The financial impacts of electrification on the electricity distribution industry

Mark Davis

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Executive summary

The principle objective of this study has been to evaluate the financial impacts of electrification of the electricity distribution industry, incorporating new information and examining new questions in doing so. In particular, this study has considered the effects of:

- institutional changes in the distribution industry;
- the implementation of capacity differentiated supplies (2.5A/20A/60A);
- the reduction of electrification targets by 20%; and
- the introduction of a capital expenditure limit (R4000 per connection).

The analysis has measured the impacts of electrification by attempting to quantify:

- capital requirements over a 20 year period;
- operating losses and surpluses over the same period;
- accumulation of debt given different levels of subsidisation; and
- the required subsidies to ensure sustainability, and mechanisms to raise and distribute these subsidies.

The institutional options considered in this analysis were:

- the *status quo*: Eskom's Distribution Group and non-Eskom distributors;
- the establishment of a National Electricity Distributor (NED); and
- the establishment of Regional Electricity Distributors (REDs), based along provincial boundaries.

The methodology used has been a financial analysis from the viewpoint of a specific distribution agency (for simplicity, non-Eskom distributors were grouped together). This analysis involved the quantification of capital and operating costs, revenue and finance charges. Assumptions had to be made concerning future tariff levels, operating costs and consumption growth (including losses). Connection rates were based on those used by Els (1994), broken down for each province in such a way that access levels are substantially improved in all regions of the country. Details of assumptions and connection rates are presented in appendix A.

Capital costs were derived from a modelling exercise undertaken by Eskom Distribution Technologies for this study. This exercise calculated grid extension costs for each magisterial district based on existing and projected demographic patterns and existing distribution networks. Demographic data was extracted from the NELF demand-side database for this exercise.

The capital cost modelling exercise has revealed the following results:

- Average costs per connection are likely to be higher than assumed in other analyses and higher than the proposed capital limits. Using capacity differentiated supplies, average costs under the NED scenario were R 4 500 per connection.
- There are large regional differences: provinces with large rural populations require the largest capital investment. In particular, the Eastern Cape has exceptionally high average costs of connection and will require 25% of all investment.
- The use of capacity differentiated supplies in rural areas reduces the capital costs by some 30%, and these savings are particularly pronounced later in the programme as more remote settlements are reached.
- Reducing electrification targets will reduce capital costs by slightly more than the percentage reduction in connections. This is due to the postponing of more expensive connections.

- Total capital requirements are in the region of R1.5 to R2 billion per annum, resulting in a total capital investment of some R28 billion over the period 1992-2011.

Summary of key results for the *status quo* and NED scenarios: 1992-2011

	Eskom	Non-Eskom	Eskom + Non-Eskom	National distributor
Connections	4 mill	2.2 mill	6.2 mill	6.2 mill
Ave connections per annum	200 000	110 000	310 000	310 000
Capital expenditure (capex)	R 19 bill	R 9 bill	R 28 bill	R 28 bill
Ave capex per annum	R 930 mill	R 420 mill	R 1350 mill	R 1 350 mill
Capex per connection	R 4 700	R 4 000	R 4 500	R 4 500
Net Present Value (NPV)	(R 14 bill)	(R 6 bill)	(R 20 bill)	(R 20 bill)
NPV per connection	(R 3 450)	(R 2 600)	(R 3 250)	(R 3 250)

The main results from the analysis of the net present value (NPV) of the programme are summarised below.

- In terms of NPV, there only negligible differences between a rationalised industry and the *status quo*.
- The NPV of the electrification programme is highly negative (-R20 billion), and this result is not affected by a sensitivity analysis on the key variables.
- The use of conventional supply levels (40A/connection) decreases the NPV of the programme by approximately 30%.
- The introduction of a capital limit would mean that approximately R9 billion would have to be provided by non-utility sources in order to meet connection targets, and this would increase the NPV by 22%.
- Lower targets (a 20% reduction) have the effect of increasing the NPV by 28%. Most of this increase is made up of reduced capital costs.

Operating losses (excl. finance charges): 1992-2011

Province	Ave monthly surplus/(loss) per customer	Present value of surplus/(loss) 1995 R mill	Portion of total loss %
Eastern Cape	(R5.93)	(R289)	27%
Northern Province	(R 6.28)	(R177)	17%
KwaZulu/Natal	(R2.83)	(R121)	12%
Free State	(R5.99)	(R119)	12%
Mpumalanga	(R5.52)	(R108)	11%
North West	(R4.70)	(R98)	10%
Western Cape	(R3.86)	(R78)	8%
Northern Cape	(R4.69)	(R27)	2%
Gauteng	(R1.21)	(R12)	1%
Total	(R4.01)	(R1 029)	100%

Note: If the time period 1996-2011 is taken, the losses decrease and, in the case of Gauteng, turns to a surplus. This is because revenues improve later in the programme.

It was clear that electrification would make substantial *operating losses* (even before the effects of finance charges are considered). Under the NED scenario, operating losses turn to surpluses towards the end of the programme, but this is insufficient to meet the losses accumulated during the early years. Provinces with the high rural populations experience the highest losses.

Cumulative debt for different levels of subsidisation				
Cross subsidy [R/customer/month]	Eskom	Non-Eskom	Eskom + Non-Eskom	NED
No cross-subsidy	R 38 bill	R 17 bill	R 55 bill	R 55 bill
R10	R 30 bill	R 13 bill	R 43 bill	R 43 bill
R30	R 13 bill	R 5 bill	R 18 bill	R 18 bill
R50	R 0.2 bill	no debt	R 0.2 bill	no debt

In analysing debt levels and required subsidies, the analysis arrived at the following results:

- The electrification programme requires extensive subsidisation to be financially viable.
- These subsidies are in the range of R1 billion to R1.2 billion per annum, equivalent to approximately 70% of capital costs.
- There are sufficient surpluses within the electricity distribution industry to provide these subsidies, if they are available for this purpose.
- If surpluses are not available, a general price increase of 0.39c/kWh (a 4% increase) would be required to ensure the financial sustainability of the programme. If the price increase was applied only to domestic customers, the price increase would have to be in the order of 2.6c/kWh (a 16% increase). Alternatively, Government would have to contribute approximately 70% of capital costs.
- Under a system of REDs, financial transfers could be effected either through an electrification fund or a system of bulk supply discounts and surcharges.

Subsidies required for electrification: 1995-2011				
	as an annual transfer	as a % of surplus	as a general price increase[2] [c/kWh], [(%)]	as a domestic price increase[3] [c/kWh], [%]
Eskom	R875 mill	105%	0.54 (4%)	n/a
Non-Eskom	R400 mill	15%	0.33 (3%)	n/a
NED	R1 200 mill	40%	0.39 (4%)	2.6 (16%)

If a distribution utility (or utilities) is to be created, separate from Eskom's Generation and Transmission Groups, and if much of the existing surplus associated with electricity distribution continues to be earmarked for local governments, it is clear that such a utility will be in a precarious financial position. Under these circumstances, careful consideration will have to be given to the following:

- mechanisms to raise sufficient capital at low cost, with the assurance that loans and finance charges will be met;
- mechanisms to transfer subsidies (or utilise cross-subsidies) in order to ensure financial sustainability of distribution;
- adequate regulation of bulk supply tariffs to ensure that the surpluses associated with electricity supply are equitably allocated between a generation and transmission utility on the one hand, and a distribution utility (or utilities) on the other.

Table of contents

1. Introduction

The underlying objective of this study is to explore the financial consequences, for the electrification programme, of changes in the structure of the electricity distribution industry. In particular, the analysis has attempted to quantify the effects of:

- ***rationalising the distribution industry***, either into a national electricity distributor (NED) or regional electricity distributors (REDs);
- introducing ***capacity differentiated supplies***, with associated tariffs;
- introducing a ***capital expenditure limit*** for electrification projects; and
- ***reducing electrification targets***.

This analysis has clear implications for electrification planning: not only are the consequences of institutional structures relevant to planning, but the utilisation of capacity differentiated supplies and capital expenditure limits are of direct significance.

In addition, the study has looked at options to ensure the financial sustainability of electrification, in particular examining the option of cross-subsidies from other consumers, government contributions towards capital expenditure, and options to facilitate financial transfers between distributors.

This report will firstly review previous analyses of the financial impact of electrification, focusing on three studies by van Horen (1994), the National Economics of Electrification Study (NEES, 1993) and Els (1994). Thereafter the design and methodology used in this analysis will be presented, followed by a description of the rates of electrification assumed in the study, and resulting levels of access. The results will be presented in three sections: firstly looking at the capital requirements for electrification; secondly analysing the net present value of the electrification programme, and lastly investigating the subsidy options available.

2. Review of previous work

There have been three published studies investigating the financial impact of the electrification programme:

- NEES (1993), which investigated three electrification scenarios (low, medium and high rates of connection) - the medium scenario is discussed here;
- Van Horen (1994), who investigated a 'business-as-usual' scenario and an 'Integrated Energy Planning' (IEP) scenario. The latter scenario assumed that electricity distribution would be rationalised in some form and is discussed here; and
- Els (1994), who looked at the electrification programme proposed by the Reconstruction and Development Programme (RDP), and distinguished between Eskom and non-Eskom distributors.

In terms of connection rates, van Horen's IEP scenario, the NEES medium scenario and Els' scenario are all roughly similar - a peak of 450 000 to 500 0000 connections per year.

Capital requirements

All three studies reach broadly similar conclusions regarding the capital investment requirement of the programme. The NEES study looked at the years 1993 to 2010 and concluded that capital expenditure would be in the order of R28 billion (1993 terms). Van Horen calculated that the total capital requirement over the slightly shorter period 1994 to 2010 would be in the order of R22 billion (1993 terms). The difference is partly due to a shorter time period, but also because the NEES analysis had a higher average cost per connection, and included high expenditure on unelectrified rural farms. Els looked at the longest period, 1992 to

2012, and arrived at a total capital requirement of R23.2 billion, in 1994 terms. These totals correspond to an annual capital requirement of R1.2 to R1.5 billion (Van Horen 1995), of which approximately 75% will be spent by Eskom.

Table 1 presents the essential assumptions and results from the three studies. Although connection rates, support costs, losses, and consumption rates are roughly similar, there are important differences regarding electricity supply costs, refurbishment and tariffs. Els assumed a higher bulk supply cost than the other two studies and also assumed real tariff decreases (13% over four years) as contained in Eskom's price compact.

Finance charges

An important methodological difference concerns the inclusion of finance charges in calculating annual costs: Els included these charges whereas the other studies excluded them.

In calculating the NPV of the programme, finance charges are irrelevant since the discount rate reflects the cost of capital. However, when calculating the annual cash flow, their inclusion depends on the source of financing. If loan financing is used, then there will be annual interest charges which should be included. If cross-subsidies are used, then it may be argued that no return is expected and so finance charges are not applicable. Alternatively, if 'cross-subsidies' are regarded as a form of self-financing (or equity investment), it is reasonable for the utility to expect a return and so hypothetical finance charges may be included.[1] Van Horen justifies their exclusion by defining the financing requirement as net of finance charges and implies that additional costs will be incurred in raising these funds, depending on the financing source.

In quantifying the financial impact of electrification on a utility, as opposed to the capital or financing requirement, finance charges should be included with realistic assumptions made about the cost of these funds. In Eskom's case, capital for electrification has largely been raised from financial markets (through Electrification Participation Notes - EPNs) with cross-subsidies used to cover operating losses. In future it is likely that there will have to be greater reliance on cross-subsidies in order to contain debt levels and reduce finance charges.

Average and marginal costs

Els points out that a distinction should be made between average (or embedded) costs and marginal (or incremental) costs. If the costs of electrification are to be based on average costs, then this implies that new consumers are expected to pay for a pro-rata portion of previously installed infrastructure. If costs are based on marginal costs, then the analysis includes only the additional costs which new customers impose. Although (long-run) marginal costs are usually higher than average costs, in Eskom's case where there has been an over-investment in generation capacity, the opposite is the case, at least until excess capacity has been taken up. Els opted to use average costs in the calculations, although the other two studies did not make their approach explicit. Els argues that the use of average costs ensures that all customers share the burden of past investments in an equitable manner. However, the use of 16c/kWh as the bulk supply cost appears excessively high given that in 1994 the bulk supply price was 10.2c/kWh.

An economic rather than a financial analysis would always use marginal rather than average costs since past investments are 'sunk costs' and should not influence the decision to invest in new projects. However, in the financial analysis of an electricity distributor, the tariff charged by the bulk supplier would usually be sufficient to both cover past costs and meet costs associated with future investments (thereby ensuring financial viability and providing appropriate price

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1 In an economic as opposed to a financial analysis, there is always an opportunity cost associated with any capital requirements (whatever its source) and this is reflected in the discount rate.

signals). In practice this means setting tariffs at the higher of marginal and average costs and so in the (unusual) Eskom case where marginal costs are low, the appropriate bulk supply tariff should be based on average costs.

Historic and current costs

A distinction should also be made between historic and current costs. This affects pricing policy in that tariffs are calculated to recover current investment costs, that is, they are calculated to escalate with inflation so that when new investments in refurbishment and replacement have to be made, there is no sudden jump in tariffs. However, if all figures are expressed in real prices, this consideration should not affect the result of any analysis. Of course there may be *real* price changes as a result of technology changes, exchange rate movements, changes in labour costs or productivity. If there are any justifiable grounds for suspecting any such changes they should be included in the calculations.

TABLE 1: Essential assumptions and results of three financial analyses

	NEES	*Van Horen*	*Els*
Base year	1993	1993	1994
Cost per connection[1]	R4 000	R3 500	R3 800
Bulk supply cost	9.5c/kWh	11.2c/kWh	16.2c/kWh[2]
Support cost	R15-R20/mth	R20/mth	R15-R23/mth
Refurbishment	included in bulk supply cost	2% of capex per annum	20% at yr 10; plus 50% at yr 20
Consumption[3]	150 - 450 kWh/mth	150 - 450 kWh	150 - 450 kWh/mth
Tariffs	18c/kWh	20c/kWh	22c/kWh[2],
Losses	20%	12%	20%
Real discount rate	4%	3%	6%
Capital investment	R28 bill	R22 bill	R23.2 bill
Financing requirement	R28 bill	R22.4 bill	n/a
Financing req. after 4% levy	n/a	R9.2 bill	n/a
Cumulative cash flow[4]	n/a	n/a	- R70 bill
Cum. cash flow after 5% levy	n/a	n/a	- R3.4 bill
Net Present Value	- R19.4 bill	- R18 bill[5]	- R11.7 bill

1 This varies for housetype, region and time. Averages are presented.
2 Declining by 6% real in year 1, 6% in year 2, and 1% in years 3 and 4.
3 Consumption is different for each consumer category and varies with time.
4 This includes finance charges assuming 100% debt finance.
5 Calculated from cash flows presented by van Horen.

Results

One conclusion of the NEES analysis and van Horen's study is that operating losses are small in comparison to capital costs, and that operating losses turn into surpluses after approximately 10 years (if the urban and rural components are combined - rural electricity supply never generates a surplus). The NEES analysis concluded that the financing requirement after 20 years would be R28 billion. Van Horen arrived at a similar result, concluding that the financing requirement would be R22.4 billion (the difference being almost completely accounted for by differences in capital cost assumptions). However, Els arrives at a different result - the cumulative cash flow would be negative R70 billion - two to three times greater than that estimated by van Horen and NEES. The principal reason for this difference is that Els calculated a different quantity from the other studies: Els calculated the cumulative cash flow (which includes finance charges assuming that all financing requirements are met by debt) and the other studies arrived at the financing requirement excluding finance charges. Although this latter quantity may strictly be the amount that must be financed as a result of the programme, the former quantity better expresses the impact on the utility (if it is true that all financing sources, including any cross-subsidies, require a return).

Van Horen (1995) has estimated that cumulative operating losses to date have amounted to more than R300 million. If this amount is spread over all new customers over the past three years, the loss per customer per month is close to

Theron's (1995) estimate of R20 per month for each newly electrified customer. If finance charges are included (assuming that all losses and capital expenditures are covered by debt), the loss increases to R60 per customer per month (Theron 1995).[2] Clearly, finance charges have the effect of dramatically increasing the operating loss and it is this which accounts for most of the difference in results between Els and the other two studies.

It should be noted that the negative cash-flows experienced in the electrification programme are not all financed by debt. Cross-subsidies from other customers are also used. Els looked at the effect of using cross-subsidies to cover annual operating losses and found that these were equivalent to a levy of approximately 5% of other electricity sales. These cross-subsidies dramatically reduced financing requirements over 20 years from R70 billion to R3.4 billion. Van Horen looked at the impact of a 4% levy on electricity generation and found that this reduced the peak cumulative financing requirement to R9.2 billion.

Els' study arrived at a lower net present value than the other two studies, despite having a higher discount rate. In fact, the cause of this difference (when comparing Els with NEES) is that Els estimated lower capital costs. Given this difference it is van Horen's result which appears relatively high and there is no obvious explanation for this.

Only Els' report separated Eskom's costs from those experienced by other distributors and found that Eskom would bear approximately 75% of capital costs, cross-subsidies and financing requirements. Els concluded that although this appeared achievable for Eskom, there were doubts concerning the ability of non-Eskom distributors to raise both the necessary finance and cross-subsidies.

3. Methodology

The methodology used in this study is a financial analysis of electrification, from the viewpoint of the electricity distributors under consideration. This approach requires the quantification of capital expenditures, refurbishment costs, operating and support costs, revenues and finance charges.

The measurement parameters selected for comparison were (1) the capital requirements; (2) the net present value; (3) accumulated debt; and (4) the required subsidies.

3.1 Capital requirements

Capital requirements were obtained from a modelling exercise undertaken for this study by Eskom Distribution Technologies. Demographic information contained in the National Electrification Forum (NELF) database was combined with information describing the current status of the distribution network in the country. Capital requirements included distribution and reticulation lines, transformers and service connections. Since the costs of any investment in transmission equipment is included in the bulk supply cost, it is excluded as an explicit item in the calculation of capital requirements.[3] The required distribution line and transformer capacity was calculated from projected demand growth and linked to existing capacity in the area. Projects were prioritised in order of least capital cost, and household formation was accounted for in the modelling exercise. Detailed assumptions are provided in appendix A.

This modelling of capital requirements represents the introduction of a new aspect to financial modelling of electrification. Previous estimates of capital costs have been largely based on rough estimates of costs per connection, extrapolated

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[2] It should also be noted that these losses will decrease as consumption increases.

[3] The distinction between transmission and distribution equipment is usually based on line voltages with 132kV and below being classified as distribution lines. Within Eskom, the Transmission Group owns a small proportion of 132kV lines.

into the future. Although more detailed capex modelling represents a significant improvement on this, it is recognised that the accuracy of results will be affected by a number of factors, including the accuracy of existing demographic information, the reliability of demographic projections, technology and cost changes as well as changes to technical standards and connection policies. However, the results obtained are the best that can be achieved with existing information and, at the very least, indicate the implications of continuing with current practices, technologies and standards.

3.2 Electrification planning procedures

A number of assumptions about electrification planning are contained in the analysis. Firstly it should be noted that planning is target driven and that targets are based on the number of household connections to be made. These targets are set for each province and must be met by a distributor within its area of supply. For simplicity, all non-Eskom distributors are treated as a single distributor.

The prioritisation of projects is based on least capital-cost. Although this means that the cost per connection is likely to increase over time, there are cases where the establishment of infrastructure in early years is expensive and allows lower-cost connections to be made in subsequent years. The principle of least-cost first implies that urban areas receive priority. However, the principle is modified by two factors. Firstly, targets must be met within a distributor's area of supply, and since Eskom currently does not have access to many urban sites this means that many of their connections will be based in rural areas. Secondly, targets are provided for each province in an attempt to improve access rates evenly throughout the country. This means that more costly connections will be made in provinces such as the Eastern Cape and KwaZulu/Natal when cheaper connections could be made in some of the main metropolitan centres.

These assumptions represent a simplification of the planning process. In reality a wide range of factors affect project prioritisation, not least of which is the progress of consultations with the affected communities. However, when adopting a time horizon of 15 to 20 years these additional factors are impossible to incorporate.

3.3 Sales and consumption growth

The estimation of sales growth is one of the key factors in developing a financial analysis. Although a number of urban townships have had electricity for decades, their consumption levels have not proved to be accurate indicators of electricity consumption in more recently electrified areas. Since the electrification programme only started in earnest in 1992, consumption data only goes back for a few years.

Prior to the electrification programme, sales figures in some of the main urban townships indicated average consumption levels well in excess of 500 kWh per month (Berrisford 1990). Not only were consumption levels found to be high, but consumption growth was rapid. Berrisford reports that 'usage grows quickly once electricity becomes available, and within a year the household is using over half of its ultimate consumption'. Even in the low-income village of Bapong, Berrisford found monthly electricity consumption to be 400 kWh per customer nine months after electrification.

Table 2 indicates the average sales levels in Eskom's electrification projects over the past four years. In most cases averages have been below 100 kWh/month - much lower than early predictions. The situation has been complicated by the high level of non-technical losses due to theft and meter failures. At present non-technical losses are estimated, nationally, to be 34% of total consumption (Bezuidenhout 1995) which means that actual consumption levels have been in the order of 125 kWh/month.

TABLE 2: Sales levels for Eskom's electrification projects since 1992

	Average sales [kWh/month]

Region	1992 (Dec)	1993	1994	1995
Free State	138	76	79	78
Eastern, Northern & Western Cape	201	137	123	124
KwaZulu/Natal	105	73	88	83
Gauteng	53	70	67	83
Northern, North West & Mpumalanga	32	51	55	59
Total	**96**	**75**	**80**	**83**

Sources: Eskom 1992, Eskom 1993, Eskom 1994, Eskom 1995

Note: Figures for 1992 are for December only, not averaged across the entire year. Since there is usually a December peak in sales, the 1992 figures may over estimate the annual averages.

An analysis of consumption growth rates in newly electrified settlements around the country has shown that growth has been in the region of 10-20% per year (Davis 1995). However, this has been off a very low base and growth is unlikely to be sustained at these high rates.

The approach taken in this analysis has been to associate consumption with the type of technology selected by the customer and the type of locality (rural or urban). For 2.5A supplies the maximum monthly consumption was set at 100 kWh. For 20A supplies the limit was set at 200 kWh (rural) and 250 kWh (urban) and for 60A supplies the maximum consumption was 300 kWh (rural) and 350 kWh (urban). Details on consumption growth are provided in appendix A.

Naturally, as new customers are connected to the system each year, average consumption levels will be depressed. That is, growth rates of say 20% per annum for an individual household will not translate to a 20% average annual increase. This is because each year a large number of customers are connected who start off with very low consumption levels. The financial modelling has taken this effect into account.

The focus of this analysis has been on household electrification. However, in any electrification project schools, clinics, shops and other businesses are routinely connected. In addition, there is anecdotal evidence to suggest that electricity provides new opportunities for small businesses, particularly in urban areas (Thom et al 1995). The effect on electricity consumption and utility revenues as a result of non-domestic consumption is not made explicit but is implicit and conservatively estimated in the consumption growth used for households.

Technical and revenue losses were used to convert sales figures to consumption. Table 3 presents the assumptions used.

TABLE 3: Technical and revenue losses

	Technical losses					
	1992	1993	1994	1995	1996	1997 on
Rural	15%	15%	15%	15%	15%	15%
Urban	8%	8%	8%	8%	8%	8%
	Revenue losses					
	'92-'95	1996	1997	1998	1999	2000 on
Rural	30%	25%	20%	15%	10%	10%
Urban	40%	35%	30%	25%	20%	20%

3.4 Other assumptions

The time frame for the analysis was taken to be twenty years (1992 to 2011), and assets were depreciated, in a straight line, over twenty years. It was assumed that distributors are ring-fenced from other activities, and any subsidies to electrification are dealt with explicitly.

The real discount rate used is 6% and finance charges are based on a nominal interest rate of 16% (with inflation at 10%).

Electricity supply costs are based on bulk supply tariffs plus a small distribution cost, rather than the lower marginal costs of supply. This cost equates to 10c/kWh in 1995 and is assumed to decrease in real terms in line with Eskom's price compact.

Where conventional supply technology is used, the tariff is based on the existing Eskom Homelight tariff and is adjusted in line with Eskom's price compact. Where capacity differentiated supplies are introduced, the system of phased-in tariffs and connection fees proposed by Barnard (1995) has been used. Table 4 presents these proposed tariff levels, together with the Homelight tariff.

TABLE 4: Domestic Tariffs [c/kWh] (in 1995 terms)

	1995	1996	1997	1998	1999	2000 on
Homelight[1]	25.8	24.8	23.0	22.8	22.6	22.4
2.5A	R14/mth	R14/mth	R14/mth	R14/mth	R14/mth	R14/mth
20A	25.8	24.4	24.4	24.4	24.4	24.4
60A	25.8	24.4	25.3	26.2	27.1	28.0

1 Used where capacity differentiated supplies are not introduced.

Electrification targets were based on those proposed by Els (1994), broken down for each province. Connections were assumed to be made evenly throughout each year, with an equal number of new customers being connected each month. Costs and revenues were calculated to reflect this gradual increase in customers. Capital costs were also assumed to be spread evenly throughout the year.

All assumptions are presented in Appendix A.

3.5 Key uncertainties

Any analysis of this nature requires the projection into the future of a number of critical variables, thus embedding a level of uncertainty. The key uncertainties relate to:

Capital costs: this has been addressed through modelling as described above. However, there remains a level of uncertainty associated with the results obtained.

Sales growth: this is a function of consumption growth and the level of revenue losses. Experience over the past few years indicates that initial expectations of consumption growth were unrealistically high. High levels of revenue loss, largely through theft, have compounded the problem. However, basing consumption growth for a twenty year period on only a few years experience is difficult.

Where practical, the analysis has included a sensitivity analysis on these key variables, and the discount rate, to indicate the effects on the results of any variation in the assumptions made.

3.6 Institutional options

The analysis was conducted for a variety of institutional arrangements. These are described in more detail below.

Continuation of existing arrangements - the status quo scenario

In this case supply rights are divided between Eskom and local authorities, largely based on the *status quo*, with the exception that all metropolitan areas are the responsibility of the respective metropolitan authorities. The analysis is conducted for Eskom, and non-Eskom distributors. Although combining all non-Eskom suppliers under one heading clearly simplifies a complex situation, it does indicate the over-all effects of continuing with existing arrangements.

In Eskom's case, only the Distribution Group is included in the analysis and unless otherwise stated, the term Eskom refers to this part of Eskom's business. Naturally there are difficulties in separating overhead costs between distribution and generation/transmission. However, Eskom's calculation of unit support costs includes a pro-rata portion of most overheads.

In this scenario connection targets must be achieved within an institutions' respective area of supply. This has implications for Eskom which does not have access to many urban areas.

It is assumed that Eskom introduces capacity differentiated supplies and local authorities continue to provide 40A connections.

The introduction of a national electricity distributor - the NED scenario
Here the distribution industry is rationalised into one national agency responsible for all areas of the country.

In this scenario, two cases are examined: (1) where the utility introduces the use of capacity differentiated supplies, with associated tariffs; and (2) where the practice of providing 40A supplies is continued. For the case where capacity differentiated supplies are introduced, the options of reducing current RDP connection targets by 20%, and the introduction of a R4 000 per connection capex limit, are also examined.

The introduction of regional electricity distributors - the RED scenario
The option of breaking distribution into regional utilities is examined. As a first building block, regions are based on provincial boundaries. Results for provincial distributors can then be combined should an investigation into larger distributors be required.

The option of a national fund and differential bulk supply tariffs to manage financial transfers between REDs is examined under this option.

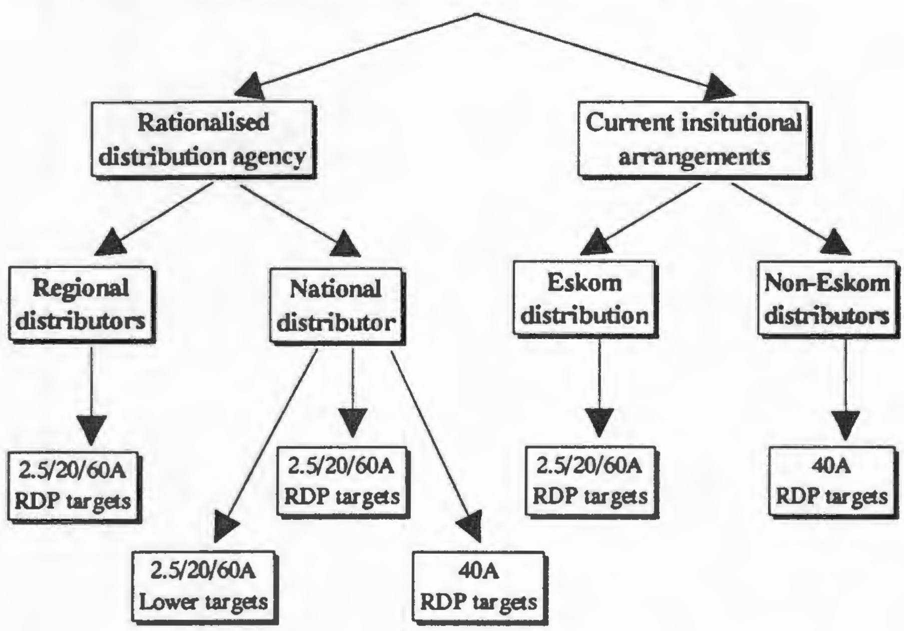

FIGURE 1: Cases examined in the analysis

4. Connection rates and access levels

Figure 2 illustrates the connection rates and the resulting level of access to electricity. It can be seen that the percentage of households with access to electricity climbs steadily to around 70% around the turn of the century. Thereafter, connection rates only slightly exceed the assumed household formation rate and the level of access by 2010 is 76%.

The connection targets used have the effect of ensuring that all provinces have access levels of 70% or more by 2012. This set of targets, based on what might be termed a 'geographical equity' principle, clearly has a cost penalty attached. The alternative would be to prioritise projects on the basis of least cost, regardless of location. This approach would mean that urban areas, particularly the main metropolitan centres, would receive priority and as a result capital requirements in the earlier years would be reduced. Provinces with large rural populations would only be electrified later in the programme. This would inevitably lead to different levels of access in different provinces. Although the analysis has not been able to accurately quantify the effects of this alternative strategy, rough calculations indicate that in the first five years (1995 to 1999) electrification would concentrate in Gauteng, Western Cape and Northern Cape, saving 18% of capital requirements during this early period (approximately R1.7 billion). Expenditure in later years would increase as more costly areas in the Eastern Cape, Northern Province and KwaZulu/Natal were electrified.

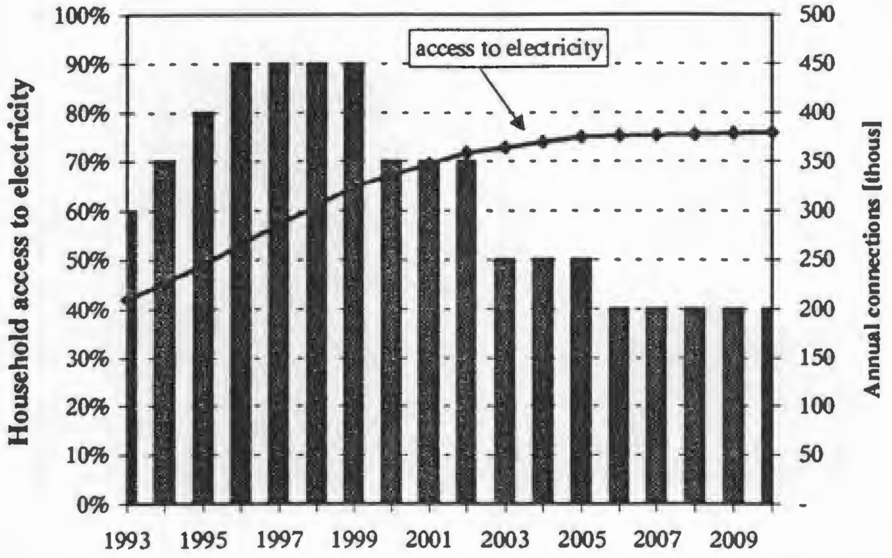

FIGURE 2: Connection rates and level of access to electricity

The first observable effect of rationalising the distribution industry (the NED or RED scenario) is the shift in the spatial distribution of electrification. The modelling assumed that there were fixed electrification targets for each province, over a twenty year time horizon. Within each province, electrification projects were selected on the basis of least cost, constrained by the institution's rights of supply. Where Eskom does not have access to many urban localities, it is forced to achieve its targets in more remote, rural areas. In the case of a national distributor being established, this entity has supply rights to the entire country and so there is a tendency to concentrate on urban areas in the first few years of the programme, and leave rural areas to later in the programme. This effect is illustrated in figure 3.

Secondly, the capex modelling revealed that it would be difficult for non-Eskom distributors to reach the targets assigned to them, simply because electrification levels in many urban centres would reach 100% before the end of the programme and electrification in these areas subsequently deals only with new household formation. Exceptions are in Gauteng, Western Cape and KwaZulu/Natal where urban distributors are able to meet their targets. A more careful distribution of provincial targets would help address this problem, but would not completely solve it.

For the purposes of the financial modelling, it was assumed that non-Eskom distributors would, in fact, manage to reach their targets.

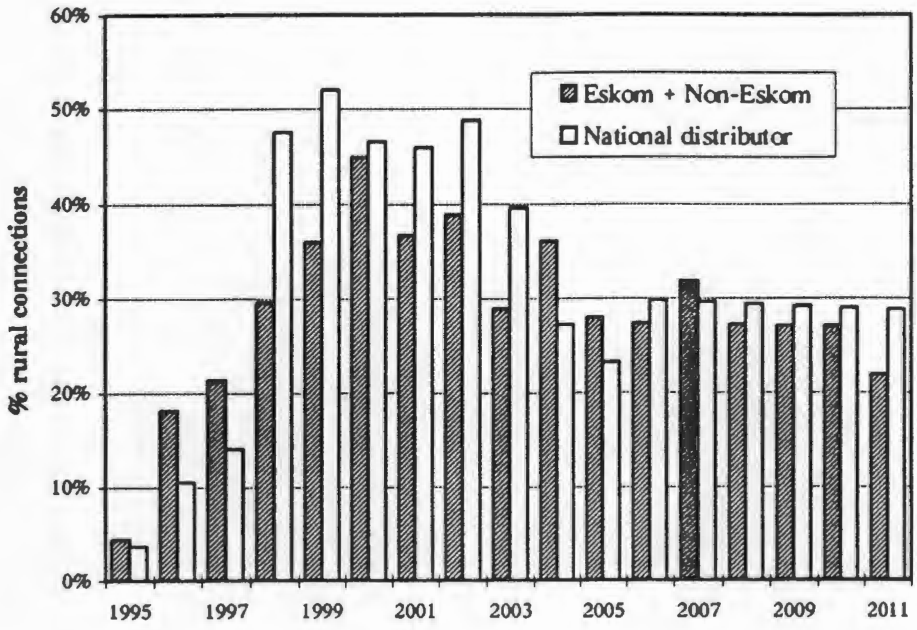

FIGURE 3: Percentage connections in rural (low density) areas comparing the *status quo* with NED scenario

5. Capital requirements for electrification

Capital expenditure requirements were modelling using the computer tool developed by Eskom Distribution Technologies and the results are reported here. Both the average costs per connection and the total capital requirements are presented.

5.1 Average costs per connection

Figure 4 presents the estimates of average capital costs for three different institutions: Eskom, non-Eskom[4] and a national distributor. Although costs are below R5 000 for the first few years, as higher cost areas are reached average costs increase considerably. This increase is particularly marked for Eskom and the national distributor as these agencies are responsible for more remote rural areas. It should be noted that average costs are high - much higher than estimated by Els (1994) or van Horen (1994), and well in excess of current proposals for capital expenditure limits - R2 000 per connection in urban areas and R3 000 in rural areas (Barnard 1995).

The results presented in figure 4 indicate that the containment of capital costs will likely prove to be the largest challenge facing distribution agencies. Given the current pressures to reduce capital requirements, it is extremely unlikely that Eskom, or any other distribution utility, would continue with electrification at these high costs.

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4 There is an apparent anomaly as costs for non-Eskom distributors are relatively high in the first few years. This can be attributed to the need to establish distribution networks in many areas, which can then be used to connect other households in subsequent years.

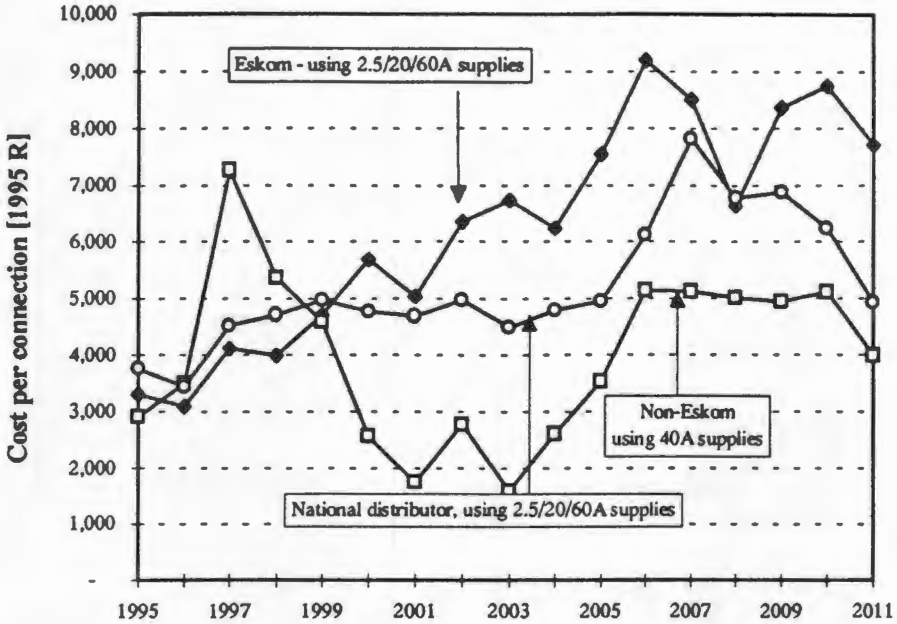

FIGURE 4: Capital costs per connection for different institutional options - 1995 to 2011

The effect of capacity differentiated supplies

Figure 5 presents the effect of utilising capacity differentiated supplies in rural areas. Since the 2.5A technology is only expected to be used in low density rural localities, costs are compared only for these areas. It can be seen that considerable capital savings are to be made through the use of this supply option. These figures are based on an assumption that 60% of households in these areas opt for the 2.5A supply and 40% choose a 20A supply. It should be noted that the costs do not reflect the possibility of large numbers of capacity upgrades in the future. Should these be necessary, the cost saving will be reduced.

Overall, capex savings are substantial, particularly later in the electrification programme as more remote areas are reached. For the next five years, the savings per rural connection are in the order of 20-30%. In subsequent years, savings increase to 50-60%.

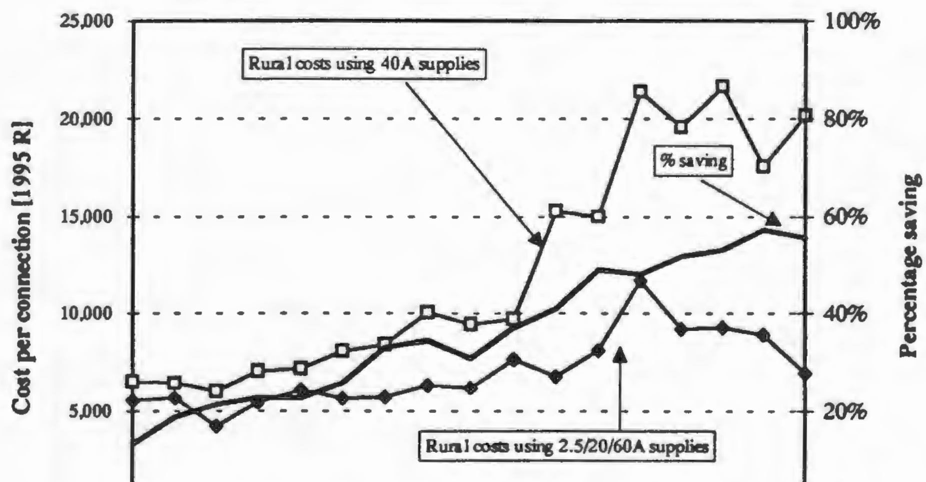

FIGURE 5: Capital costs per connection in rural areas comparing the use of capacity differentiated supplies with standard 40A supplies

Average costs for different provinces

Costs vary considerably for different provinces. Table 5 presents the average capital costs for the nine provinces. It can be seen that costs in the provinces with the highest rural populations are higher, and that the savings from using capacity differentiated supplies are correspondingly greater.

TABLE 5: Average costs per connection [1995 R] for the different provinces - figures are a weighted average for 1995 - 2011

Province	% using 2.5A supply	Using 2.5/20/60A	Using 40A	Saving
Eastern Cape	40%	R 8 100	R 14 300	44%
Northern Province	30%	R 5 900	R 8 600	32%
North-West	26%	R 5 700	R 8 000	28%
KwaZulu/Natal[1]	10%	R 5 000	R 6 200	20%
Northern Cape	28%	R 4 800	R 6 100	20%
Western Cape	16%	R 4 300	R 5 400	21%
Mpumalanga	30%	R 4 100	R 5 200	22%
Free State	31%	R 3 900	R 5 500	29%
Gauteng	0%	R 2 800	R 3 400	16%
Total	20%	R 4 900	R 7 000	31%

1 The proportion of households opting for a 2.5A supply is calculated as 60% of the low density or 'rural' areas. In KwaZulu/Natal, population density in much of the province is high and so this has had the effect of reducing the number of 2.5A connections.

The effect of reducing connection targets by 20%

A 20% reduction in annual targets in each province means that there will be one million fewer connections over the period 1995 - 2011. During the first five years (1995 to 1999), this target reduction means that 440 000 fewer households will be connected. The effect of this reduced electrification rate is to achieve a 60% level of access by 2000, compared with 66% using the original set of targets.

TABLE 6: The effect of reducing electrification targets by 20%

	Number of connections		Level of access	
	1995-1999	1995-2011	2000	2011
Using full targets	2 200 000	5 000 000	66%	67%
Using 20% lower targets	1 760 000	4 000 000	60%	76%
Difference	440 000	1 000 000	6%	9%

Reducing targets has two effects on capital costs: firstly fewer connections are made, and secondly higher cost connections are postponed to later in the programme, thereby reducing average costs per connection. This second effect is shown in figure 6. The effect of lowering targets by 20% reduces the average cost per connection, on average, by 8%.

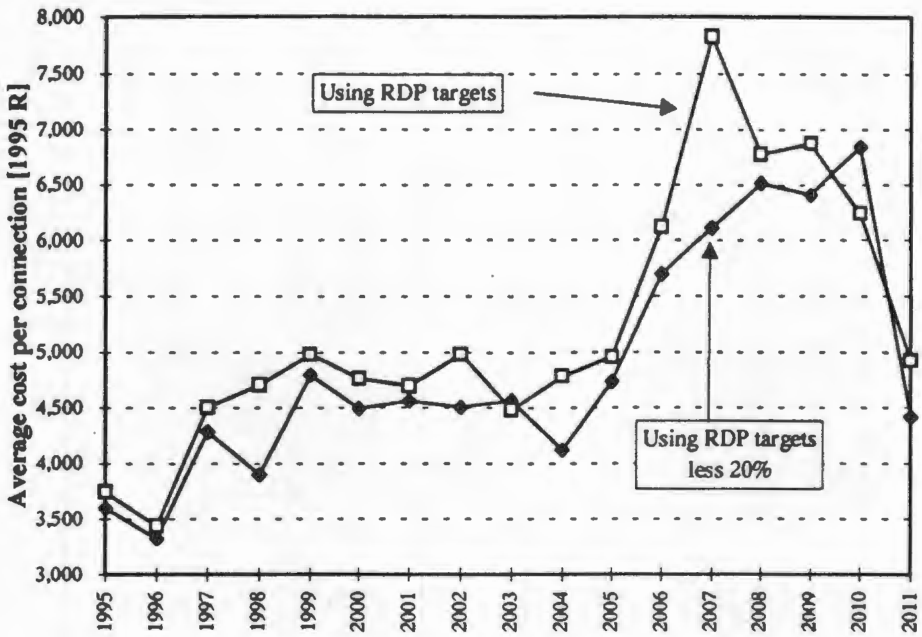

FIGURE 6: Average costs per connection, using capacity differentiated supplies, presented for two sets of connection targets

5.2 Annual capital requirements

Figure 7 presents the annual capital investments made by different institutions. Where capacity differentiated supplies are used, the total annual investment (for all distributors) peaks at R2.2 billion, declining to around R1 billion as the programme develops. The savings from using capacity differentiated supplies are particularly evident in later years as more remote settlements are reached.

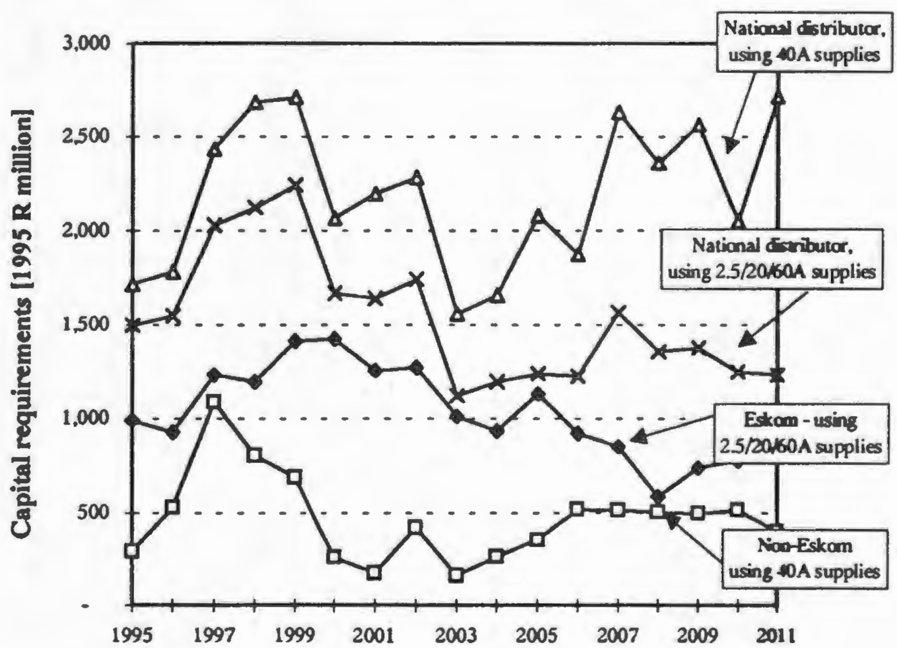

FIGURE 7: Annual capital requirements for the electrification programme[5]

[5] The RED scenario is not shown since, in the modelling exercise performed here, the national sum of REDs capital costs equals the NED scenario.

Table 7 shows the capital required for the next 17 years of the electrification programme. If capacity differentiated supply options are used, the total capital required is in the order of R26 billion - comparable with that estimated by Els (1994) and van Horen (1994). However, if current supply options continue to be used, capital costs will be significantly higher - in the order of R37 billion. The overall capital saving by using capacity differentiated supplies is in the order of R10.9 billion, equivalent to a 30% saving. It should be noted that this modelling exercise represents the first attempt to quantify the savings of using capacity differentiated supplies on a national basis. Although there may be errors associated with the costing estimates of these technologies, the order of magnitude of the result (an average saving of R600 million per annum) indicates that the potential savings are large.

The modelling found that capital savings from the use of capacity differentiated supplies would be moderate up to the year 2000. Thereafter savings increase substantially as the electrification programme moves into more remote and inaccessible areas. Up until the year 2000, the savings on a national basis are in the order of R 2.3 billion - approximately 15% of required capex. In the following 11 years, savings are R8.6 billion - around 40% of required capex.

Much of the electrification programme has been premised on achieving capital costs below R 4 000 per connection. The results of the capital cost modelling exercise suggest that this is highly unlikely if current practices are continued. Utilising capacity differentiated supplies may help make this target realisable.

TABLE 7: Capital costs (1995 R million) for NED and *status quo*: 1995 - 2011

	1995 - 2000	2001 - 2011	1995 - 2011
NED - using 2.5/20/60A	R 11 100	R 15 600	R 26 700
NED - using 40A	R 13 400	R 23 900	R 37 300
Eskom - using 2.5/20/60A	R 7 200	R 10 900	R 18 100
Non-Eskom - using 40A	R 3 700	R 4 300	R 8 000

Table 8 shows the total capital requirement for different regions. It can be seen that the Eastern Cape, KwaZulu/Natal and the Northern Province together account for over half of all capital requirements. It will be seen later in the analysis that these three provinces also have the poorest financial results and require the most subsidisation.

TABLE 8: Total capital costs (1995 R million) for REDs: 1995 - 2011

	% of total	1995 - 2000	2001 - 2011	1995 - 2011
Eastern Cape	25%	R 2 100	R 4 500	R 6 600
KwaZulu/Natal	20%	R 1 800	R 3 600	R 5 400
Northern	14%	R 1 500	R 2 200	R 3 700
Gauteng	10%	R 1 600	R 1 300	R 2 900
North West	9%	R 1 000	R 1 400	R 2 400
Western Cape	8%	R 1 100	R 1 100	R 2 200
Free State	6%	R 900	R 600	R 1 500
Mpumalanga	6%	R 800	R 700	R 1 500
Northern Cape	2%	R 300	R 200	R 500
Total	100%	R 11 100	R 15 600	R 26 700

5.3 Summary

The capital cost modelling exercise has revealed the following results:

- Average costs per connection are likely to be higher than assumed in other analyses and higher than the proposed capital limits.
- There are large regional differences: the provinces with large rural populations require the largest capital investment. In particular, the Eastern Cape has exceptionally high average costs of connection and will require 25% of all investment.
- The use of capacity differentiated tariffs in rural areas reduces the capital costs by some 30%, and these savings are particularly pronounced later in the programme as more remote settlements are reached.
- Reducing electrification targets will reduce capital costs by slightly more than the percentage reduction in connections. This is due to the postponing of more expensive connections.
- Total capital requirements are in the region of R1.5 to R2 billion per annum, resulting in a total capital investment of R26.7 billion over the next seventeen years (using capacity differentiated supplies). This is equivalent to a cost per connection of R4 900.

6. The net present value of the programme

The net present value (NPV) is calculated as the discounted net income stream, which includes all capital expenditure, operating costs and revenues. Finance charges are excluded since the nominal discount rate, at 16%, incorporates the cost of capital.

Capital expenditure is taken over a twenty year period from 1992 to 2011. For each year in this period, a set of new customers are connected. For each set of new customers, future operating costs and revenues are projected for 20 years into the future. Thus, the NPV incorporates all capital expenditure and all revenue and cost streams associated with that expenditure, even for customers connected during the last few years of the programme.

6.1 NPVs for different institutions

The net present value of the programme is negative, and this result is not affected by a sensitivity analysis of the key uncertain variables.

TABLE 9: Summary of results comparing *status quo* with NED scenario: 1992-2011 (using capacity differentiated supplies)

	Eskom	Non-Eskom	Eskom + Non-Eskom	National distributor
Connections	4 mill	2.1 mill	6.1 mill	6.1 mill
Ave connections per annum	200 000	110 000	310 000	310 000
Capex	R 19 bill	R 9 bill	R 28 bill	R 28 bill
Ave capex per annum	R 930 mill	R 420 mill	R 1350 mill	R 1 350 mill
Capex per connection	R 4 715	R 4 290	R 4 570	R 4 680
Net Present Value (NPV)	(R 14 bill)	(R 6 bill)	(R 20 bill)	(R 20 bill)
NPV per connection	(R 3 450)	(R 2 600)	(R 3 250)	(R 3 250)

Note: The capital requirement here is slightly greater than that reported in table 7 because this result includes investments during 1992-1994. Similarly, the cost per connection is lower than reported in table 5 due to the effect of lower cost connections during 1992-1994.

If the required rates of connection can be met, the financial analysis reveals that in terms of capital expenditure and NPV, there is little to distinguish the different institutional arrangements. The NPV for the entire programme is approximately negative R20 billion, equivalent to negative R 3 250 per connection. It should be noted that the NPV per connection for non-Eskom distributors is significantly greater than that for Eskom, and this can be attributed to the higher proportion of rural consumers serviced by Eskom. These results are presented in table 9.

6.2 NPVs for urban and rural electrification

Nationally, the NPV per rural customer is approximately twice as negative as for urban customers. In rural, low density areas, the NPV per customer was found to be negative R5 000. In urban areas it was found to be negative R 2 600.

6.3 The effect of capacity differentiated supplies

The drive behind the initiative to introduce capacity differentiated supplies is to reduce capital costs. Since there is little experience with the widescale use of this technology, it is difficult to ascertain the effect on operating costs, particularly support costs and expenses incurred in upgrading from low capacity to higher capacity supplies. For the purpose of this analysis, it was assumed that support costs for load limited supplies would be the same as those for standard supplies, and that consumption would be lower.

Table 10 shows the results of introducing these capital cost savings into the financial modelling, taking account of changes in sales levels and revenues (using the proposed tariff system). As can be seen, the reduction in capex leads directly to an increase in NPV.

TABLE 10: The effects of using capacity limited supplies

	Using 40A supplies	Using 2.5/20/60A	% change
Total capex (1995 - 2011)	R 39 bill	R 27 bill	30%
Capex per connection (1995 - 2011)	R 7 000	R 4 900	30%
Net present value (1992-2011)	- R29 bill	- R 20 bill	31%

If the results using capacity differentiated supplies are compared with Els (1994), van Horen (1994) and NEES (1993), it can be seen that they are broadly in agreement. However, it should be noted that the capex modelling undertaken in this study shows that capital costs will only be kept within the range calculated by previous studies if capacity differentiated supplies are utilised. This study has found that if electrification continues to supply connections at this capacity, the NPV will be negative R29 billion - a 31% difference.

6.4 The effect of introducing a capital cost per connection limit

In many localities the capital costs of electrification appear to exceed R4 000 per connection, even if capacity limited supplies are used. This section examines the effects of introducing the criterion that any costs in excess of R4 000 per connection (at the magisterial district level) must be provided by non-utility sources.

Imposing this criterion will require that R9 billion from outside utilities must be made available over a seventeen year period (1995 to 2011). Although the amount required will vary from year to year, the average required amount is R580 million per year, and the maximum requirement in any one year is R850 million.

The effects of introducing capital limits are presented in table 11. An alternative approach would be to estimate the number of connections which could be made within this limit. However, the modelling approach used here has not allowed this quantity to be estimated.

TABLE 11: The effects of enforcing capex limits of R4 000 per connection (on a national distributor using capacity differentiated supplies)

	With R4000 capex limit	Without R4000 capex limit	Percentage change
Total capex (1992 - 2011)	R28 bill	R 28 bill	
External funding	R 9 bill	none	
Distributor capex	R19 bill	R 28 bill	32%
Capex per connection	R 3 200	R 4 700	32%
Net present value	(R15.6 bill)	(R 20 bill)	22%
NPV per connection	R 2 550	R 3 250	22%

6.5 The effect of lower targets

Table 12 summarises the financial impacts of reducing electrification targets by 20%. Since capex costs per connection are also reduced in this scenario, and there is greater concentration in urban areas, the effect is to reduce the NPV by 28%. However, the NPV *per connection* would be increased by only 9%.

TABLE 12: The effects of reducing electrification targets by 20% (on a national distributor using capacity differentiated supplies)

	RDP targets less 20%	RDP targets	Percentage change
Connections	4.9 mill	6.1 mill	20%
Net present value	(R 14.4 bill)	(R 20 bill)	28%
Net present value per connection	(R 2 900)	(R 3 250)	9%

6.6 Sensitivity analysis

A sensitivity analysis was performed, varying the discount rate, sales, losses and capital costs. The real discount rate was varied between 2% and 10%; losses were varied between 0% and 40%, and sales and capital costs were varied from 30% below to 30% above the base figures.

In all cases, the NPV remained negative, and the maximum NPV reached was (R12 billion); indicating that under all plausible circumstances, the NPV would not be positive.

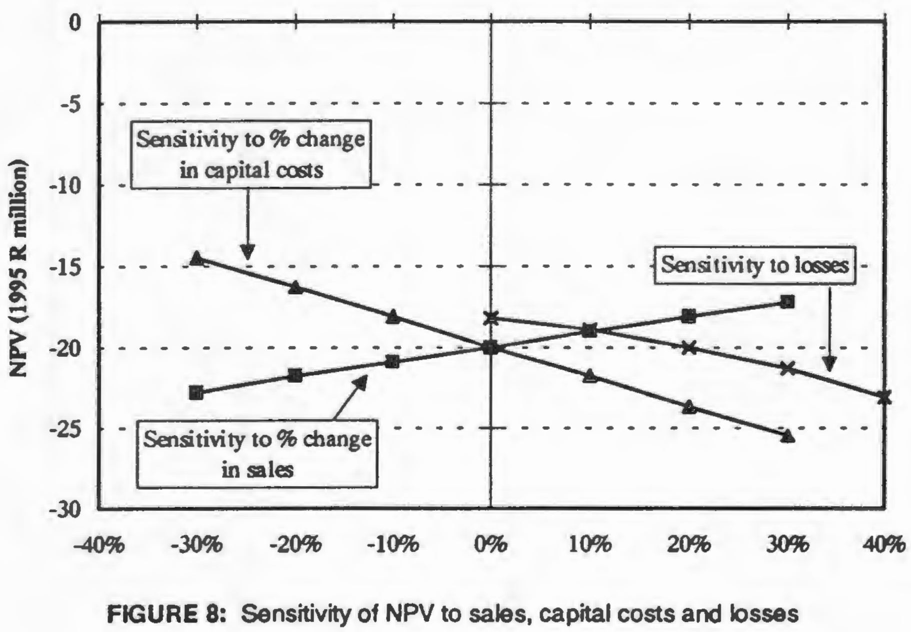

FIGURE 8: Sensitivity of NPV to sales, capital costs and losses

6.7 Summary

The key results from the above discussion are summarised below.

- In terms of NPV, there only negligible differences between a rationalised industry and the *status quo*.
- The NPV of the electrification programme is negative (-R20 billion, using capacity differentiated supplies), and this result is not affected by a sensitivity analysis on the key variables.
- The use of capacity differentiated tariffs increases the NPV of the programme by approximately 30%.
- The introduction of a capital limit would mean that approximately R9 billion would have to be provided by non-utility sources, and this would increase the NPV by 22%.
- Lower targets (by 20%) have the effect of increasing the NPV by 28%. Most of this is made up of reduced capital expenditure.

7. Cash flow, debt and cross-subsidisation

This section will look at operating losses and surpluses in the electrification programme and the effect of loan financing on accumulated debt. This will be followed by an examination of existing surpluses in the distribution industry and an analysis of mechanisms to ensure that the electrification programme is financially viable.

7.1 Operating loss/surplus in electrification

Operating losses/surpluses are calculated as the difference between all operating costs (bulk supply and support costs) and revenue from electricity sales and connection fees. Finance charges are excluded in this definition of losses. The effect of finance charges is included in the calculation of debt levels, presented in section 7.2.

The analysis shows that for most of the time period under consideration, there are operational losses rather than surpluses. However, these are an order of magnitude lower than capital costs. The analysis reveals that the trend is for operating losses to decrease over time, as consumption increases. For the national distributor, losses are estimated to turn to surpluses towards the end of the programme. This is largely a result of the new pricing arrangements introduced in conjunction with the capacity differentiated supplies which imply real increases in tariffs (excepting the 2.5A supply) as opposed to real decreases as contained in Eskom's pricing compact. The performance of the NED is better that that of the *status quo* due to the larger proportion of urban households electrified early on in the programme and the real tariff increases. If the model is run using real price decreases (in line with Eskom's price compact), the operating loss never turns into a surplus. These results suggest that real price increases are necessary to ensure the sustainability of operating electrification projects.

The net operating income is strongly sensitive to the key assumptions. Relatively small changes in tariffs or sales levels affect the annual cash flow.

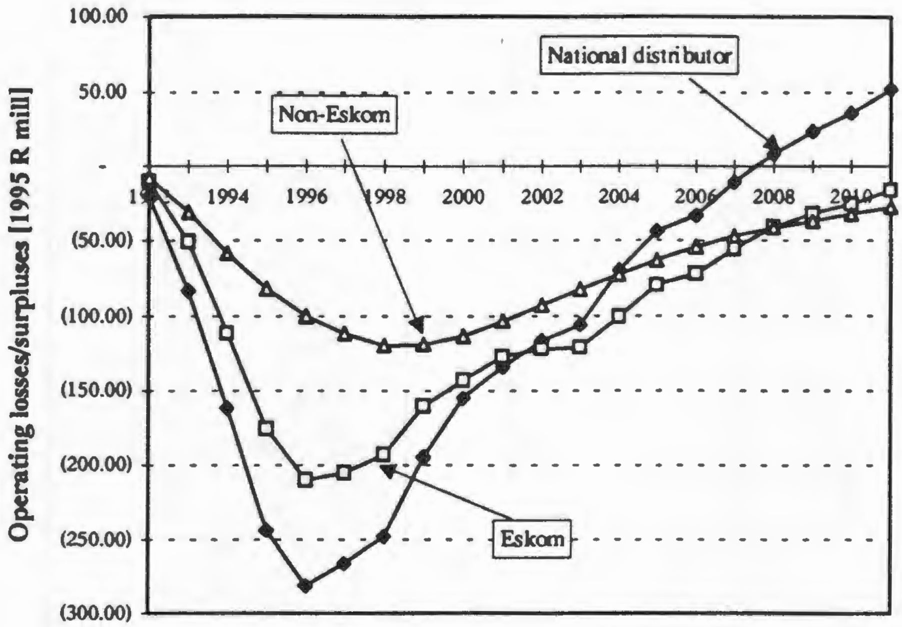

FIGURE 9: Operating losses for the electrification programme (excluding capital expenditure and finance charges)

Within a national distributor, or between separate REDs, there are large differences in operating losses/surpluses. On a provincial basis, Gauteng makes the least loss per customer. All other provinces make substantial losses, as shown in table 13.

TABLE 13: Operating losses/surpluses for each province: 1992-2011

Province	Ave monthly surplus/(loss) per customer	Present value of surplus/(loss) 1995 R mill	Portion of total loss %
Eastern Cape	(R5.93)	(R289)	27%
Northern Province	(R 6.28)	(R177)	17%
KwaZulu/Natal	(R2.83)	(R121)	12%
Free State	(R5.99)	(R119)	12%
Mpumalanga	(R5.52)	(R108)	11%
North West	(R4.70)	(R98)	10%
Western Cape	(R3.86)	(R78)	8%
Northern Cape	(R4.69)	(R27)	2%
Gauteng	(R1.21)	(R12)	1%
Total	(R4.01)	(R1 029)	100%

Note: If the time period 1996-2011 is taken, the losses decrease and, in the case of Gauteng, turns to a surplus. This is because revenues improve later in the programme.

7.2 Loan financing and accumulated debt

If the electrification programme is financed by debt, it is clear that a 'debt trap' will result. Operating surpluses, if they exist, are small and only prevalent towards the end of the programme. Debt will have to be used to cover capital costs, operating losses and interest payments (calculated at 15% per annum of accumulated debt).

In tables 14 and 16 a debt to equity ratio figure is presented. This does not refer to the debt:equity for the distribution agency as a whole, but refers only to the electrification programme. Debt is calculated as the accumulation of capital expenditure, operating losses and finance charges on accumulated debt. Equity is calculated as the current value of assets, that is, assets are depreciated in a straight line over 20 years and revalued to take account of inflation. The debt:equity is a useful indicator of the relative size of accumulated debt.

TABLE 14: Accumulated debt, using 100% loan finance

REDs	Accumulated debt [1995 R mill] 2000	2011	Debt:Equity in 2011
Eastern Cape	R 3 000	R 12 800	2.6
KwaZulu/Natal	R 3 100	R 10 200	2.5
Northern	R 2 500	R 8 200	3.2
North West	R 1 600	R 4 800	2.8
Western Cape	R 1 700	R 4 700	3.3
Mpumalanga	R 1 500	R 3 700	3.8
Free State	R 1 500	R 4 000	4.5
Northern Cape	R 500	R 1 200	4.6
Gauteng	R 600	R 6 500	3.5
NED scenario - using 2.5/20/60A	R 19 900	R 55 000	2.3
Eskom - using 2.5/20/60A	R 13 800	R 38 000	3.3
Non-Eskom - using 40A	R 6 300	R 17 000	3.0

In practice neither Eskom nor other distributors use only loan finance - cross subsidies from other consumers are also used. Although this is dealt with in more detail below, tables 15 & 16 summarise the effect on debt for different levels of cross-subsidy (expressed in terms of Rands per electrification customer per month). As can be seen, to achieve a debt:equity ratio of one, the subsidy must be equivalent to R30 per customer per month.

TABLE 15: Cumulative debt (1995 R) for different levels of subsidy

Cross subsidy [R/customer/month]	Eskom	Non-Eskom	Eskom + Non-Eskom	NED
No cross-subsidy	R 38 bill	R 17 bill	R 55 bill	R 55 bill
R10	R 30 bill	R 13 bill	R 43 bill	R 43 bill
R30	R 13 bill	R 5 bill	R 18 bill	R 18 bill
R50	R 0.2 bill	no debt	R 0.2 bill	no debt

TABLE 16: Debt:equity for different levels of subsidy

Cross subsidy [R/customer/month]	Eskom	Non-Eskom	Eskom + Non-Eskom	NED
No cross-subsidy	3.3	3.0	3.2	3.0
R10	2.6	2.3	2.5	2.4
R30	1.1	0.9	1.1	1.0
R50	0.02	n/a	n/a	n/a

7.3 Sensitivity analysis

Figure 10 shows the sensitivity of debt (assuming 100% debt finance) to changes in capital costs, sales and losses. It can be seen that debt is particularly sensitive to changes in capital costs. This is because operating losses, influenced by sales and losses, are small in comparison with capital costs. The accumulation of debt is largely driven by capital costs of electrification.

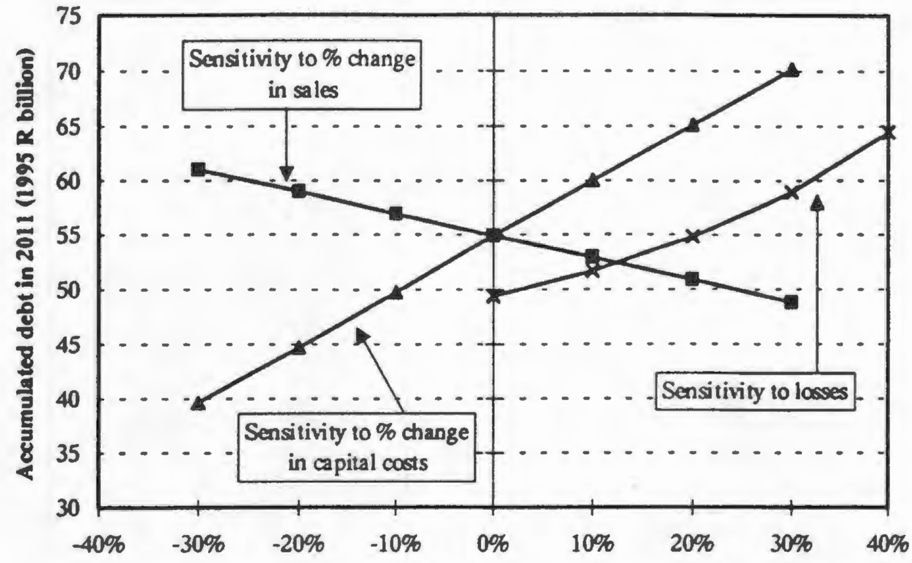

FIGURE 10: Sensitivity analysis on accumulated debt in 2011 (assuming 100% debt finance)

7.4 Existing surpluses in the distribution industry

It is well known that local authorities have, in the past, made substantial surpluses on the distribution of electricity. In general, these surpluses have been used to fund other service activities within each municipality. The most accurate and comprehensive data available on electricity distribution finances is available from the National Electricity Regulator (NER). Table 17 summarises surpluses in the distribution industry for the 1992/3 financial year.

In this financial year most distributors, including Eskom, had only small electrification programmes, and so the figures can be taken to be an estimate of surpluses outside of a potential electrification programme. In fact, given that there were some electrification losses in 1992/3, the actual surplus from non-electrification distribution would be slightly higher than stated. However, it should be noted that the figures exclude certain distributors, particularly in the former homeland areas, and so may *over represent* the actual surpluses.

The total surplus in the industry during 1992/3 was R1.6 billion (in 1995 terms), equivalent to 1.2 cent/kWh sold. Of the total surplus, only 24% was in Eskom distribution and more than half was accumulated in Gauteng. This is not only a consequence of the greater size of distribution in Gauteng, but also because distributors in Gauteng make a greater surplus per unit of electricity sold. Surpluses in Eskom are only 0.5c/kWh compared with 2.2c/kWh in non-Eskom distributors.

It should also be noted that Eskom's bulk supply costs to its own distribution business (used in project financial analyses) are approximately 20% lower than those charged to municipal distributors. If transmission tariffs were equal, Eskom's surplus in distribution would decrease dramatically and may even turn into losses. In addition, it can be argued that Eskom's financial health is dependent on using annual profits to reduce its overall debt. For both these reasons, the RED/NED scenarios have not included existing Eskom distribution surpluses as a potential source to cross-subsidise electrification.

TABLE 17: Sales and surpluses in the distribution industry - 1992/3
(Source: Mountain 1995)

Province	Distribution [1000 MWh/year]			Surplus [1995 R million/year]			Surplus
	Eskom	Non-Eskom	Total	Eskom	Non-Eskom	Total	[1995 c/kWh]
Gauteng	17 962	23 384	41 346	200	722	922	2.22
N West	14 820	5 630	20 450	174	60.0	234	1.14
K/Natal	8 860	10 788	19 648	61.2	112	173	0.88
Mpuma.	15 088	1 404	16 492	(36.7)	14.6	(22.1)	(0.13)
W Cape	3 292	7 786	11 078	(54.8)	199	144.2	1.30
Free State	7 537	2 098	9 635	(1.3)	43.8	42.5	0.44
Northern	3 467	852	4 319	37.2	(23.0)	14.2	0.33
E Cape	418	3 667	4 085	11.4	57.0	68.4	1.67
N Cape	2 404	549	2 953	(13.7)	22.6	8.9	0.30
TOTAL	73 871	56 138	130 009	379	1 207	1 586	1.22

7.5 Requirements to make electrification financially viable

Tables 15 & 16 indicate the effect of subsidies, measured in terms of a subsidy per household. However, it is more meaningful to measure subsidies as a levy on sales or as a proportion of operating surplus within the distribution industry. This analysis investigates the level of subsidy required to ensure that the accumulated debt in 2011 is not greater than the current value of depreciated assets. It is assumed that sales, and operating surpluses (for non-electrification activities), grow at a rate of 8% per annum - similar to average annual growth over the past 15 years.[6]

Two useful ways of determining the subsidy requirements to make electrification viable are:

- to ensure that the NPV of the programme is zero or positive; and
- to ensure that accumulated debt is less than or equal to the depreciated value of revalued electrification assets, i.e. an electrification debt:equity of less than one.

The first criterion is stricter and implies greater subsidy requirements. Since any operating surpluses are small or non-existent in order to make the NPV non-negative additional funds must cover all capital costs and operating losses. In this case there is no accumulated debt since all expenses are covered. Under the second criterion, debt is allowed to build up, but is contained within limits so that after twenty years the debt is no larger than the (revalued) book value of electrification assets.

If the first criterion is used, the total subsidy requirement is exactly equal to the negative NPV of the programme, as presented in section five of this report. The rest of this section will look at subsidy requirements to contain debt levels.

Figure 11 presents the required level of subsidy to ensure the financial sustainability of the programme. Total subsidies peak at around R1.5 billion in 1999 and thereafter vary between R1 billion and R1.2 billion for the rest of the programme.

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[6] Growth in electricity demand is usually higher than GDP growth.

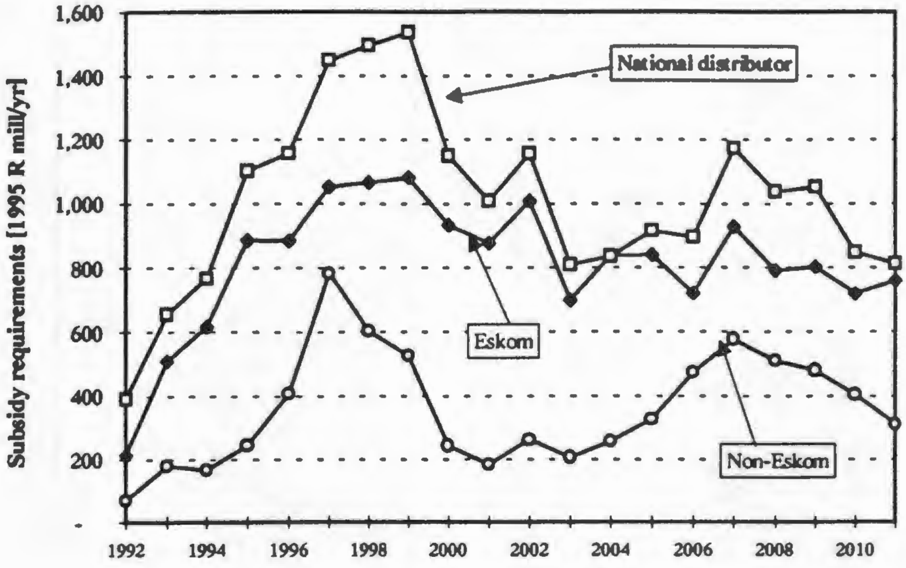

FIGURE 11: Subsidies required by the electrification programme

There are three possible ways to fund these required subsidies:

- as a direct transfer from the Government fiscus;
- as a cross-subsidy from surpluses within the distribution industry; and
- from a price increase, either to all customers or only domestic customers.

Figures 12 & 13 express the subsidy requirements as a percentage of operating surpluses in the distribution industry and as a price increase.

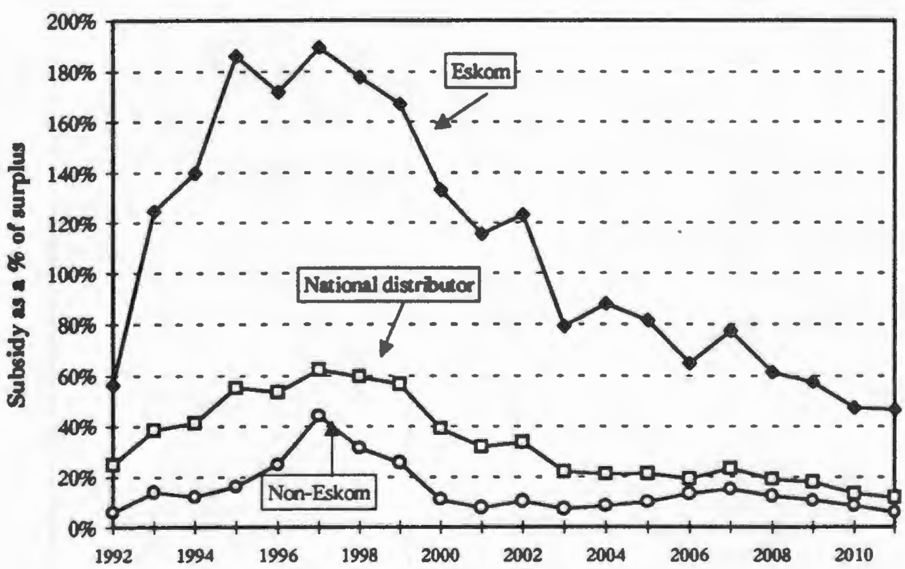

FIGURE 12: Subsidies as a percentage of national surpluses

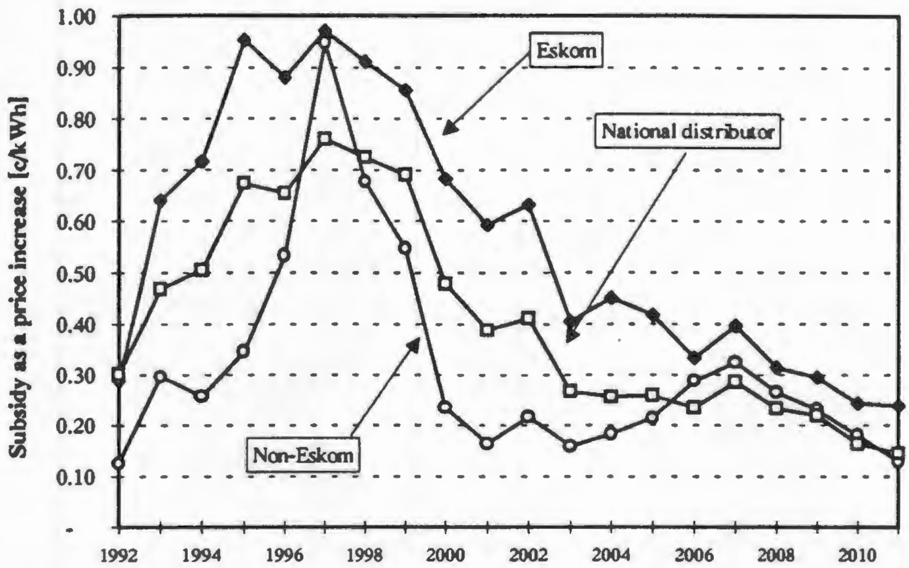

FIGURE 13: Subsidies as a general price increase

Within Eskom Distribution, current surpluses are insufficient to cover operating losses. However, a general price increase of 0.54c/kWh (equivalent to a 5% increase) would ensure the financial viability of Eskom's electrification programme.

It is possible to perform this analysis for non-Eskom distributors as a group, although there is limited value to the result as surpluses and deficits vary greatly between distributors. However, if transfers could be effected between municipal distributors (and this would be largely from Gauteng to other areas), their electrification programmes would be viable if 15% of surpluses could be captured. This would be equivalent to a 0.33c/kWh general price increase, approximately 3% of current price levels. However, the difficulties of utilising cross-subsidies with this institutional arrangement effectively rule out this subsidy mechanism. Firstly, existing surpluses are largely used to cover other municipal requirements and using them for electrification may precipitate a crisis in local government financing. Although a price increase could raise sufficient funds, the practicality of co-ordinating transfers between three hundred or more distributors would make this option extremely difficult to implement.

Lastly, in the case of a national distributor, it is assumed that current surpluses in the industry can be extrapolated into the future, growing at 8% per annum. Under these circumstances, the programme would be viable if 40% of surpluses could be captured, equivalent to a 0.39c/kWh general price increase (a 4% increase). If these price increases were only applied to domestic customers, so that cross-subsidisation only occurs within the domestic sector, the price increase would be 2.6c/kWh, equal to a 16% increase (given domestic tariffs of 16c/kWh).

If the capital limit of R4000 per connection is enforced and the utilities' capital costs are reduced, then the required general tariff increase would be reduced by approximately 50%.

TABLE 18: Subsidies required for electrification[1]: 1996-2011

	as an annual transfer	as a % of surplus	as a general price increase[2] [c/kWh], [(%)]	as a domestic price increase[3] [c/kWh], [%]
Eskom	R875 mill	105%	0.54 (4%)	n/a
Non-Eskom	R400 mill	15%	0.33 (3%)	n/a
NED	R1 200 mill	40%	0.39 (4%)	2.6 (16%)

1 Averaged over the 16 year period.

2 Percentage price increases are approximations for non-Eskom distributors.
3 Assuming that 15% of all electricity sold is for domestic consumption.

The size of the price increase necessary to sustain electrification is dependent on the annual growth in electricity consumption. The results presented in table 18 are based on an annual growth rate of 8%. Over the past 15 years, average growth in electricity consumption has been of this magnitude. Figure 14 presents the sensitivity of the required price increase to growth in electricity consumption. It can be seen that for higher growth rates (corresponding to higher national economic growth), the required increase is considerably smaller.

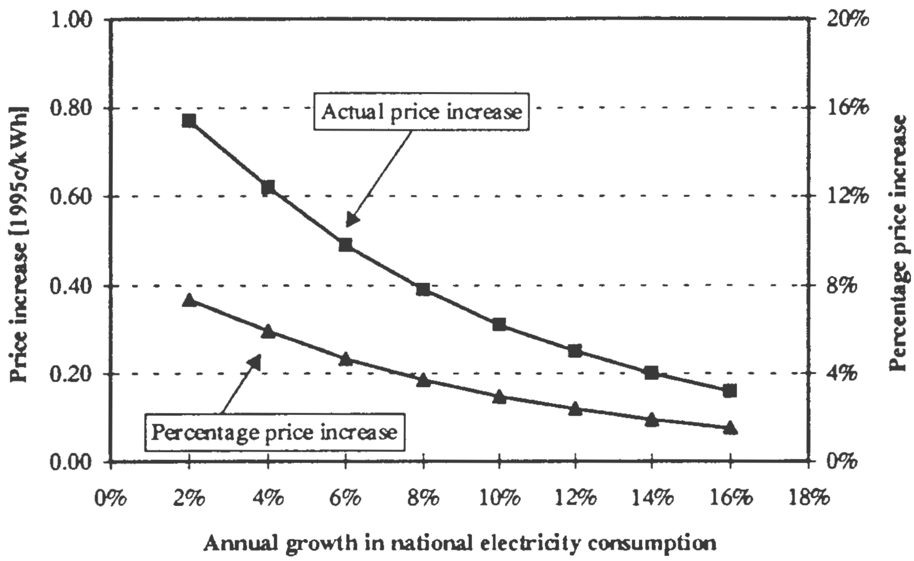

FIGURE 14: Sensitivity of required price increase to general electricity consumption growth

7.6 Subsidies for REDs

In order for the electrification programmes in each province to be financially sustainable, it is necessary for a large proportion of capital expenses and operating losses to be paid for by grants or cross-subsidies. Figure 15 shows the subsidy requirements for each provincial region. The Eastern Cape, KwaZulu/Natal and the Northern Province together account for some 55% of the total subsidy required. This can be attributed to their large rural populations.

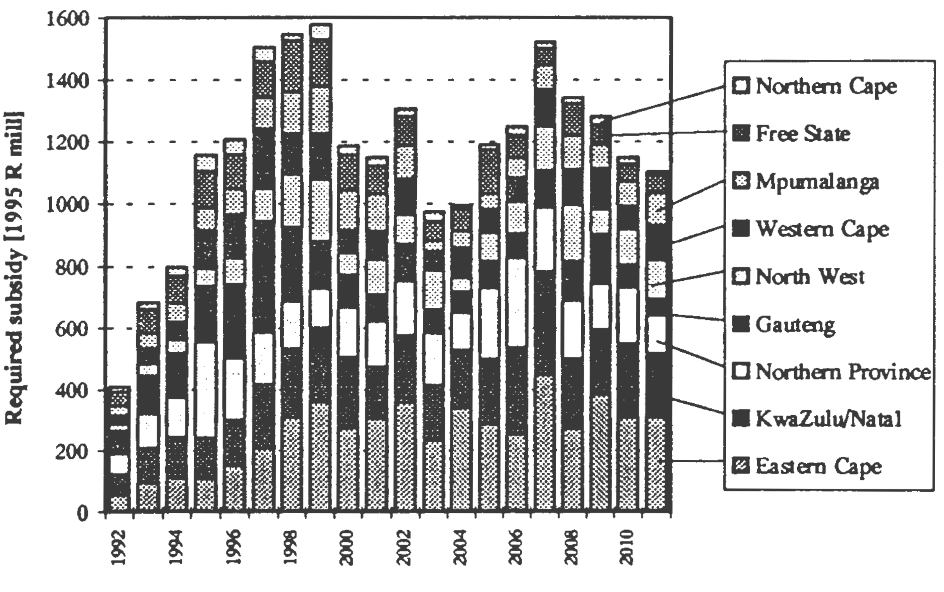

FIGURE 15: Required subsidies for each province

As before there are three ways of providing the necessary funds: (1) as a direct grant from Government; (2) as a cross-subsidy from existing surpluses; or (3) as a price increase. If either of the last two methods are used, it is necessary to provide a mechanism to transfer funds between REDs. This can be done either through a fund, which redistributes surpluses among REDs; or through transfer pricing at the bulk tariff level.

On average, the required subsidy is approximately 70% of capital expenditure. If there were Government contributions towards electrification, they would have to amount to this high proportion of capital costs in order to make the programme financially viable for utilities.

One mechanism to generate the required funds for electrification is to increase general tariffs, that is to tax electricity distribution. It was found that a general tariff increase of 0.39c/kWh was necessary to generate sufficient funds. Two ways to distribute these funds would be to establish an electrification fund, or to use transfer pricing at the bulk supply level.

An electrification fund would receive money raised from a price increase that is not used for a RED's own electrification programme, and distribute it elsewhere. In effect this fund would mainly tax Gauteng and pay other provinces. Table 19 shows the average annual payments to and from such a fund.

The same transfers can be effected through a system of bulk tariff discounts and surcharges. The net effect on the bulk supplier would be zero, but some areas would receive cheaper electricity and others would pay more. This mechanism can be adapted to match the required transfers and table 19 presents the average surcharges and discounts for each province.

TABLE 19: Annual funding using a general 0.39c/kWh price increase - averaged over 1996-2011

Province	Required subsidy 1995 R mill	Generated from tariff increase 1995 R mill	Net contribution to fund 1995 R mill	Surcharge/ (discount) on bulk tariff c/kWh
Eastern Cape	300	39	(261)	(4.06)
K/Natal	218	187	(31)	(0.11)
Northern Province	176	41	(135)	(2.02)
Gauteng	134	423	289	0.41
North West	115	195	80	0.23
Western Cape	110	106	(4)	(0.06)
Free State	95	92	(3)	(0.07)
Mpumalanga	93	157	64	0.22
Northern Cape	26	28	2	(0.02)
Total	1 267	1 267	0	

7.7 Summary

The main findings of this component of the analysis can be summarised as follows:

- The electrification programme requires extensive subsidisation to be financially viable.
- These subsidies are in the range of R1 billion to R1.2 billion per annum, equivalent to approximately 70% of capital costs.
- There are sufficient surpluses within the electricity distribution industry to provide these subsidies, if 40% of surpluses are available for this purpose.

- If surpluses are not available, a general price increase of 0.39c/kWh (under a rationalised industry) would be required to ensure the financial sustainability of the programme. A smaller increase would be required under a scenario of higher economic growth. Alternatively, Government would have to contribute approximately 70% of capital costs.
- Under REDs, financial transfers could be effected either through an electrification fund or a system of bulk supply discounts and surcharges.

8. Conclusions

This analysis has attempted to examine the financial effects of a number of factors which affect electrification, including the use of capacity differentiated supplies, decreasing electrification targets, and most importantly, restructuring the industry. The main conclusions are summarised below.

The effects of using capacity differentiated supplies

It was found that the capital savings associated with the use of capacity differentiated supplies were in the order of 30%. This led directly to a 30% improvement in the NPV of the programme.

It should be noted that average costs per connection are likely to be significantly higher than assumed in previous analyses, especially later in the programme as more remote areas are included. The use of capacity differentiated supplies can go some way towards reducing supply costs, but there will still be a large number of settlements where the average cost of supply is well in excess of a R4 000 limit.

If a capital cost per connection limit is introduced, either a large contribution towards capital expenditure will be required (in the order of R9 billion over 20 years) from Government or customers; or the electrification programme will have to be scaled down. The option of utilising off-grid power supplies, in particular photovoltaic systems, requires further investigation.

The effect of decreasing electrification targets

A scenario where electrification targets are decreased by 20% was investigated. This had the effect of reducing average costs per connection by approximately 8%, thereby bringing down the total capital requirements by more than the 20% reduction that might have been expected, and increasing the NPV of the programme by 28%.

The effects of rationalising the distribution industry

If connection targets can be achieved under all scenarios, the differences between institutional arrangements, measured in terms of NPV and capital requirements, are minimal. However, it should be stressed that the modelling showed that it would be extremely difficult for non-Eskom suppliers to meet their targets within their areas of supply. This is simply because electrification will approach saturation in some urban areas and electrification will be reduced to the rate of household formation. Under a rationalised industry, rights of access problems are resolved and it is possible to prioritise electrification areas appropriately.

Under a rationalised industry the operating losses are smaller and turn to surpluses later in the programme, largely as a result of tariff increases, but also because a higher percentage of urban connections are made earlier in the programme. It should be noted that this result is sensitive to small changes in some of the base assumptions.

It should be noted that operating losses are small compared to capital requirements and the financial results are largely driven by capital costs. Given this result, together with the conclusion that capital costs may be higher than previously anticipated, one of the major challenges facing the distribution industry will be to reduce connection costs.

Given that operating losses are comparatively small, it is concluded that relatively small improvements in sales, losses, operating costs and possibly a tariff increase would make operating electrification a financially viable enterprise.

Subsidies and cross-subsidies
The subsidies required to keep debt within acceptable levels were quantified in this analysis. For a rationalised industry, subsidies would have to be in the order of R1 to R1.2 billion per year, approximately 70% of total capital requirements.

These subsidies could come (1) from Government; (2) 40% of surpluses in the entire distribution industry; (3) a 0.39c/kWh levy on electricity sales throughout the country (a 4% increase); or (4) a 2.6c/kWh levy on domestic electricity consumption (a 16% increase). If REDs were in place, either a central fund or a system of bulk tariff discounts/surcharges could be used to redistribute the funds among the utilities.

If a distribution utility (or utilities) is to be created, separate from Eskom's Generation and Transmission Groups, and if much of the existing surplus associated with electricity distribution continues to be earmarked for local governments, it is clear that such a utility will be in a precarious financial position. Under these circumstances, careful consideration will have to be given to the following:

- mechanisms to raise sufficient capital at low cost, with the assurance that loans and finance charges will be met;
- mechanisms to transfer subsidies (or utilise cross-subsidies) in order to ensure financial sustainability of distribution;
- adequate regulation of bulk supply tariffs to ensure that the surpluses associated with electricity supply are equitably allocated between a generation and transmission utility on the one hand, and a distribution utility (or utilities) on the other.

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Appendix A: List of assumptions

A.1 Technology choice

Where capacity differentiated supplies are offered, it is assumed that there are different take-up rates in low and high density areas, as presented below.

Technology choice				
	2.5A	20A	60A	Total
Rural	60%	40%	0%	100%
Urban	0%	80%	20%	100%

A.2 Discount rate, time horizon

The discount rate used is 16% and an inflation rate of 10%.

The time horizon is twenty years, and assets are depreciated over this period to calculate the residual value of assets.

A.3 Capital costs and refurbishment

Capital costs are calculated from Distribution Technologies capex model. the assumptions used in the modelling are presented below. Costs are based on 1995 quotes from contractors.

Bulk sub-station transformer size	20 MVA	
Bulk HV line type	88kV Panther as average	
Bulk MV line type	22 kV Mink as average	
MV/LV infrastructure % losses	9%	
Bulk % losses	3.5%	
MV infrastructure technology:		
Low density:	MV Maypole technology	
High density:	Optimised MV/LV 3-phase technology	
Service connection costs (excl. meter)	1 - 100 connections:	R440 per connect.
	100 - 500 connections:	R 415 per connect
	> 500 connections:	R 396 per connect
Metering costs:	ECU	R 350
	Circuit breaker & earth leakage	R 150
ADMD: Rural:	1.06 kVA	
Urban:	1.94 kVA	

Refurbishment is calculated as 20% of original capital (inflated to current values) at year 10.

A.4 Losses, load factor and support costs

Losses are expressed as a percentage of total energy supplied.

Technical losses						
	1992	1993	1994	1995	1996	1997 on
Rural	15%	15%	15%	15%	15%	15%
Urban	8%	8%	8%	8%	8%	8%

Revenue losses						
	'92-'95	1996	1997	1998	1999	2000 on
Rural	30%	25%	20%	15%	10%	10%
Urban	40%	35%	30%	25%	20%	20%

Load factor			
	2.5A	20A	60A
Rural	25%	35%	40%
Urban	25%	40%	40%

Support costs [1995 R/cust/month] - for 1995			
	2.5A	20A	60A
Rural	R25	R25	R25
Urban	R25	R25	R25

A.5 Tariffs and connection fees

Tariffs [1995 R]						
	1995	1996	1997	1998	1999	2000 on
Homelight[1]	25.8	24.8	23.0	22.8	22.6	22.4
2.5A	R14/mth	R14/mth	R14/mth	R14/mth	R14/mth	R14/mth
20A	25.8	24.4	24.4	24.4	24.4	24.4
60A	25.8	24.4	25.3	26.2	27.1	28.0

1 Used where capacity differentiated supplies are not introduced.

Connection fees [1995 R]						
	1995	1996	1997	1998	1999	2000 on
Homelight[1]	R45	R45	R45	R45	R45	R45
2.5A	R45	R9	R9	R9	R9	R9
20A	R45	R45	R90	R135	R181	R272
60A	R45	R272	R363	R545	R727	R909

1 Used where capacity differentiated supplies are not introduced.

A.6 Price changes over time

	Price changes relative to inflation		
	Inflation	Homelight tariff	Ave bulk costs
1992	10%	-5%	-5%
1993	10%	-2%	-2%
1994	10%	-1%	-1%
1995	10%	-5.5%	-5.5%
1996	10%	-7%	-7%
1997	10%	-1%	-1%
1998	10%	-1%	-1%
1999	10%	-1%	-1%
2000	10%	0%	0%
2001	10%	0%	0%
2002	10%	0%	0%
2003	10%	0%	0%
2004	10%	0%	0%
2005	10%	0%	0%
2006	10%	0%	0%
2007	10%	0%	0%
2008	10%	0%	0%
2009	10%	0%	0%
2010	10%	0%	0%
2011	10%	0%	0%

All other prices and costs (support costs, material costs) are assumed to remain constant in real terms.

A.7 Consumption growth

Each category of consumer is assigned a consumption growth profile. This, together with the connection rate and cumulative number of each type of connection, is used to calculate average consumption for each year.

Consumption growth						
	Rural			Urban		
	2.5A	20A	60A	2.5A	20A	60A
Min	50	50	100	50	50	100
Max	100	200	300	150	250	350
1	50	50	100	50	50	100
2	63	70	133	67	73	136
3	76	89	166	83	95	173
4	89	109	200	100	118	209
5	100	129	233	116	141	246
6	100	149	266	133	163	282
7	199	168	299	150	186	318
8	100	188	300	150	209	350
9	100	200	300	150	231	350
10	100	200	300	150	250	350
11	100	200	300	150	250	350
12	100	200	300	150	250	350
13	100	200	300	150	250	350
14	100	200	300	150	250	350
15	100	200	300	150	250	350
16	100	200	300	150	250	350
17	100	200	300	150	250	350
18	100	200	300	150	250	350
19	100	200	300	150	250	350
20	100	200	300	150	250	350

A.8 Connection rates

Two national scenarios are used: one follows the RDP or NEES medium-rate scenario, and the other is 20% less than this. These totals are broken down into Eskom and non-Eskom (assuming existing rights of supply), and the combined total is used for the case of a single national distributor. The tables below only show the RDP scenario.

Connection rates (RDP scenario) - National distributor

	E Cape	Mpum.	KwaZul	N-W	N Cape	North	F.S.	G'teng	W Cape	Total
1992	12 400	19 600	70 000	21 400	5 300	14 200	14 200	28 700	14 200	200 000
1993	25 100	26 900	71 800	26 800	14 300	32 200	52 000	46 600	23 300	319 000
1994	35 900	25 100	70 000	17 900	14 300	48 500	34 100	64 700	39 500	350 000
1995	61 400	27 200	75 800	22 000	11 000	65 000	39 800	68 800	29 000	400 000
1996	87 600	33 600	85 800	35 400	10 200	39 000	35 400	91 200	31 800	450 000
1997	81 000	32 400	86 400	36 000	10 800	39 600	34 200	93 600	36 000	450 000
1998	86 600	32 600	84 800	41 600	9 200	43 400	32 600	86 600	32 600	450 000
1999	82 400	32 000	86 000	41 000	8 600	46 400	32 000	86 000	35 600	450 000
2000	62 500	24 700	71 500	31 900	6 700	42 700	24 700	57 000	28 300	350 000
2001	58 700	24 500	73 000	31 700	6 500	42 500	24 500	58 600	30 000	350 000
2002	57 100	24 700	73 200	31 900	4 900	42 700	24 700	58 900	31 900	350 000
2003	39 400	17 800	53 700	21 400	3 400	30 300	16 000	43 000	25 000	250 000
2004	39 400	17 800	53 700	21 400	3 400	30 300	16 000	43 000	25 000	250 000
2005	39 400	17 800	53 700	21 400	3 400	30 300	16 000	43 000	25 000	250 000
2006	30 300	14 000	42 700	17 900	2 600	25 000	12 500	35 700	19 300	200 000
2007	30 300	14 000	42 700	17 900	2 600	25 000	12 500	35 700	19 300	200 000
2008	23 000	14 000	42 700	14 000	3 500	21 200	14 000	42 800	24 800	200 000
2009	23 000	14 000	42 700	14 000	3 500	21 200	14 000	42 800	24 800	200 000
2010	23 000	14 000	42 700	14 000	3 500	21 200	14 000	42 800	24 800	200 000
2011	28 700	17 900	52 000	17 900	4 400	25 000	17 900	53 900	32 300	250 000

Connection rates (RDP scenario) - Non-Eskom only										
	E Cape	Mpum.	KwaZul	N-W	N Cape	North	F.S.	G'teng	W Cape	Total
1992	5 000	1 100	21 700	2 900	1 600	3 100	6 800	1 000	6 800	50 000
1993	12 200	6 600	38 100	6 500	5 100	6 300	33 500	1 500	12 200	122 000
1994	17 400	4 800	25 200	5 000	6 900	4 100	8 200	18 500	9 900	100 000
1995	20 700	5 000	22 600	3 500	4 600	5 800	12 100	17 000	8 700	100 000
1996	33 900	18 800	2 200	9 500	8 400	3 900	16 900	35 700	20 700	150 000
1997	31 000	17 600	900	10 100	9 000	4 500	15 700	38 100	23 100	150 000
1998	25 500	14 100	16 000	8 300	5 500	900	12 300	49 600	17 800	150 000
1999	23 200	13 500	15 300	7 700	4 900	3 900	11 700	49 000	20 800	150 000
2000	18 100	8 100	21 200	6 000	3 000	3 900	6 200	20 000	13 500	100 000
2001	18 000	9 700	7 800	7 700	2 800	7 400	7 900	23 500	15 200	100 000
2002	20 100	11 800	37 500	11 600	2 200	11 300	9 900	27 500	18 100	150 000
2003	13 500	10 400	22 000	6 600	1 600	8 100	4 900	19 000	13 900	100 000
2004	13 500	10 400	22 000	6 600	1 600	8 100	4 900	19 000	13 900	100 000
2005	19 100	10 400	3 300	8 500	1 600	10 000	6 800	24 500	15 800	100 000
2006	10 000	6 600	42 300	5 000	800	4 700	3 300	17 200	10 100	100 000
2007	10 000	4 800	44 100	5 000	800	4 700	3 300	17 200	10 100	100 000
2008	6 400	4 800	40 500	2 900	1 700	900	2 900	26 200	13 700	100 000
2009	6 400	4 800	40 500	2 900	1 700	900	2 900	26 200	13 700	100 000
2010	6 400	4 800	40 500	2 900	1 700	900	2 900	26 200	13 700	100 000
2011	6 400	4 800	40 500	2 900	1 700	900	2 900	26 200	13 700	100 000

Connection rates (RDP scenario) - Eskom only										
	E Cape	Mpum.	KwaZul	N-W	N Cape	North	F.S.	G'teng	W Cape	Total
1992	7 400	18 500	48 300	18 500	3 700	11 100	7 400	27 700	7 400	150 000
1993	12 900	20 300	33 700	20 300	9 200	25 900	18 500	48 100	11 100	200 000
1994	18 500	20 300	44 800	12 900	7 400	44 400	25 900	46 200	29 600	250 000
1995	40 700	22 200	53 200	18 500	6 400	59 200	27 700	51 800	20 300	300 000
1996	53 700	14 800	83 600	25 900	1 800	35 100	18 500	55 500	11 100	300 000
1997	50 000	14 800	85 500	25 900	1 800	35 100	18 500	55 500	12 900	300 000
1998	61 100	18 500	68 800	33 300	3 700	42 500	20 300	37 000	14 800	300 000
1999	59 200	18 500	70 700	33 300	3 700	42 500	20 300	37 000	14 800	300 000
2000	44 400	16 600	50 300	25 900	3 700	38 800	18 500	37 000	14 600	250 000
2001	40 700	14 800	65 200	24 000	3 700	35 100	16 600	35 100	14 800	250 000
2002	37 000	12 900	35 700	20 300	2 700	31 400	14 800	31 400	13 800	200 000
2003	25 900	7 400	31 700	14 800	1 800	22 200	11 100	24 000	11 100	150 000
2004	25 900	7 400	31 700	14 800	1 800	22 200	11 100	24 000	11 100	150 000
2005	20 300	7 400	50 400	12 900	1 800	20 300	9 200	18 500	9 200	150 000
2006	20 300	7 400	400	12 900	1 800	20 300	9 200	18 500	9 200	100 000
2007	20 300	7 400	400	12 900	1 800	20 300	9 200	18 500	9 200	100 000
2008	16 600	9 200	2 200	11 100	1 800	20 300	11 100	16 600	11 100	100 000
2009	16 600	9 200	2 200	11 100	1 800	20 300	11 100	16 600	11 100	100 000
2010	16 600	9 200	2 200	11 100	1 800	20 300	11 100	16 600	11 100	100 000
2011	21 600	14 200	7 200	16 100	6 800	30 300	16 100	21 600	16 100	150 000

Study sites for Case Study 8 - 29 January

The study will be carried out in two magisterial districts in the N E Cape: Mt Ayliff and Bizana.

Conversation with Reinholdt Viljoen - IDT programme manager

There are 7 clinics and 2 hospitals in Mt Ayliff.

There are 16 clinics and 3 hospitals in Bizana (Mkambati, St.Patrick, Greenville).

Of the clinics in the former Transkei which are to be electrified, about %0% will be grid and 50% non-grid.

The assessment of the clinics in the area was originally done by Tescor and is somewhat outdated.

IDT will be carrying out some grid-extensions to clinics - falling outside of the 5-year Eskom plans.

The process has been that IDT prepares a plan for the provincial Department of Health - the provincial Department of Health will make some changes to the plan based on their priorities. The D of Health is the final arbitrator.

Conversation with Godfrey Sibanda - field manager for DLV

Dries Louw is the manager of the overall project at DLV (linked me with Sibanda)

He suggested the following study:

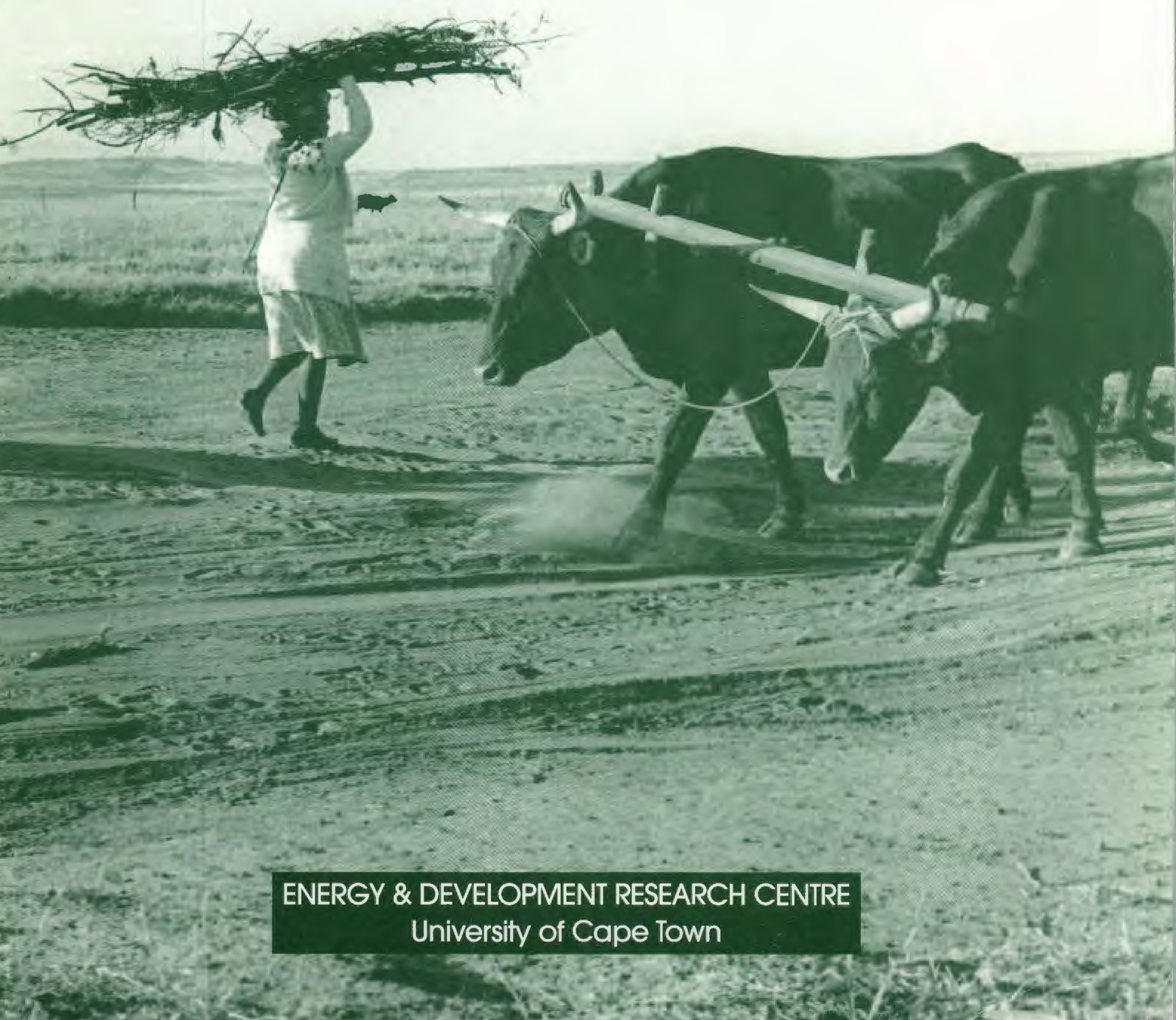
Mnceba - Mzalwaneni (grid)
Eskom will probably be electrifying this area in mid-1996.
It includes three villages: Mnceba, Ndantaka and Mvenyane.
The clinic is called Mnceba clinic.
There is a junior school and a secondary school in the area. There is also a mission with a resident priest.
Mzalwaneni is located past Kokstad take the road to Mt Ayliff and then take the turn off to Tabankulu. Drive for 5-7km and then take the Mnceba turn off.

The Mt Frere settlement area will be a problem because it is serviced by the Mt Frere hospital - too urban.
Another possibility is Sipetu - but this will only be electrified in 1997.

EDRC REPORT SERIES

The financial impacts of electrification on the electricity distribution industry

Mark Davis



ENERGY & DEVELOPMENT RESEARCH CENTRE
University of Cape Town