problems with marginal costs are:

- whether electricity prices should be based on short-run costs or long-run costs<sup>2</sup>;
- the fact that economic costs do not include sunk costs from past additions to supply capacity; and
- the fact that marginal costs do not include any future operating costs attributable to past sub-optimal choices of capacity.

For a complete justification of marginal cost-based electricity prices as the pricing policy, it is necessary to assume that the rest of the economy has already moved to prices based on opportunity costs, particularly prices of electricity substitutes, of energy using equipment, and of products manufactured with electricity. In reality, however, this assumption is never valid, and electricity pricing must therefore take account of the constraints that invalidate this assumption.

A further macro-economic constraint on marginal cost based pricing is the fact that the required intensive analysis of inter-linkages among sectors is practically impossible for most economies, and hence a strictly optimal pricing policy is not feasible. This condition requires the marginal cost basis to be justified on less rigorous grounds, such as the assumption of both low cross-elasticities and interdependencies between electricity and other outputs. In practice therefore the approach to setting the prices of electricity has to start by focusing specifically on the economic and financial costs of power supply, explicitly disregarding these linkages, and subsequently modifying the prices to account for the constraints elsewhere in the economy that cause major distortions to the price signals for electricity use.

Besant-Jones (1992:195-6) does in fact concede that since electricity costs are usually less than 5 percent of total operating costs for industrial, commercial and agricultural users, and likewise less than 5 percent of total household expenditures, a price increase above (or decrease below) marginal costs would in fact create only negligible distortions in the economy (Besant-Jones 1992:195-6). This admission has particular relevance for the household sector where strict application of marginal cost-based tariffs could cause electricity prices to be out of the reach of the majority in most developing countries.

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In the short-run case, supply capacity is considered to be fixed relative to the level of output; in the long-run case, supply capacity is considered adjustable. SRMC therefore reflects changes in the costs of power systems operations from existing capacity in response to an increase in system demand. LRMC is the change in total system costs of meeting an incremental change in demand, sustained indefinitely into the future, when needed capacity adjustments are possible (Besant-Jones 1992:196).

### 2.2.2 Goals for electricity pricing

The Industry and Energy Department of the World Bank spells out its approach to formulating electricity pricing policies in a paper titled '*Domestic Pricing Policies*' (1989). The paper echoes Munasinghe's original five objectives for pricing policy (1980), namely:

1. *efficient* allocation of national economic resources;
2. *fairness and equity* in: cost allocation, price stability and minimum levels of service to consumers unable to afford the full cost of supply;
3. *financial viability* of the power sector;
4. tariffs *simple* enough to implement; and
5. '*other*' economic and political requirements such as subsidised electricity supply to certain sectors to enhance growth or to certain geographic areas for purposes of regional development.

The proposed approach to reconciling these (conflicting) objectives is to *start with the efficiency objective* by calculating the Long Run Marginal Costs (LRMCs) of supply. The paper suggests that prices should then be structured so that they vary according to the marginal costs of serving demands:

- by consumer category;
- by season;
- by hour of the day;
- by voltage level; and
- by geographical region.

Once LRMC based tariffs have been established according to these criteria a second stage should be commenced whereby these strict LRMC based tariffs are *adjusted to meet the other objectives*, of which the most important one is the financial requirement. Possible adjustments suggested for the domestic sector may be a uniform national tariff, or subsidised rural electrification. The paper notes that each adjustment deviating from the LRMC will impose an efficiency cost on the economy, and that the costs of this need to be weighed up against the benefits to be derived from such an adjustment.

#### 2.2.2.1 The question of equity as a goal for pricing

Although the World Bank paper is quite clear that *efficiency is the priority goal* it is careful to state that this does not mean that *equity* considerations are irrelevant. Rather, through careful tariff design (e.g. increasing block or "lifeline" tariffs) and a balance of project selection (e.g. a rural electrification component to the investment programme) it suggests a government can ensure that the living standards of the poor can be raised without significant loss of efficiency (Vedavalli 1989:24).

Besant-Jones argues though that governments need to consider carefully the effect of imposing the costs of socio-political objectives on the power sector which compromise the efficiency objective for pricing, such as might occur under rural electrification programmes. For example, granting unduly low electricity prices to specific consumers for non-efficiency objectives could

stimulate demand uneconomically (Besant-Jones 1992:191-192).

On the question of equity the International Monetary Fund (IMF) notes that there is a strong argument that rising fuel prices have a regressive impact on low-income groups, on the basis of evidence which shows that "the share of energy expenditure in the total is significantly higher for low-income groups than for high income groups" (IMF 1991:25).

As to whether policy should aim to ameliorate this regressive impact by subsidising fuels for low income households the IMF argues that three factors need to be taken into account:

1. whether or not the benefit of subsidies do indeed reach the low-income groups;
2. whether or not there may be unintended consequences. (Such as a multiplication of connection requests in the case of inclining block tariffs, or the adulteration of expensive liquid fuels with subsidised paraffin); and
3. whether the potential benefits are limited to the low-income households or do in fact accrue to higher income groups. (Such as the case of rural electrification where wealthier households can afford to utilise the energy source, thus leading to greater levels of rural differentiation) (IMF 1991:25-26).

The IMF concludes that, in general, direct help to the low-income groups would be more appropriate than subsidies and that, furthermore, any subsidies on fuels should be financed by general taxes on commodities (IMF 1991:26). Clearly, though, the practicalities of delivering direct assistance to low-income groups present severe difficulties, and in countries with inoperative or inefficient welfare systems cross-subsidies on fuels may be one of the few effective strategies for increasing the welfare of poor households.

### 2.2.3 Strategies for electricity pricing in developing countries

Because of the difference in conditions - economic, financial, institutional and technical - among the power sectors of developing countries, the literature generally concludes that there is no single best or universal approach to electricity pricing. For a particular country it is necessary to *start from basic policy objectives* in order to develop a strategy for electricity pricing that fits the country's general strategy for the structure and control of the power supply industry.

In practice then, electricity pricing systems must be designed to accommodate both economic and financial objectives, where financial viability is a necessary condition for satisfactory supplier performance (Besant-Jones 1992:191-192).

The Instituto de Economía Energética/Asociado a Fundación Bariloche claims to have developed a set of methodological approaches to the analysis of the level and structure of energy tariffs within the context of macro-economic and energy policies. These methodologies take into account problems of inequitable income distribution, satisfaction of basic needs, and the generation and transfer of natural and institutional rents. In line with Munasinghe's work on pricing

policy the Instituto de Economía Energética/Asociado a Fundación Bariloche has pointed out the need for tariff structures which consider not only the financial balance of the supplier companies, but also the principles and objectives of social equity and environmental protection. On this basis an *inclining block tariff structure* is proposed for domestic users which, if properly designed, should guarantee long term economic and financial balance.

In comparison with the classic marginal cost tariff this system is claimed to provide a concrete solution to the problems of unequal income distribution and of unequal access to higher quality energy sources (Bouille 1992:70).

A further point is made that fuel substitution, which is encouraged by this pricing structure, has multiple environmental effects. It not only reduces the pressure on forest resources, as well as the excessive emission of carbon-dioxide, but also benefits the end-users by diminishing emissions. This emission is regarded by the World Bank, in its report on World Development (1992), as one of the most acute environmental problems in developing countries (Bouille 1992:70).

### 2.3 Pricing practice

This section discusses the practicality of some of the pricing objectives proposed by the theoreticians as well as the practise of electricity pricing in developing countries. A number of topics are covered, including subsidies, demand side management, taxation, rural electrification and finally price regulation.

#### 2.3.1 Industrialised country pricing practices vs. criteria for developing countries

Given that the World Bank's proposed approach to electricity pricing for developing countries is fairly theoretical and, at points, highly abstract, questions have been raised as to the usefulness of the approach. Furthermore, the viability of applying these theories in even the developed systems of the industrialised countries has been challenged.

In a paper by MacKerron the application of electricity pricing criteria in the UK during the early to mid-1980s is contrasted with the criteria required by aid agencies, such as the World Bank, when lending money to developing countries. He identifies two key criteria for the purpose of the study, namely:

- the financial viability rule; and
- the economic efficiency rule.

In practice, MacKerron notes, many developing country governments and utilities have failed to follow one or both of these pricing rules. MacKerron suggests that, should industrialised countries, with their better developed and more sophisticated market systems, find it difficult to adhere to orthodox accounting and economic principles in their energy pricing policies, it would be logical to suggest that developing countries will find it even harder to do so.

Choosing the UK as an example of an industrialised country with sophisticated

energy markets MacKerron goes on to demonstrate that official British policy towards prices is indeed close to the policies commonly advocated for developing countries, i.e. a mixture of viability and efficiency, with preference given to the viability over the efficiency objective when the two come into conflict<sup>3</sup>.

The paper then examines the extent to which the viability/efficiency pricing rules have been followed in practise during the 1980s in the British electricity supply industry. Without going into the details, which show, as MacKerron puts it, that the industry was being run on a policy of "financial viability with a vengeance" (1987:37), the conclusion is reached that, although the viability and efficiency rules have been present as considerations in pricing policies, they have *not* been the principle determinants of electricity price levels. Viability has been achieved (or over-achieved) for electricity and, in the efficiency area, whilst marginal cost-based tariff *structures* prevail, tariff *levels* have almost certainly been too high relative to marginal costs.

Thus, he concludes, industrialised countries can systematically over-ride the efficiency rules in the interest of what governments see as more important policy objectives or constraints. Furthermore, MacKerron notes, the UK, like other industrialised countries, has a highly specialised energy policy-making organisation and a government with an ostensible commitment to limiting its own powers of intervention in order to allow market forces to determine economic and energy outcomes. If, in these circumstances, we find a market and political structure which does not achieve either viability or efficiency objectives we should not be surprised if developing country governments exhibit similar inability to achieve viability or efficiency in their price-making policies (MacKerron 1987).

Given this stern warning on the viability or practicability of World Bank policies the following discussion of the actual performance of developing country pricing policies should not be unexpected.

### 2.3.2 Developing country pricing policies

During the 1960s electricity tariffs were not under serious pressure because of generally low inflation and interest rates, stability in oil prices and declining marginal costs arising from the capturing of economies of scale in power supply. During the 1970s and particularly the 1980s, however, administered tariffs for electricity in most developing countries have failed to track changes in supply costs which followed the rise in global inflation, oil price increases, and the growth in debt commitments from large borrowings and rises in interest rates (Besant-Jones 1992:51).

Rather, many governments in developing countries have insisted on keeping tariffs below the economic costs of supply in order to support their economic

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It is commonly recognised that these two 'rules' may be mutually inconsistent if marginal costs are systematically below average costs.

policies for growth and inflation and maintain their social policies for protecting the living standards of low income groups. In some cases, delays in tariff increases have substantially weakened the financial position of power utilities and reduced their operating efficiency, even to the point of threatening the physical integrity of the power system in extreme cases. The build up in pressure for increases has eventually provoked much larger and more disruptive changes to tariffs than required under sound price administration, so that tariffs have been far more volatile in developing countries than in industrialised countries (Besant-Jones 1992:53).

In a paper prepared by the Technical and Administrative Unit of the Southern African Development Co-ordination Conference (SADCC, now SADC) for an energy ministers seminar on energy pricing<sup>4</sup> the key problem with energy prices was seen to be the reluctance of governments to price energy to reflect its economic costs because of their concerns with the adverse effects of price increases on:

- industrial competitiveness;
- household budgets (especially low income families); and
- inflation (in terms of its direct economic effects and its longer term social and political ramifications) (SADCC 1992).

The SADCC paper points out that in the period 1973-88 electricity prices have generally been set below long run marginal costs and remain substantially lower in some countries<sup>5</sup>. Resolution of the pricing issue has been complicated by the fact that energy price-setting is typically the responsibility of government, rather than energy enterprises. In setting energy prices governments have tended to give more weight to industrial competitiveness, impact on household budgets and inflation, than economic efficiency or the financial viability of energy enterprises (SADCC 1992:10).

### 2.3.2.1 Electricity tariff levels in developing countries

A working paper of the Industry and Energy Department of the World Bank (1990) entitled *Review of electricity tariffs in developing countries during the 1980's* provides a detailed, but limited, perspective of electricity tariff performance in the developing world. The report is based on data from some 60 countries and focuses chiefly on tariff levels in 1987<sup>6</sup>.

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The author notes that official working papers from the World Bank's Industry and Energy Department, Energy Series papers were used as a basis for the paper.

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These conclusions are reached on the basis of the World Bank Industry and Energy Department Working Paper, Energy Series Paper No. 13, April 1989, *Domestic energy pricing policies*.

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As the study did not extend to primary data collection some of the data, particularly that on the incremental costs of power expansion, is based on

At the outset the paper states that the two major principles for electricity pricing are that tariffs should reflect *economic efficiency* prices (in terms of structure and level) and that tariffs should be set so as to make power utilities *financially viable* with an acceptable rate of return. Despite the fact that the World Bank has on many occasions recognised the potential for conflict between these two principles (and the existence of other legitimate pricing objectives) the paper goes on to review the performance of developing country utilities solely in terms of the first principle, effectively ignoring the constraints that the second principle may impose, or any other constraints for that matter.

Nonetheless the results of the review illustrated the poor status of utilities:

- the average level of tariffs in developing countries was only about 55% of the average level in OECD<sup>7</sup> countries;
- the average level of tariffs in developing countries was only about half the level required to cover the incremental costs of the planned expansion of power systems during the 1990s;
- average tariffs expressed in constant local price terms were far more volatile in developing countries than in the OECD countries;
- electricity tariffs in 1987 were not based on the marginal costs of supplying electricity in nearly 80% of developing countries, even though the marginal costs had been studied in most countries;
- over 60% of developing countries had no intention of basing tariffs on marginal costs in the near future (World Bank 1990:3).

On the matter of domestic tariffs the survey had little to say, although a possible indication of the existence of cross-subsidies between industrial and domestic consumers was taken to be the ratio of bulk tariffs to low voltage tariffs. Since it is inherently more costly to supply low voltage consumers than high voltage consumers this ratio should be less than 1. Indeed, in the majority of OECD countries, chosen as a benchmark for the study, bulk tariff levels were between 50-75% of low voltage tariff levels.

In developing countries, analysis of average tariffs by supply voltage level<sup>8</sup> showed that:

- the ratio of bulk to low voltage tariffs fell outside the 50-75% range in about three-quarters of the countries surveyed;
- the ratio of bulk to low voltage tariffs for about one-quarter of the countries surveyed was greater than unity; and

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estimates.

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The Organisation for Economic Co-operation and Development, consisting of countries such as Switzerland, Portugal, Japan, Ireland, Greece, Canada, the United Kingdom, etc.

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For the 21 developing countries for which tariff yield data were available at all voltage levels.

- in a quarter of the countries bulk tariffs were below 50% of the low voltage rates, indicating substantial subsidies to bulk power users (World Bank 1990:13).

The World Bank concluded that these results indicate that tariffs in these (21) countries do not reflect the costs of supply at different voltage levels and that there are major subsidies between industrial and domestic consumers (in both directions!) (1990:13).

Whilst this report has some important limitations (e.g. reliance on imperfect data, such as unreliable exchange rates), and is oblivious to pricing objectives other than economic efficiency, it nonetheless serves to indicate the level of disarray in the electricity pricing policies of developing countries.

The literature also reports that the process of revising tariffs lacks transparency in most developing countries, and often allows influential consumer groups to benefit from unduly favourable terms. In many countries, cross-subsidies between consumer categories encourages uneconomic use of electricity (Besant-Jones 1992:51-53).

The failure of electricity utilities to set prices at levels which at least cover their costs, has frequently been reported (not only in World Bank publications) as a fundamental constraint on their ability to deliver a reliable electricity service to current and potential consumers. In a COPED review of the electricity systems of 11 developing countries in Africa, Asia and Latin America, it was found that revenues were frequently insufficient to cover costs, with the result that the quality of existing services generally deteriorated, and new investment were ruled out (De Oliveira 1991:84). In India and China, tariffs frequently were below actual costs, while in several African utilities, electricity prices did not even cover fuel costs. Examples include the Tanzanian utility, TANESCO (Kjellstrom et al 1992:96) and the Angolan utility (Horvei and Dahl 1993:21); the electricity prices in the latter are around 0.015 US\$/kWh using the parallel foreign exchange rate, or 0.18 US\$/kWh using the official exchange rate. Clearly, with revenue at such low levels, huge subsidies are required from the fiscus to sustain utilities' operations, let alone to finance new investment. Moreover, such sources of grant finance from the government are generally not easy to sustain, and carry huge opportunity costs in relation to other demands on the state.

Similarly, the Zimbabwe Electricity Supply Authority (ZESA) operated under direct political control after independence, which hampered its ability to set prices at levels sufficient to meet the utility's revenue requirements. The consequence has been *'the progressive undermining of both the financial viability of ZESA and its standing as a recipient of donor funds for investment purposes'* (Robinson 1993:170).

In recognition of the serious constraints resulting from sub-economic electricity prices, many utilities in developing countries have begun the process of increasing their price levels and to levels which increase their financial viability (De Oliveira 1991:84). With an improvement in their financial status, apart from the additional revenue generated internally, utilities are more likely to attract external capital to finance new investments - whether these are aimed at increasing bulk supply capacity or widening household access to electricity.

### 2.3.2.2 Electricity tariff structures in developing countries

In a review of electrification programmes in six countries Dingley (1988) found a range of domestic pricing policies which are summarised in Table 1.

**Table 1** Domestic pricing policies from six countries (Dingley 1988).

Country	Utility type	Tariff	Percentage electrified
B r a z i l (COPEL)	Regional distributor	Inclining block for urban (4 blocks at 0, 100, 200 and 300 kWh) Single flat rate for rural Uniform domestic tariffs for all regional distributors Intentions of introducing a two rate TOU tariff Fairly high connection fee, but with repayment facilities to assist access for the poor	65%
Costa-Rica (ICE)	Regional distributor	Inclining block (0-250 kWh at lowest rate then increasing for each 200 kWh thereafter to a maximum at 1500 kWh per month) Uniform national tariffs for urban and rural consumers No connection fee	85%
USA Rural Cooperatives	Cooperatives	Varying tariffs including two part, declining block and flat rate tariff structures Uniform domestic tariffs in each area of supply, including urban and rural consumers	100%
Hong Kong (CLP)		Flat rate tariff Uniform domestic tariff in all areas of supply, including urban and rural consumers No connection fee	95%
Thailand (PEA)		Inclining block (9 steep blocks) Uniform national tariff (urban and rural) Low connection fee	75%
Greece (PPC)		Inclining block (4 blocks) Two level TOU tariff option Uniform national tariffs (urban and rural) No connection fee	100%

Each of the countries included in Table 1 has implemented successful domestic electrification programmes, such that the lowest level of electrification is almost twice South Africa's current level of electrification. Conclusions which may be reached on tariff structures are:

- that the principle of urban to rural cross-subsidisation is widely accepted, and is generally implemented in the form of a uniform tariff for both categories (Dingley 1988:27);
- that the practice of cross subsidising within the domestic consumer group, from high level consumers to low level consumers, is also widely accepted; and
- that connection fees need to be kept low in order to make electricity accessible to the poor.

In a survey by Eskom of domestic tariffs in the Southern African region the following pricing policies were found (as per Table 2):

**Table 2** Domestic pricing policies from eight Southern African countries (Eskom 1991).

Country	Domestic tariff structure	Price level <sup>9</sup> (SAc/kWh)
Botswana	two part	37
Lesotho	two part	27
RSA (Eskom)	two part or flat rate (S tariff)	23
Malawi	low density (high income) areas - basic charge plus declining block at 250 kWh high density (low income) areas - basic charge plus inclining block at 150 kWh	20.5
Swaziland	two part	18
Namibia	flat rate	9
Zimbabwe	unmetered, load limiter or inclining block with basic charge	8
Zambia	unmetered, load limiter or two part	1

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Since Eskom represented prices only in graphical form these figures may be slightly incorrect. Of more concern, however, is the problem of relying on official exchange rates in translating tariffs from local currencies into SAc/kWh. These price levels reflect the average price per kWh at a level of 250 kWh per month.

Besant-Jones (1992:53) concludes that electricity tariff structures (for all market segments) in most developing countries are relatively simple. Few countries have incorporated the concepts of marginal costs or cost of service in tariff structures, even though marginal cost studies were carried out in most countries in the 1980s (1992:53). Nonetheless, as argued earlier, the advantages of applying marginal cost principles in deriving domestic tariff structures are rather doubtful. He also notes that *'domestic ... customers now usually pay a uniform energy rate instead of the complex block tariff rates for various consumption levels that used to be applied, although some of these tariffs have a low rate for a limited amount of energy for residential use to help low income households'* (1992:53). Although this statement on tariff structures does seem to contradict the evidence of the above two tables the intention to provide a measure of relief to low income households is consistent in all three research efforts.

### 2.3.2.3 Time of use tariffs

The literature on time of use (TOU) pricing for domestic consumers in developing countries appears to be rather limited. In one of the few applicable papers titled *'Time of day pricing schemes for electricity utilities in developing countries'*, Babu Ram (1991) remarks that implementation of TOU tariffs in the domestic sector requires relatively large expenditure on metering, but that this must be weighed up against the propensity of these consumers to contribute to peak load. The comment is made that the introduction of TOU pricing schemes for domestic consumers may have to be considered on an optional basis with consumers bearing the additional metering costs in exchange for the opportunity to reduce their bills. A further point is made about the potential benefits of delaying the construction of additional power plants (Ram 1991:10-11). No economic analysis of costs or benefits is, however, advanced to justify these remarks.

Utilities in industrialised countries, particularly the United States, appear to have been experimenting with domestic TOU tariffs since the late seventies (Caves & Christensen 1983). One such experiment with volunteer households produced the following five key policy results:

- participants in the voluntary programme exhibited a significant response to TOU tariffs, reducing their on-peak usage share from 19% to 15%;
- customer usage patterns and responses to TOU tariffs depended on appliance holdings and weather;
- the response of the voluntary customers was substantially larger than the response of customers in prior mandatory TOU tariff experiments;
- the volunteer population appeared to have on-peak usage shares under standard tariffs that were similar to the overall residential population; and
- there was limited evidence that, as customers become more knowledgeable, those with higher usage shares tend to migrate back to standard tariffs (Caves et al 1989:84).

Although no references could be found that dealt explicitly with TOU tariffs for domestic consumers the existence of these tariffs in some developing countries

has already been noted in the literature (such as Brazil and Greece in the above table).

#### 2.3.2.4 National vs. regional/local tariffs

Munasinghe makes the point that uniform nation-wide energy prices are a political necessity in many countries, although this practise implies cross-subsidisation, e.g. urban consumers subsidising those consumers in remote rural areas where distribution costs are higher (Munasinghe 1983:9).

He also notes that the full economic benefits of such a policy may be much greater than the apparent efficiency costs which arise from any divergence between actual and efficient price levels. In fact this policy is likely to have much more significant benefits in a developing country than in a developed country, not only because of the high cost of energy relative to incomes in the former, but also because the available administrative or fiscal machinery to redistribute incomes or achieve regional development objectives by other means is frequently ineffective.

#### 2.3.3 Subsidies and cross-subsidies

The World Bank argues in its *World Development Report 1992* that subsidies on energy contribute to wasteful uses of resources, and that their removal is one of the most important pre-requisites for improving the possibilities of increased economic growth in the developing countries (in SADCC 1992:11). An important distinction to make, however, is whether the World Bank is referring to:

- subsidies to bulk electricity users or subsidies to low income domestic energy users; and
- subsidies from the fiscus or cross-subsidisation within particular energy sub-sectors.

On the basis of previous comments by Munasinghe on the role of lifeline tariffs it may be safely assumed that the World Bank is largely concerned with direct fiscal grants to meet utilities' operating deficits, as well as subsidies to non-domestic consumers from the fiscus and large cross-subsidies between market segments, rather than cross-subsidies between consumers within the same market segment.

As mentioned earlier an important component of pricing policy for domestic consumers is the redistributive effect of pricing structures. One of the most popularly advocated methods of achieving a progressive impact is the lifeline, or inclining block, tariff. This section therefore examines the role and experience of these tariffs as reported in the international literature.

##### 2.3.3.1 Lifeline tariffs

Adjustments to efficient prices are often motivated on the basis of socio-political or equity arguments and these often take the form of 'lifeline', or inclining

block, tariffs. Economic reasoning based on externality effects is also used to support such cross-subsidy measures, e.g. to reduce excessive firewood use or to prevent deforestation and erosion (Munasinghe 1983:7).

Munasinghe advances a practical economic model based on income distribution arguments to assist with the design of lifeline tariffs. The model is intended to assist decision makers on the parameters of inclining block tariffs, namely, the number of energy blocks, the size of each block and the price for each block of consumption. In practise this requires a form of social weighting, based on empirical observations of the low income group within the country, and no generalisable law has been derived (Munasinghe 1983:8).

### 2.3.3.2 Lifeline tariffs in the United States

The potential drawbacks of lifeline tariffs are well illustrated by the case of California as reported by Hennesy & Keane (1989:123).

Originally mandated by the state legislature in 1975 lifeline rates were justified on the basis of two assumptions:

- that light and heat were *basic human rights and must be made available to all the people at low cost for basic minimum quantities*; and
- that the declining block residential rate structure in place at the time penalised small-volume consumers and encouraged *wastefulness*.

The size of the lifeline block was intended to provide for the *essential needs* of space heating, water heating, lighting, cooking and food refrigeration and was to vary by climatic conditions in the state and by season. The price of the lifeline block could not be greater than the average rates in effect at the time and could not change until the average system rate increased to greater than 25% of the level of 1 January 1976.

Almost immediately the problem arose of determining an *'essential needs'* amount. Special lifeline allowances were legislated for paraplegics and consumers dependent on life-support systems. In 1978 legislation defined air conditioning as *essential* for all consumers living in hot regions of the state.

This proliferation of special interest groups eventually prompted an amendment of the original legislation, resulting in what was termed *baseline* rates. These defined the baseline amount as 50 to 60% of *average residential consumption* where the baseline amount was priced from 15% to 25% lower than the system average rate (Hennesy & Keane 1989:124).

An important point to note is that the Californian utility determines the revenue requirements of each consumer class separately and the practical effect of these tariffs is for high level consumers to cross-subsidise low level consumers. This effect has been the subject of intense debate and study in the United States with

a series of studies evaluating the social impact of the system<sup>10</sup>. Whilst it is clearly inappropriate to contrast the social conditions of an industrialised society such as the United States with the conditions pertaining in developing countries some interesting results are worth recording:

- a study in Utah suggested that lifeline rates are a relatively inefficient method for redistributing income and that the concept could be improved by establishing some kind of need criteria for eligibility, such as requiring customers to certify income levels. It concluded that the same results could be achieved at lower cost by providing direct subsidies to low income groups (Petersen 1982); and
- a study based on data gathered in the US-wide Annual Housing Survey showed that 45% of the low income group which a lifeline tariff is designed to help would be bypassed or possibly hurt by the introduction of such a tariff structure while on the other hand 38% and 31% of the middle and high-income groups, respectively, would benefit from such a tariff (Roll & Lande 1980);

Despite the evidence of studies such as these, many states in the US continue to implement lifeline tariffs, largely as a result of political pressure from the electorate. Perhaps the most significant lesson for developing countries is the inherent danger of combining this tariff structure with a decision-making system whereby public pressure can easily influence the level, size and qualifying conditions attached to the initial low price block of energy. Whilst this should in no way be construed as an argument against public accountability in pricing it should be noted that this tariff structure is more likely to be abused than others.

In defence of the lifeline concept Hennesy quotes Berg as saying, '*opportunities are missed when our lack of complete understanding causes unnecessary delays. The goal of perfect policies is one of the greatest enemies of the achievement of good policies*' (Berg in Hennesy 1984:340).

#### 2.3.4 Demand side management

The issue of demand side management (DSM) and energy conservation features prominently in international literature on electricity pricing, particularly in relation to the domestic context. DSM objectives assume added importance in the context of an accelerated electrification programme because of the potentially adverse impact of typical domestic demand patterns on the overall system. Munasinghe's paper '*Third world energy policies: Demand management and conservation*' is a particularly useful contribution on the topic (Munasinghe 1983). In the paper he makes the point that conservation is an important part of DSM and that it involves measures that specifically seek a deliberate

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See Hennesy & Keane (1989), Howe (1976), Pace (1975), Roll & Lande (1980), Frank (1977), Dahl (1978), Hennesy (1984), Petersen (1982) and Blocker (1985).

reduction in the use of energy below the level that would otherwise prevail. Such reductions involve:

- elimination of outright waste;
- reduction of energy-using activities;
- substitution of one form of energy by another; or
- substitution of other productive factors such as capital and labour for energy (Munasinghe 1983:9).

Clearly though such energy conservation programmes need to be implemented only after determining whether their economic benefits exceed the corresponding costs (Munasinghe 1983:4).

A key constraint in this regard is the fact that energy users who confront high opportunity costs of capital (as is often the case in developing countries), will find costly capital-intensive energy conservation measures relatively less attractive than users who have access to low-cost sources of capital. This factor is aggravated by the prevalence of market imperfections, particularly in the pricing of energy, in most developing countries. Where market costs diverge from real economic costs, such as in the presence of energy price subsidies or high tariff barriers on energy efficient appliances, individual consumers will tend to make economically inefficient energy-use decisions (Munasinghe 1983:12).

Munasinghe also makes the point that appropriate pricing is only one strategy among a wide variety of direct and indirect policy measures that can be taken to bring about desirable levels of energy conservation. Among them are direct regulation of energy uses, regulation of the use of energy-using equipment and appliances, mandatory standards, mandatory information requirements about energy consumption rates, taxes and subsidies, appropriate infrastructure investments for energy-saving facilities, education, propaganda and others. Particularly relevant strategies for domestic electricity consumers include:

- disseminating up to date information;
- improving conservation awareness;
- installing more energy efficient equipment (particularly fluorescent lighting instead of incandescent bulbs<sup>11</sup>);
- altering architectural design practices; and
- using appropriate building materials (Munasinghe 1983:13).

### 2.3.5 Taxation on electricity

In a survey of industrialised countries the International Monetary Fund (IMF) found that the average tax rate on electricity as a percentage of its pre-tax price was around 17 percent (IMF 1991:5). Interestingly it also found that taxes on electricity were substantially higher for domestic consumers than for industrial

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See Sathaye & Gadgil 'Aggressive cost-effective electricity conservation: Novel approaches' for an excellent economic analysis of this topic.

consumers, who faced on average a tax rate of around 4 percent on the pre-tax price.

In a survey by the UK based Electricity Association of a selection of industrialised countries various tax rates on domestic electricity prices were found (see Table 3).

Little information on the taxation of electricity in developing countries was available, an indication perhaps that it is not a common practise. One exception was Brazil where a tax is levied at a flat rate per kWh, regardless of the fact that the tariff for urban consumers is an inclining block structure. Furthermore, there is no tax on the first 30 kWh and no tax for rural consumers.

**Table 3** VAT rates on domestic electricity prices in industrialised countries (Electricity Association 1991).

Country	VAT rates
Austria	20%
Belgium	17%
Denmark	22%
Finland	17.5%
France	basic charge 5.5% energy 15%
Germany	14%
Greece	18%
Ireland	10%
Italy	9%
Luxembourg	6%
Netherlands	18.5%
Portugal	8%
Spain	12%
Sweden	25%
United Kingdom	0%

### 2.3.6 Rural electrification

Literature on the topic of rural electrification tends to focus on the economic

costs and benefits of these projects and rarely touches on the issue of price<sup>12</sup>.

Instead electricity prices are, it seems, generally taken as a given, as determined by national policy. The question usually addressed in the literature therefore becomes one of relative prices, where prices of other energy sources are determined by a combination of: policy prescriptions, market forces and free common property resources (such as wood). Furthermore, there is also the connection charge to be considered, the cost of wiring and the cost of appliances. As Anderson et. al. note (in Pearce and Webb 1987:336), *'it is the total cost, inclusive of appliances etc. that will determine whether or not to connect to the system'*.

In a paper on the social financing of electrification Dingley (1990:12-13) does, however, show that subsidisation out of public funds is required for rural electrification to be viable. This, he remarks, needs to come from government funds or from foreign loans at low interest rates. He also comments that cross subsidisation among electricity consumers is widely practised, and is sometimes unavoidable if tariffs are to be kept simple. Care should, however, be taken not to impose too high an *electricity tax* on wealthy or large consumers. Nonetheless, Dingley does propose a flat rate tariff structure as a compromise between economic and social objectives. This is further justified on the basis of the practical advantage of simplicity and the facilitation of the introduction of prepayment metering.

### 2.3.6.1 Remote Area Power Supplies

On the matter of Remote Area Power Supplies (RAPS), as an alternative to grid electrification, there appear to be some difficulty in establishing clear guidelines for determining break-even points between technologies. An investigation by Sinha and Kandpal (1991:448) into the economic factors underlying India's extensive rural electrification programme showed conclusively, however, that for small and isolated villages with low load factors, decentralised energy technologies made economic sense.

Local researchers, Eberhard and Borchers (1990:6), also remark on the difficulty of broad economic and environmental cost benefit analyses. Nonetheless, they do show, on the basis of narrow financial criteria, that photovoltaic (PV) RAPS systems can be cost effective for small energy users in remote areas. The comment is made that PV technology is based on a renewable energy source and that, with continued technological advances, PVs have the potential to provide not only for remote area power needs but also, in the longer term, for electrical power requirements closer to metropolitan centres. Given a growing awareness of environmental issues, such as the question of emissions from thermal power stations, it is argued that PV systems will become increasingly attractive.

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Even Munasinghe in *'The economics of rural electrification projects'* fails to develop any significant arguments around pricing for rural electrification.

### 2.3.7 Price regulation

The topic of price regulation is both broad and contentious with perhaps almost as much literature devoted to it as the issue of pricing itself. As the original brief for this study did not call for an investigation into the regulatory aspects of pricing it is not examined in any detail. Some pertinent comments on the topic by Besant-Jones are, however, worth noting.

He reports that electricity tariffs have generally been administered by governments or their regulators to protect the interests of electricity users by controlling the monopoly power of utilities. An unfortunate side-effect of this arrangement in the context of the economic conditions that the developing countries have found themselves under in the 1980s has been *'lags between increases in supply costs and tariffs.'* Besant-Jones (1992:51) attributes these to *'technical and political limitations in the regulatory process'*. The resulting distortions of tariffs from economic costs has led to inefficient supply and use of electricity.

## 2.4 Success factors

This section briefly covers some of the key success factors identified in the international review of literature on electricity pricing.

### *Start with clear policy objectives*

In order to implement the necessary trade-offs between pricing objectives, particularly the efficiency vs. equity debate, it is essential to start with clearly defined national economic and development policies.

### *Perform pricing within an integrated energy planning framework*

Rational electricity pricing policies are most appropriately arrived at within an integrated energy planning framework located within an overall understanding of the national economy. Policy-making in respect of electricity pricing should not be done in a narrow, supply-oriented manner, independently of other energy sub-sectors. In addition, policy-making should be consistent with overall economic and development goals.

### *Tariff levels and subsidies*

Tariff levels should, as far as possible, achieve *overall* cost recovery for the domestic market segment. *Significant deviations from this policy will severely prejudice the financial viability of the utility and hence its capacity to maintain and expand electricity services.*

Given the capital intensity of large scale electrification programmes and low income levels among potential consumers, it may not be possible to set affordable tariffs which will enable full cost recovery, in which case external subsidies may be required.

Ideally subsidies to the poor should be sourced from the general fiscus and should be direct, rather than take the form of cross subsidies via electricity tariffs. However, where welfare systems are not capable of delivering direct subsidies, uniform tariffs (across urban and rural areas) can facilitate rural electrification and wealth transfers from urban to rural areas. In such cases, it may therefore be efficient, from a redistributive perspective, to implement cross subsidies.

**Tariff structures**

Tariff structures for domestic consumers must take distributional effects into account and achieve the following:

- ensure that electricity is accessible to the poor, via free or low connection fees;
- reduce the regressive impact of electricity prices on low-income groups; and
- pass on appropriate signals to high-income groups capable of demand side management by adjusting their load patterns in response to the price signal. This is most effectively achieved through time of use tariffs.

**Be clear which pricing criteria apply to which market segments**

There is clear consensus in the literature that various pricing criteria require different weightings in the policy formulation process for different market segments. To simplify this slightly the following distinctions can be made (Table 4):

**Table 4** Brief summary of criteria weightings for domestic and non-domestic electricity pricing policies.

Criteria	Economic efficiency	Financial viability	Equity
Non-domestic consumers	Second criterion	Top criterion	Important, but usually interpreted as 'fairness' or 'cost-reflectiveness'
Domestic consumers	Non-critical	Top criterion, need to recover the average costs of the market segment (Although capital injections are common)	Very important, the heart of the debate. Issues of transparency, distributive effects, external capital subsidies, etc.

Ultimately economic efficiency appears to be given little weight by most policy

makers in the process of deriving *domestic* electricity tariffs. This condition arises from the following:

- the relatively small size of the domestic market segments, which means that overall price distortions in the energy market arising from 'non-efficient' domestic electricity prices are minimal (Besant-Jones 1992);
- the frequent existence of strong distortions in the price of substitute fuels, such as paraffin, comprises the efficiency benefits which would result from efficient pricing of electricity;
- the difficulty of passing on appropriate pricing signals to domestic consumers, not only in terms of price *levels*, but particularly in relation to the varying costs according to *time* of use, because of the high cost of time of use meters; and
- the relatively high weighting usually attached to the question of equity, generally interpreted, in the context of large income inequalities and limited welfare systems, as the need to redistribute wealth via energy pricing mechanisms.

#### ***Develop and maintain the institutional capacity for pricing policy-making***

A recognition of the difficulties of setting overall policy for electricity pricing emphasises further the necessity of developing and maintaining the institutional capacity to carry out such policies. This requires at least the following two pre-conditions to be satisfied:

- firstly the institutional capacity will have to exist to perform the integrated energy planning and overall economic *analysis*. Such policy formulation should involve planners, economists and engineers who should provide a framework for energy pricing to the decision-makers; and
- secondly, institutional mechanisms empowered to *implement* such policies will also have to exist.

Both of these planning and implementation functions will inevitably require a degree of centralisation, probably at a national level, if policy-making is to be truly effective.

#### ***Price regulation systems should be open and transparent***

Price regulation systems need to recognise the rights of government, the electricity utility and other stakeholders to play a role in price-setting. Conflicting interests should be catered for in an open and transparent manner to prevent any one group dominating the process. Essentially government will always be involved in the process, but should be kept at arms length from the utility. Failure to achieve this may result in an abuse of power, which in the long term has frequently resulted in damage to the financial health of utilities and hence their capacity to expand access to electricity.

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### 3. The financing of electrification

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#### 3.1 Introduction

This section describes the literature review conducted around the subject of the financing of electrification. The objective of the review was to gain insights into international experiences with the financing of large-scale electrification programmes, in order to identify factors which may assist in the planning and implementation of South Africa's own programme.

Whilst there is a large amount of literature published internationally on the broad subject of financing in the energy sector generally and the electricity power sub-sector specifically, there is considerably less dealing directly with the financing of household electrification programmes. Nonetheless, some important lessons can be drawn from the experiences of a number of countries, such as Thailand, Argentina, Bangladesh and Brazil, which have all been involved, to a greater or lesser extent, in programmes to widen households' access to electricity.

Several issues which have emerged from the literature review will be addressed in the following three sections:

- possible sources of finance for electrification;
- mechanisms and institutions for managing finance; and
- key success factors.

From a definitional point of view, it is understood that finance is generally required for two main kinds of expenditure in electrification programmes. The first and usually the largest amount relates to the initial *capital* investment in new distribution and reticulation infrastructure; while the second relates to the finance which may be required to cover ongoing *operating* losses which are incurred when revenues from new consumers are insufficient to cover all operating costs. This is especially relevant where newly-connected households consume smaller amounts of electricity than required for utilities to recover their fixed costs. It is assumed that in the present discussion, financing arrangements may relate to both of these expenditure flows.

#### 3.2 Sources of finance for electrification programmes

A wide range of sources of finance have been tapped to finance the investment required for electrification programmes in other countries. These sources carry different costs and conditions associated with their use, and inevitably almost all sources require some trade-off to be made against competing alternative uses of those funds. This section outlines the range of sources which may be available to finance electrification investments, based on international experience.

### 3.2.1 Private savings of end-users

People who have sufficient incomes to allow them to accumulate savings, may be able to afford an upfront cash payment for connection costs, which therefore reduces the financing requirement of electrification dramatically (where their cash payment relates not only to the final stage of metering and wiring the house, but to their share of total capital expenditure necessitated by electrification). In such cases, supply authorities require only short-term finance, and expect to recover connection costs from new consumers within a short period. Finance costs are therefore minimised, although there is also an opportunity cost for households who are diverting their savings from other possible applications.

While this is a favourable option from the point of view of electricity utilities, it is clear that the lack of savings in most unelectrified households rules out this option. Most countries which have implemented large electrification programmes have faced this constraint, and at most, have required new customers to pay a small amount of cash as a deposit.

### 3.2.2 Government grant finance from the fiscus

In response to the inability of poor households to afford the connection cost, coupled with strong pressures on government to deliver services to their constituencies, many governments have played active roles in ensuring that investments are made in distribution systems. One of these roles has been to encourage utilities to invest heavily in electrification, often with low tariffs, and to finance utilities' operating deficits on an ongoing basis from the fiscus (De Oliveira 1991). In other cases, governments have made fiscal grants specifically for electrification investment costs. In Ireland after World War Two, for example, the government provided a 50% capital subsidy for new connections (Foley 1990:172-173). With this sustained support, over the following thirty years, virtually 100% of rural households in Ireland were electrified.

A capital subsidy scheme also operated successfully in New South Wales, Australia. The Rural Electricity Subsidy Scheme (RESS) ran from 1946 to 1983 and provided each new consumer with a capital subsidy which usually covered all or most of their connection costs (Harrington 1986:14). This system financed the electrification of almost 100% of rural dwellings, funded 50% each by the Electricity Commission of NSW and the state Treasury.

As Hill (1992:347) points out, the allocation of general fiscal resources to the electricity sector means that resource are diverted from other development sectors. In addition, where government revenues are insufficient to sustain high levels of expenditure, governments have often resorted to deficit financing, and mostly from foreign lenders.

Other examples of electrification programmes in which the state has provided grant or concessionary finance for electrification are described in section 3 in the context of the institutions and mechanisms used for the management of finance.

### 3.2.3 Foreign borrowings

The scarcity of local finance in many developing countries, together with the high liquidity of major lenders during the 1970s, were key factors which led to greater utilisation of foreign borrowings to finance power sector investments in developing countries. While these investments mainly entailed expansions of their generation capacity, expansion of their distribution sectors played a similar role.

Investments in the electric power sector have accounted for a large portion of foreign borrowings in developing countries such as Mexico, Brazil, Argentina and Thailand. As the experiences of some of these countries show, increasing debt levels can rapidly run out of control, to the extent where huge amounts of resources flow out of the country to meet debt obligations. In the case Mexico, for example, financing costs came to account for 50% of the average cost of electricity in 1985 (De Oliveira 1992:77). At the same time, the ESI debt in these countries contributed a significant portion of their total external debt. In Mexico, ESI debt accounted for 33% of foreign debt in 1970, increasing in real terms by 11% per annum to reach \$14 billion in 1982, while in Thailand, expansion of the power system resulted in huge increases in foreign debt, accounting for 20% of national debt by 1989 (ibid:79). Ultimately these high debt levels were unsustainable, and the 'debt crisis' which resulted, led to a shift in financing and pricing policies in utilities, towards a trend of improving their financial viability and self-sufficiency.

### 3.2.4 Self-financing by electricity utilities

A strong theme in the literature is the need for utilities to improve their *self-financing ratios*, or in other words to increase the proportion of total investment funds which is met by internally-generated surpluses from operations. This, in turn, is closely related to the pricing regime in force in electricity utilities.

In an important study, COPED (an international network of energy research institutions) reviewed the key issues facing the electricity supply industries (ESIs) of eleven developing countries from Asia (China, India and Thailand), Africa (Ivory Coast, Senegal, Mali, Algeria and Zaire), and Latin America (Argentina, Brazil and Mexico) (De Oliveira 1991:4). Several of the utilities had negative self-financing ratios because of their operating deficits. One of the primary findings in the study was that their ESIs need to recover their financial viability and ability to invest: *'The self-financing ratio of utilities must be increased substantially to reduce external financial needs'* (ibid:102). It was suggested that pricing policy should be restructured so as to allow utilities to generate operating surpluses, which should be applied to new investment. The COPED study argued that this was necessary to reduce the dependence on scarce and expensive private capital. At the same time, equity objectives need not be compromised by pricing policies which aim to cover average costs. Ultimately, the ability of ESIs to make additional investments is a precondition for the achievement of their objectives, one of which is to widen household access to electricity.

In South Korea, the government's policy since the 1960s has been to finance expansions of parastatals such as the Korea Electric Power Corporation

(KEPCO), as far as possible from *within* corporations themselves (Hill 1992:347). Whilst the major investment in Korea has been in the area of additional generation capacity, similar lessons could be applied to investments in distribution systems. KEPCO's capacity increased more than fiftyfold from 367 MW in 1961 to 19 944 MW in 1988, and a large part of this was self-financed. From 1967 to 1988, between 39% and 100% of capital expenditures were financed from within KEPCO (ibid:349). Moreover, not only were investible funds increased through pricing policies, but additional resources were made available through technical efficiency improvements, with the result that the utility's self-financing ratio was further increased. As a consequence, KEPCO was well-placed to sustain and increase its investment levels.

### 3.2.5 Private loan and equity investments

Notwithstanding increases in revenues due to higher tariffs, financing constraints remain, because utilities can optimistically self-finance only a portion of their investment; according to De Oliveira (1992:83), this might account for 40% of total financing requirements. Furthermore, concessionary support from government and multilateral and bilateral agencies is likely to be limited. Hence many utilities are moving towards inducing private capital investment (ibid). This is a consistent trend in many developing countries, where increased private sector involvement is seen as one of the few options for increasing investment levels (Barnett 1992:36, Churchill and Saunders 1989). The ability to attract private capital is closely linked with the previous point (about self-financing ratios), since utilities are likely to attract private investors only if they demonstrate that they are able to finance their own operations by generating sufficient revenues to cover costs and make additional investments.

However, a constraint in many LDCs is that there are no markets which channel private domestic savings into investment (De Oliveira 1991:98), and in these cases, institutional development is seen to be a priority. In South Africa, however, the same probably does *not* apply, since the country's financial sector is very well-developed, with banks and institutional investors having access to large amounts of private savings.

### 3.2.6 Cross-subsidies, taxes and levies from other consumers

Revenues generated from wealthier domestic and industrial consumers have been an important source of finance in several electrification programmes.

In Argentina, major progress was made in widening household access to electricity over the period 1945 to 1985, with about 50% of the population having access to electricity in 1945 (only 12% in rural areas) and 88% of the total in 1985 (96% urban and 34% rural) (Bouille 1993:54). This was financed by the state through levying taxes on the petroleum sector, complemented by taxes on higher-income electricity and gas consumers (ibid:73). For the expansion of the electricity (and natural gas) networks, these funds were successfully channelled through the National Savings and Insurance Institute which acted as the financing institution. Only in the late 1970s did this arrangement become less efficient, when the state utilised this source of finance to assist in meeting its massive debt obligations. By then, however, electricity was already widely

available. Bouille recommends: *'Financial mechanisms that will mobilise and orient local savings for energy investment need to be established. This could be based on the levying of a consumption tax on the high-income sector, luxury use, heavy polluters, or on imported energy fuels.'* (ibid:76).

Robinson (1993:179) quotes the Kenyan idea of placing a 2% levy on urban and large customers to generate finance for rural electrification. He also states that: *'the pursuit of equity will inevitably entail a significant degree of cross-subsidisation in the tariff structure. This can be achieved without undue compromise to economic efficiency if marginal-cost pricing principles are applied to broad categories of consumers'* (ibid:175-176). In other words, careful design of tariffs such that the poor are cross-subsidised, can contribute towards equity goals in the form either of lower tariffs for the poor, or of capital subsidies for their connection, financed by cross-subsidies from wealthier consumer groups.

Likewise, in France, rural electrification was subsidised by a tax on electricity consumption, which *'represents a significant transfer of funds from urban to rural areas'*, via the Fonds d'Amortissement des Charges d'Electrification (Hourcade et al 1990:866).

### 3.2.7 Lending agencies such as the World Bank

Multilateral agencies such as the World Bank have a major influence on the financing of electricity investments, although this influence is often more of an intellectual nature than in the actual disbursement of funds (Barnett 1993:100, De Oliveira 1992:96).

The World Bank has devoted relatively little attention to the electricity distribution industries of developing countries and has focused instead on large projects in the generation and transmission sectors (Collier 1984). For instance, Barnett (1993:103) reports that in the period 1965 to 1980, nearly 60% of the Bank's power sector loans were for generation and only 9% for distribution. This is in spite of the fact that some 20 - 30% of utilities' investments are generally in the distribution sector, and that it often accounts for about 70% of total staff, 100% of revenues and 60 - 80% of losses.

In addition, the Bank's loans are generally granted only in respect of projects which are *'economically justifiable'* (for example, World Bank 1991d:13, 1991c:27). Consequently, the fact that many electrification programmes do not produce the rates of return required by the Bank, means that there are limits on its potential role as a lender in the distribution sector.

Finally, it must be noted that the World Bank is also criticised very sharply in the literature for its narrow attention on financial or economic measures of progress at the expense of social and equity measures, as well as for the strict conditionality attached to most Bank projects. Consequently, there is a strong body of literature which views finance from institutions such as the World Bank as problematic.

### 3.2.8 Foreign donors

Foreign donors, especially in the form of public sector agencies from Scandinavia, Europe, Canada, and Japan, have also funded a sizeable portion of electrification investments in many countries, particularly in poorer ones like Bangladesh (Foley 1990:130). Usually however, these relationships have particular origins and histories which makes them not easily transferable or generalisable to other developing countries.

## 3.3 Mechanisms and institutions for managing finance

This section outlines the kinds of systems described in the literature for the management of financial resources.

### 3.3.1 Viable electric utilities

As noted earlier, financially viable utilities are frequently argued to be the most important institutional requirement for electrification programmes to succeed. Without financial viability, electricity authorities are unlikely to be able to maintain existing supply systems, and will have even less capacity to expand their systems to serve unconnected households. If their revenues are insufficient to cover costs and earn a return on their capital sufficient to provide for future investment, it is most unlikely that they will be able to attract private loan or equity finance. Moreover, government grant finance is usually an unsustainable source of finance in developing countries.

Clearly, although of primary importance, financial viability is only one criterion for successful utility performance, along with others such as technical competence.

### 3.3.2 Electrification financing institutions

In Brazil, the raising of finance is done centrally by Eletrobras, the central co-ordinating electricity utility which also plans and executes electricity policy (De Oliveira 1992:40). In other words, the bulk raising of finance is done centrally, while operations are managed at a more decentralised level by other utilities in the sector. The principle of raising bulk finance centrally, close to the point of electrification planning, is also one of the motivations behind the proposals for an Electrification Fund in the South African context (EPRET 1993:28).

In the USA, the rural electricity cooperative movement established a non-profit corporation to raise bulk finance to complement concessionary finance provided by the state. The US cooperative system will be discussed in more detail in the next section.

In Thailand, where about 80% of rural villages and 70% of rural households have been connected, there are two financing options for unelectrified areas (Dingley 1988:E-5,6):

- Non-contributory schemes, in terms of which the state-funded Provincial Electricity Authority (PEA) pays the full cost of

connection. The number of villages to be connected in each province is determined in proportion to the number of unconnected villages, hence advancing electrification equitably.

- Contributory schemes, in terms of which communes or villages have to contribute 30% of the cost, by way of materials, labour or money in order to be electrified. Hence these villages get connected earlier than they would otherwise have been; it is reported that wealthy people often contribute more than their share to get connected sooner.

Using these arrangements, Thailand aimed to connect nearly 500 000 new customers per year during the period 1987 to 1991, only one quarter of which were in previously unelectrified areas. Based on these targets, the average connection rate for the 15 years from 1976 to 1991 would have been 400 000 per annum (ibid:E-12).

On a smaller scale, loan funds have also been proposed to raise finance for purchasers of photovoltaic (PV) systems, who are usually unable to afford the upfront capital costs (Waddle and Perlack 1992:1258). This was done on a small scale for PV systems in the Dominican Republic, in which over 100 PV systems were financed in a 5 year period, and another 600 or so sold for cash. Similarly, the Philippines government established a loan fund financed by the Development Bank to fund residential energy systems (ibid:1258).

### 3.3.3 Electricity cooperatives

Electricity cooperatives have been established in many countries, especially in rural areas, with varying degrees of success.

Possibly most well-known and successful, are those of the US National Rural Electric Cooperative Association. With President Roosevelt's support in 1935, the state established a scheme to provide long-term concessionary finance (and other comprehensive assistance) to rural cooperatives through the Rural Electrification Administration (REA) (Dingley 1988:5,7, C-4). In addition to support for the electrification of households, the REA also included lending for *productive* activities, especially those related to agriculture (such as for silos), thus contributing to overall development goals. Between 1935 and 1987, the REA made loans totalling \$20 billion to cooperatives, with only \$45000 bad debts (ibid:11). The financing arrangements favour borrowers: the term of the loans was initially 25 years but was lengthened to 35 years in 1944, and the interest rate was fixed at 2% until 1973 after which it became 5% (still lower than market rates) although special cases still pay only 2% (ibid:C-4). From 1969, the REA undertook to finance only 70% of total requirements, and so the cooperative movement formed the National Rural Utilities Cooperative Finance Corporation (CFC). As noted earlier, the CFC is a non-profit institution with the main aim of raising bulk finance at commercial rates to complement the REA's concessionary financing. As a result of these financing arrangements, rural consumers in the US have never had to make up-front capital contributions for their connection costs.

A related institutional arrangement found in the USA, is that of the joint action agency (JAA). This arrangement helps achieve economies of scale by acting on behalf of a number of smaller electricity utilities or cooperatives, for instance by

purchasing materials in bulk (and at lower cost). This is particularly useful where electricity authorities are small and would otherwise have limited implementation capacity and purchasing power.

Bangladesh also has a network of rural electricity cooperatives, which appears to operate relatively well. The state-funded Rural Electrification Board (REB) lends to PBSs (Palli Bidyut Samities, which are autonomous member-owned cooperatives) at low interest rates: 0.75% per annum during a 5 - 8 year grace period and 2 - 3% for an additional 25 years (World Bank 1990b:10).

Although not strictly the same as cooperatives, Bond (1992:153) argues for the use of community-based institutions such as Development Trusts, Loan Funds and Corporations to control and optimise the development process associated with electrification, including the management of finances.

### 3.3.4 Separate Rural Electrification institutions

The successful American REA and rural cooperative system was much more than a financing institution: it also provided education, advice, innovation and appliance finance (Dingley 1988:C-7). Perhaps recognising this factor, many authors have argued for the establishment of separate institutions to manage rural electrification (RE) programmes; for example, Kjellstrom et al (1992:185) in the Tanzanian context and Foley (1990:126) in a more general context.

Foley argues strongly for a separate RE institution, on the basis that performance objectives for RE are not confused with those of urban and industrial markets, since the obvious need for an external subsidy in RE programmes could cause severe distortions in results of utilities if not kept separate. In addition, Foley suggests that this independence might be more attractive for foreign funders and donors, who would not allocate concessionary finance, intended for RE, to national utilities.

In the Algerian utility, RE was separated from the rest of the utility's operations by forming a separate division, and this appeared to operate successfully (ibid:127). Similar procedures were adopted in Ireland for the electrification of its rural areas.

While these arguments are well-supported in the literature, it is also acknowledged that other less successful cases clearly demonstrate the need to 'ensure that the model used for the rural electrification agency fits comfortably within its national context' (Foley 1990:130). The important point arising from this is that RE, since it invariably operates without financial viability as in wealthier areas, must be managed in such a way that its relatively poor financial results do not distort the results of other parts of the utility in which financial performance is a more important criterion. This could be achieved *within* South African utilities if, for example, the excess capital costs for rural connections over and above a fixed parameter or ceiling are subsidised from outside the utility.

### 3.4 Key success factors for the financing of electrification

This section briefly identifies and summarises several key factors which have emerged from the literature review.

#### *Governments have a key role to play*

In no cases described in the literature have significant gains been made in the widening of access to electricity, without the active and sustained involvement of the state. It is clear that government has a key role to play in facilitating the flow of private capital to electrification programmes, as well as in making available concessionary finance from the fiscus where this is required. The exact role of the state will vary widely, from the provision of capital subsidies, to the provision of guarantees for private loan finance, to imposing taxes and levies to raise finance for electrification.

#### *The ESI must maintain its financial viability*

One of the most important themes in the present literature review is that of the need for electricity utilities to recover their *ability to invest*. This was expressed as follows by De Oliveira (1991:83): *'The most pressing issue that ESIs in developing countries have to face is this financial crisis, since financial viability is a precondition for achieving the objectives set for utilities. The difficult situation of developing countries' public accounts leaves little, if any, scope for financial support from governments. Moreover, private banks and multilateral and bilateral financial sources are not prepared to lend to utilities in developing countries unless they recover financial soundness. They therefore have to improve their financial situation, mainly by increasing their net revenues. This will improve both their self-financing ratio and, hopefully, the willingness of private capital either to invest directly or provide loans.'*

This, in turn, requires a 'profound review of pricing policy' so that operating surpluses can be produced: *'Average prices must more than cover average costs, although prices should accommodate equity objectives and regional policies'* (ibid:102).

#### *Utilities must be able to attract private capital*

Since it is unlikely and probably undesirable that utilities will be able to finance all their investment from internally-generated funds, and since external sources of finance (from government and foreign donors) are finite and inadequate, it is essential that utilities are able raise private capital.

#### *Rural electrification will require concessionary finance*

It is clear that rural electrification will, in many cases, compromise the financial viability of utilities, and so concessionary finance will usually be required for such projects if they are desirable for economic, social or political reasons.

As Foley (1990:109) points out: *'Experience shows that rural electrification programmes are rarely able to finance themselves. Accepting that programmes are rarely*

*likely to be profitable does not, however, mean abandoning financial discipline. Rather, it emphasises the need to pitch tariffs at a level which reduces losses as much as possible while still ensuring that RE plays its part in the balanced development of the rural areas.'* He argues that concessionary finance is required, coupled with cross-subsidies from urban and industrial consumers (ibid:113).

#### ***Financing and pricing arrangements should minimise distortions***

Whilst acknowledging that cross-subsidies and other interventions are required to achieve electrification goals, it is also important that distortions in the system are minimised. For example, capital subsidy schemes should not prejudice alternatives such as Remote Area Power Supplies (RAPS). The same applies to operating costs where rural grid electricity consumers may receive a cross-subsidy from urban consumers, but rural RAPS consumers do not. In such cases, transparent compensatory mechanisms may be required (Harrington 1986, Hourcade et al 1990:867).

#### ***Financing of appliances may be important***

A major constraint on the viability of electricity systems from both end-user and utility perspectives, even where the price of electricity is 'reasonable', is the cost of appliances which also deters people from connecting (Pearce and Webb 1987:336). Hence financing is required, to overcome the barriers to entry posed not only by high connection costs, but also by expensive electric appliances.

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## 4. Financial management

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### 4.1 Introduction

The objective of this section is to report on an international literature review of the practices of financial management in the electricity supply and distribution industry. Unlike electricity pricing policy or to a lesser extent funding policy, the *principles* of 'correct' financial management are well known and generally widely accepted. However, the practical application of these principles varies widely amongst electricity utilities. Hence this section focuses on analysing financial management *practices* used in various electricity utilities world-wide.

This section begins by describing the research methodology used. It should be noted that the scope is limited to an international review of what are seen as some of the key issues in financial management. In particular, financial management is reviewed in the context of accounting policy, revenue policy and debt policy. The body of the report concludes with a justification for transparency as an important principle underlying financial management practices in the electricity supply and distribution industry. The section concludes with a summary of the key findings.

The majority of research for this paper was conducted through a desk-based review of Annual Reports and Financial Statements of various international utilities. The utilities chosen for this review were selected primarily on the basis of the availability of reliable and current information. The utilities chosen, differ from each other in terms of ownership and function. Appendix A contains a brief description of the activities and ownership of each utility. Literature on financial management practices in the electricity utility industry is extremely thin. However a few relevant documents, detailed in the bibliography, are referenced in this paper. The literature review was supplemented by consultation with various local and international experts. Where applicable, views expressed by these experts are referenced in the document.

### 4.2 Accounting policies

Accounting policies directly impact the revenue, expenditure and hence profitability of any undertaking. There is considerable debate on which is the best accounting methodology. Most electric utilities are known to practise historic cost accounting, some practise historic cost accounting plus revaluation, while others practise current cost accounting. There are no electric utilities in the developed world which are known to practise fund accounting.<sup>13</sup> Certainly in the research for this review, no utilities beyond the borders of South Africa were found to practise fund accounting.

The prevalence of historical cost accounting in the electricity industry world-wide is due to the fact that it is seen to be more objective and less open to

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In the opinion of Dirk Els, Financial Planning Manager, Eskom.

dispute or manipulation than current cost valuations. Mayer & Helm (1989: 13), however argue against the use of historical accounting. Their argument is that historical cost accounting is particularly inappropriate in public sector utilities on account of the long life of assets that are employed. Even during periods of low inflation, historical cost valuations are seriously distorted by previous periods of inflation. In a paper reviewing World Bank lending for electric power, Munasinghe et al (1988: 88) argue, that for electricity undertakings in 60% of countries reviewed, conventional historical cost accounting without any revaluation of assets is practised. Opposition to the revaluation of assets, particularly in less developed countries exists, because of concerns of their governments that asset revaluation would contribute to inflation.

It is clear that although historical cost accounting is widely practised, it leads to accounting valuations which are severely distorted compared to economic or actual valuations (Mayer & Helm 1989: 7). This was the conclusion of the Mayer report, produced prior to the reorganisation of the UK ESI. A number of alternatives to conventional historical cost accounting do exist. The most common of which are historical cost accounting plus revaluation, or current cost accounting.

Historical cost accounting plus revaluation is generally one of the most widely accepted alternatives. It is normal practice for the World Bank to require the revaluation of assets. This requirement is normally included as part of the World Bank's loan covenant to developing country utilities (Munasinghe et al 1988). An example of this is a World Bank loan to Botswana Power Corporation where the World Bank prescribed a certain rate of return on assets, on a revalued asset base. Of the 23 utilities reviewed in this paper (see Table 5), with the exception of the few practising current cost accounting, only Botswana Power Corporation and Korea Power Company were found to have incorporated revaluation into their accounting systems. There are various methods for revaluing assets. These methods include stating assets at replacement cost, disposable value, or revaluing assets on the basis of some appropriate index. A principal criticism against historical cost plus revaluation is that the method of revaluation is highly subjective in view of the fact that reliable and accurate information, in most cases, does not exist.

Current cost accounting is seen to be practised in three different countries in this review. The line between current cost accounting and historical cost plus revaluation is vague. Essentially the difference is that current cost accounting is a comprehensive approach which attempts to restate all assets, liabilities, income and expenditure so that the full set of accounts are a reflection of economic realities. By contrast, historical cost plus revaluation is usually limited to the revaluation of specific assets only. Current cost accounting as recommended by Mayer & Helm (1989) is practised in the UK industry and all the Regional Electricity Companies, National Power, PowerGen, Nuclear Power and the National Grid Company. These companies produce both historical and current cost accounts. Of the utilities reviewed it was also found that current cost accounting is used in Iceland (almost no inflation) and Israel (high inflation). Conceptually, current cost accounting is clear, however the *practical* process of arriving at what are construed as current cost accounts, is less clear. As far as current cost accounting relates to asset valuation, Mayer & Helm (1989: 17) recommended a process for the UK that starts with the calculation of the 'length of life of company assets' and 'capital goods price' indices. Assets

are then valued individually at replacement cost, but if the economic valuation of any asset is lower than replacement cost, then such assets should be valued at economic (or value to the owner) values. Economic valuations are computed by taking a projection of the cash flows that are expected to be earned and discounting these at an appropriate risk adjusted discount rate to the present. In the case of power generation assets, where generation stations currently have spare capacity, or are expected to have spare capacity in the near future, then present values are expected to fall below replacement costs. Revenues are then determined on the basis of an assumed price profile taking account of any price regulation that is expected to be imposed.

In Iceland, Landsvirkjun arrive at current costs in a different way: the original cost of property is revalued to year-end prices. For this purpose the original cost is divided into two parts. One part, representing local Icelandic cost, is estimated as one third of total original cost, while the other part, representing foreign cost, is estimated as two thirds of the original cost. The local portion is revalued in accordance with changes in the Icelandic 'index of construction cost', while the foreign portion is revalued in accordance with changes in the exchange value of the Krona.

In Israel yet another variation of current cost accounting exists. Israel has been through periods of very high inflation and for this reason adjustments for current cost accounts are based on monthly inflation figures. Non-monetary items (fixed assets and accumulated depreciation thereon, expenses on the issue of debentures, inventory, prepaid expenses, receipts for unfinished contracts, perpetual debentures, capital reserves and shareholders equity) have been adjusted according to the changes in the 'cost of living index' from the month in which each transaction was affected, up to the index published for the month in which the accounting period ended. In contrast with the UK version of current cost accounts, the adjusted values of non-monetary assets do not necessarily represent the market value of those assets or their value to the concern, but only their cost as adjusted for changes in the general purchasing power of the Shekel.

### 4.3 Revenue policies

One of the key aspects of financial management relates to revenue policy. Arguably, the essence of revenue policy is the determination of the balance between risk and return. A wealth of literature exists on the theory of determining the optimal balance of risk and return. One of the most popular models is the Capital Asset Pricing Model. Others include the Discounted Cash Flow Model, the Risk Premium Model or the Arbitrage Pricing Theory. It is beyond the scope of this paper to enter into a discussion of these theories or how and where they are applied. A review of revenue policy in the electricity industry is more practically dealt with by firstly drawing a distinction between revenue policy in competitive and non-competitive settings and then presenting and analysing the rate of return on assets for various different utilities.

There is an important distinction to be drawn between revenue policy defined in competitive and non-competitive industries. In a non-competitive industry, the revenue policy demands that prices are computed from valuations of assets

and their required rate of return. In competitive industries, the process is reversed: the price is determined by market supply and demand, and the market value of the company is then established as the value of the future stream of profits discounted back to the present by the appropriate rate of return required to cover risk and the market cost of foregoing current earnings.

Another important distinction to be drawn, is between those utilities which have privately held and tradeable equity capital and those that do not. In the case of the former, the measurement of return on invested capital is the Return on Equity, while in the case of the latter, the rate of return is measured through the Return on Assets.

Table 5 below presents a list of different electricity utilities and figures for their Return on Assets and the Consumer Price Index (where ROA is calculated on historical cost accounts). The Return on Equity has been calculated for those utilities that have listed equity capital.

Before the information in Table 5 can be interpreted, it is necessary to explain the calculation of Return on Assets and Return on Equity used here.

1. The Return on Assets is calculated as the ratio of net income (after interest and taxation but before dividends) to the average net fixed assets for the year under review. Average net fixed assets are tangible assets and do not include Investments.
2. The Return on Equity is defined as net income (after interest and taxation but before dividends) divided by Shareholders Capital plus Distributable Reserves.
3. The earlier section on current cost accounting discussed the varying application of the principle in the calculation of current costs accounts for the various utilities in this review. For want of a better assumption, in this analysis it is assumed that where current cost asset valuations are used to calculate the return, that the ROA (and ROE where applicable) so calculated is the *real* return.
4. Utilities with older fixed assets will have lower net asset values because of the higher accumulated depreciation. This will impact the Return on Assets. No attempt has been made in the above analysis to account for the age of the assets in the calculation of the return.

Table 5 Return On Assets

	Utility	Accounting Methodology	R O A (%)	CPI (%)	ROE (%)
1	London Electricity plc (UK) (1989/90)	Current Cost	4.05	N/A	4.1
2	South Western Electricity plc (UK) (1992/93)	Current Cost	5.1	N/A	5.5
3	Seeboard plc (UK) (1992/93)	Current cost	4.6	N/A	16.6
4	Landsvirkjun, Iceland	Current Cost	0.8	N/A	-
5	Israel Electric Corporation Ltd	Current cost	0.4	N/A	1
6	Eskom (South Africa)	Historical	3.8	12	-
7	Botswana Power Corporation	Historical & Revaluation	5.3	16	-
8	Korea Electric Power Corporation	Historical & Revaluation	7.0	6.5	-
9	Boston Edison Power Company	Historical	3.3	3.2	9.9
10	Duke Power Company (USA)	Historical	4.7	3.2	10.9
11	Texas Utilities Co.	Historical	3.1	3.2	8.2
12	Southern California Edison Corporation	Historical	3.8	3.2	11.7
13	Energy Corporation, New Orleans, USA	Historical	3.0	3.2	9.3
14	Philadelphia Electric Company	Historical	3.8	3.2	10.7
15	Commonwealth Edison, Chicago, (USA)	Historical	2.8	3.2	8.3
16	British Columbia Hydro (Canada)	Historical	2.4	1.5	-
17	Chubu Electric Power Company (Japan)	Historical	1.3	1.5	7
18	China Power and Light (Hong Kong)	Historical	18.4	10	24.7
19	Electricity Supply Authority of Cyprus	Historical	8.1	6.5	-
20	Auckland Power Board, New Zealand	Historical	2.7	5	-
21	Electricity Generating Authority, Thailand	Historical	6.7	4.7	-
22	Escom (Malawi)	Historical	15	15	-
23	Electricite de France	Historical	1.1	2.5	-
24	Zimbabwe Electricity Supply Authority	Historical	(4.7)	44	-

The following observations in respect of information contained in Table 5, are made:

- Most of the utilities show a positive real return on assets. The return on privately held equity capital is obviously much higher. In American electricity utilities, historical cost accounting is used universally. Although the electric utility industry has a high degree of private ownership, the utilities are not at liberty to set their own

prices. Instead a highly complex regulatory structure exists whereby the revenue requirements of a particular utility have to be approved by regulatory commissions inside of the Federal State as well as the national Federal Electricity Regulatory Commission. It is beyond the scope of this paper to attempt to describe the regulatory process, however the essence of rate of return regulation in the US is relatively simple: utilities argue for a specific level of revenue to finance their operations, based on their financial analyses. The Federal regulatory commissions usually argue that the required level of revenue is too high. Disputes usually revolve around asset valuations or whether stated plant construction costs have been "reasonably" incurred. Issues are frequently resolved at Supreme Court or Appeal Court level.

- London Electricity, Seeboard and SWEB are primarily electricity distribution companies, created on Vesting Day, 31 March 1990. As a result of efforts to create competition in the UK industry, the Office of Electricity Regulation (OFFER) regulates the industry by not allowing price increases greater than the Retail Price Index (RPI) minus a factor 'X' (where X corresponds with expected efficiency gains). It is important to understand the difference between the determination of the Return on Assets via the price control formula in the UK ESI and the direct, usually government prescribed, rate of return on assets which are used to set prices for all other utilities in this review. In effect the RPI-X formula is an attempt to replicate the competitive approach to the determination of Return on Assets, as described earlier. Since Vesting Day, X has been zero and the handsome current cost Returns on Assets and on Equity reported, are indicative of productivity improvements which have been achieved. OFFER will review the price control formula in April 1994 with an expected focus on improving efficiency by increasing the value of X.
- Botswana Power Corporation (BPC) is another interesting case. Its rate of return on revalued assets of 5.3% compares to consumer price inflation of 16% at the time of the report (although such a comparison may not be very meaningful, since the asset base is revalued but returns are at historical costs). Under a loan covenant with the International Bank for Reconstruction and Development, BPC was required to meet the required 8% return on revalued net fixed assets. This was opposed by the Botswana government since it would have necessitated an increase in tariffs in excess of 20%, which in the Botswana Government's view, would have had serious ramifications on the rapidly developing Botswana economy.
- Zimbabwe Electricity Supply Authority reported a disastrous result in their 1991 financial year, achieving a negative return on assets of 4.7%. The origin of this dire situation is that between 1962 and 1980, the nominal price of electricity increased by only 0.8% (Zia Mian 1982: 95), while inflation was considerably higher. Prices did not increase due to the fact that on the basis of low historical asset and debt servicing costs, it was possible to achieve a nominal return on assets without increasing the price. However, with no account being

taken of the inflation rate, the real return on assets decreased dramatically so that by 1991, considerable losses were being made.

- Almost all utilities in this analysis show a positive real Return on Assets.

The discussion thus far has focused mostly on successful utilities in developed countries. Munasinghe et al (1988: 19) reported distressing declines in the historical cost Return on Assets of the power sector in developing countries between 1966 and 1985. The 1966/1973 average was 9.2% and this had fallen to an average of 6% between 1980/1985 despite significant increases in the inflation rate in most developing countries.

The World Bank has used the Return on Assets as an indicator to monitor the financial performance of utilities and the ratio is usually used as part of a loan covenant. An example of this noted earlier was the case of IBRD loans to the Botswana Power Corporation.

#### 4.4 Debt policies

Most electric utilities in the developing world fund much of their capital investment through debt. Lenders will lend capital at an interest rate which reflects their perception of the risk involved. This risk is dependent on two factors: the ability to repay interest and the ability to ultimately redeem the capital debt on due date. There are various ways of monitoring and analysing debt. Munasinghe et al (1988: 63-6) recommend the use of three ratios in monitoring the debt of electric utilities:

The first is the *self-financing ratio*, defined as: "Funds from internal sources equivalent to a defined percentage of average annual capital expenditures, after meeting operating expenses (before allowance for depreciation), debt service, taxes, dividends, increases in working capital and other significant cash outflows." However, it is difficult to compare the self-financing ratio amongst different utilities because of inconsistencies in the calculation of changes in working capital and differing taxation structures amongst utilities.

The second is the *interest coverage ratio*. This is the ratio of net income before interest and taxes, divided by the total interest expense. The ratio is a good measure of whether the utility has earned sufficient revenues to meet interest commitments on outstanding debt after meeting operating costs.

The third is the *debt to equity ratio*, which is the ratio of long term debt to equity (assets - liabilities). It is not possible to argue that a particular value of the debt to equity ratio is necessarily the correct ratio since different utilities will be able to support differing debt loads based on their unique circumstances. Furthermore, where a financially sound government is prepared to underwrite a utility's debt commitments, much higher debt to equity ratios can be supported. Table 6 contains the debt/equity ratio and the interest coverage ratio for the various utilities in this review.

Table 6 Debt/equity ratio and Interest Coverage ratio

	Utility	Debt/Equity	Interest coverage ratio
1	London Electricity plc (UK) (1989/90)	Close to 0	Very high
2	South Western Electricity plc (UK) (1992/93)	0.09	6.9
3	Seeboard plc (UK) (1992/93)	0.12	19.1
4	Landsvirkjun, Iceland	1.43	1.72
5	Israel Electric Corporation Ltd	1.3	1.17
6	Eskom (South Africa)	2.2	1.53
7	Botswana Power Corporation	1.1	1.1
8	Korea Electric Power Corporation	1.1	3.03
9	Boston Edison Power Company (USA)	1.3	2.5
10	Duke Power Company (USA)	0.9	4
11	Texas Utilities Co. (USA)	1.06	2.5
12	Southern California Edison Corp (USA)	1	3.6
13	Energy Corporation, New Orleans, (USA)	1.14	2.4
14	Philadelphia Electric Company (USA)	1.2	3.3
15	Commonwealth Edison, Chicago, (USA)	1.3	3.7
16	British Columbia Hydro (Canada)	3.76	1.26
17	Chubu Electric Power Company (Japan)	3.2	2.2
18	China Power and Light (Hong Kong)	0.54	10.4
19	Electricity Supply Authority of Cyprus	0.16	22
20	Auckland Power Board, New Zealand	0.3	2.06
21	Electricity Generating Authority, Thailand	1.5	2.2
22	Escom (Malawi)	1.08	3.7
23	Electricite de France	0.6	1.36
24	Zimbabwe Electricity Supply Authority	2	0.7

- An interesting case is London Electricity. The results for 1989/90, the last year before it was created as a public limited company, indicate the extremely low level of debt in the industry at the time of its privatisation. These lower debt levels result in higher interest coverage ratios, as also reflected in the 1993 results for South Western Electricity and Seeboard, other UK distribution companies.
- British Columbia Hydro has a relatively high debt to equity ratio. However BC Hydro's outstanding debt is either held or guaranteed as to principal and interest by the Province of British Columbia.

Furthermore, the interest cover ratio of 1.26 indicates that there is sufficient income to cover their interest expenditure.

- Zimbabwe Electricity Supply Authority presents an interesting case of where the debt/equity ratio hides a debt crisis. A debt to equity ratio of 2 is not unduly high for an electricity utility and yet the interest coverage ratio of 0.7 indicates that they are clearly not able to meet their interest commitments.
- The similar debt/equity and interest coverage ratios of the US utilities indicates uniformity brought about through the Federal Electricity Regulatory Commission. An interesting trend in the US electricity industry at present is that a number of independent power producers are constructing power stations, funded largely by debt, on the basis of firm power contracts from purchasing utilities. For these utilities, debt/equity ratios of 10 are not unusual.<sup>14</sup>

Perhaps a central comment to be made on the subject of debt management is that the debt/equity ratio, of itself, is not the key issue. It is clearly not suitable to take an orthodox view of what a 'correct' debt/equity ratio should be, because of the many different factors which may influence any particular utility's ability to manage its debt. Rather the central issue is that of the risk attached to the financial policies and strategies employed by the utility.

#### 4.5 Transparency of financial management

The review thus far has focused on three areas of financial management: accounting policy, revenue policy and debt policy. An important factor underlying every aspect of financial management is the need to ensure transparency. This has implications at many levels: from the basic book-keeping systems to the production of a clear and accurate set of accounts. It is noted that the accounts of all the utilities reviewed in this paper, were submitted to external audit. While this ensures that reported results are in accordance with the accepted accounting principles, it does not address the equally important issue that the accepted accounting policies facilitate the production of a representative set of results. With regard to the latter point, evidence from this review would seem to suggest that it is only in the UK, as a result of the privatisation of the UK power industry, that any significant amount of work has been done on the subject of producing accounts which are economically representative, that is, utilising current accounting methods.

Munasinghe et al (1988:19) describe World Bank difficulties in ensuring transparency. In its initiatives to monitor the performance of utilities in developing countries, the World Bank has instituted very specific guidelines as to how its performance indicator ratios should be drawn-up. Adherence to these guidelines in the case of some ratios has, however been poor, with the result

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Information obtained from discussion with Larron Harper, Director: Global Utilities Institute, Samford University, Alabama.

that making effective comparisons between utilities is limited.

#### **4.6 Summary**

This section has set out some of the key factors relating to financial management in the electricity supply and distribution industry. The document does not purport to be a complete review on the subject: it is recognised that there are a number of subjects of financial management that have been excluded in this review.

The key conclusions from each section of this review are as follows:

##### ***Accounting policy***

- Fund accounting is not known to be practised in any electricity utilities in the developed world.
- Historical cost accounting is widely used in the industry. However in view of the very long life of assets in the electricity industry, it is an inadequate accounting approach even in the case of countries with low inflation.
- Historical cost plus revaluation will produce accounts which are more representative of economic realities. Revaluation is normally prescribed by the World Bank in their loan covenants.
- It was found that Current Cost Accounting is practised in the UK electricity industry as well as Iceland and Israel. While the principle of current cost accounting is uniform among the utilities practising this methodology, it was found that the practical method of arriving at current costs differed considerably among the various utilities.

##### ***Revenue policy***

- There is a distinction to be drawn between the determination of Rates of Return in a competitive and non-competitive industry.
- Of the 23 utilities reviewed, most were seen to be making a positive real Return on Assets.
- Return on Assets amongst the US utilities was relatively uniform owing to their common regulatory structure.
- Rate of Return regulation in the UK through the RPI-X formula has resulted in the newly privatised Regional Electricity Companies achieving a relatively high real Return on Assets.

### ***Debt policy***

- Three ratios are referred to in the management of debt: self-financing ratio, debt/equity ratio and interest coverage ratio.
- The debt/equity ratio ranged between 3.76 for British Columbia Hydro to 0.09 for South Western Electricity plc.
- It is not suitable to take an orthodox view of what an acceptable debt/equity ratio should be, since the debt which any particular utility is able to manage is dependent on that utility's unique circumstances.

### ***Transparency***

- Transparency is an important factor underlying every aspect of financial management. Without a commitment to transparency it is impossible to determine the actual performance of any utility or to make effective comparisons with other utilities.

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## 5. Conclusion

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This report has reviewed international experience in pricing, financing and financial management in electrification programmes. Relevant conclusions are:

- The ability of electricity utilities to maintain and expand electricity services is severely prejudiced if its financial viability is undermined through inappropriate pricing, financing and financial management policies.
- Electricity pricing and financing should be undertaken within an integrated energy planning framework which establishes overall development goals and balances policy objectives between different economic and energy sectors.
- Economic efficiency and long run marginal costs are not the only criteria to be applied to deriving prices for domestic electricity consumers. Equity considerations and the financial viability of the utility have often taken precedence.
- Price regulation should be transparent and arms-length and should not result in the viability of the utility being undermined.
- Tariff levels should, as far as possible, attempt to achieve overall cost recovery for the household sector.
- Appropriate price signals (eg time-of-use tariffs) should be passed on to those consumers capable of adjusting their load patterns.
- To achieve greater equity and access, tariff structures should allow for low connection fees.
- External subsidies may be required for the lowest income categories as well as for rural electrification.
- Where the possibility of external subsidies is constrained, cross-subsidies may be affected through uniform tariffs between high and low consumers or urban and rural areas.
- To minimise distortions in pricing signals, subsidies should first be applied to capital costs of connection, before energy charges through the tariff.
- Governments have a key role to play in facilitating the flow of private capital to electrification programmes, as well as making available concessionary finance from the fiscus where this is required.
- Electricity utilities must maintain financial viability by ensuring that average prices more than cover their average costs. This will improve their self-financing ratio and the willingness of private capital, either to invest directly or to provide loans.
- Utilities must be able to attract private capital as it is unlikely and probably undesirable that utilities will be able to finance all their investment from internally-generated funds and since available external sources of finance from government and foreign donors is generally insufficient.
- Rural electrification will, in many cases, compromise the financial viability of utilities and so concessionary finance will be required for such projects if they are desirable for economic, social or political reasons.
- Financing is required to overcome the barriers to entry posed not only by high connection costs, but also by expensive electric appliances.
- Current cost accounting methods are recommended, but the most commonly used is the historical cost accounting method.
- The debt to equity ratio, the self-financing ratio and especially the interest coverage ratio are three useful measures to monitor financial performance of utilities, although 'desirable' ratios depend on utilities' specific circumstances.

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## Appendix A

- 1-3. London Electricity plc, South Western Electricity plc, Seeboard plc are Regional Electricity Companies whose principle function is the distribution of electricity. They are public limited companies with private shareholders.
4. Landsvirkjun is a generator and supplier of electricity only. It is jointly owned by the State Treasury and the Cities of Reykjavic and Akureyri.
5. Israel Electric Corporation Ltd is a vertically integrated company, generating, transmitting and distributing electricity throughout Israel. It has private shareholders.
6. Eskom has been included in this analysis for comparison purposes. Eskom is a vertically integrated parastatal.
7. Botswana Power Corporation is vertically integrated corporation falling under the Ministry of Mineral Resources and Water Affairs.
8. Korea Electric Power Corporation is a vertically integrated corporation with 79% State ownership and 21% private ownership.
- 9-15. Boston Edison Power Company, Duke Power Company, Texas Utilities, Southern California Edison, Energy Corporation, Philadelphia Electric Company and Commonwealth Edison are privately owned, vertically integrated utilities.
16. British Columbia Hydro is a vertically integrated provincial Crown Corporation.
17. Chubu Electric Power Company is a vertically integrated and privately owned power company.
18. China Power and Light is a privately owned, vertically incorporated power corporation in Hong Kong.
19. The Electricity Supply Authority of Cyprus is a vertically integrated, non-profit making Semi-Government Corporation.
20. Auckland Power Board is a distribution company owned by the government to serve the residents of Auckland.
21. Electricity Generating Authority of Thailand is a State Enterprise which supplies and transmits power in Thailand.
22. Escom is a vertically integrated Commission, responsible to President Banda.
23. Electricite de France is a vertically integrated parastatal corporation
23. Zimbabwe Electricity Supply Authority is a vertically integrated Authority reporting to the Ministry of Energy and Water Resources and Development.

# Electrification financing and tariffs: International literature review

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