National Electrification Programme Evaluation

SUMMARY REPORT

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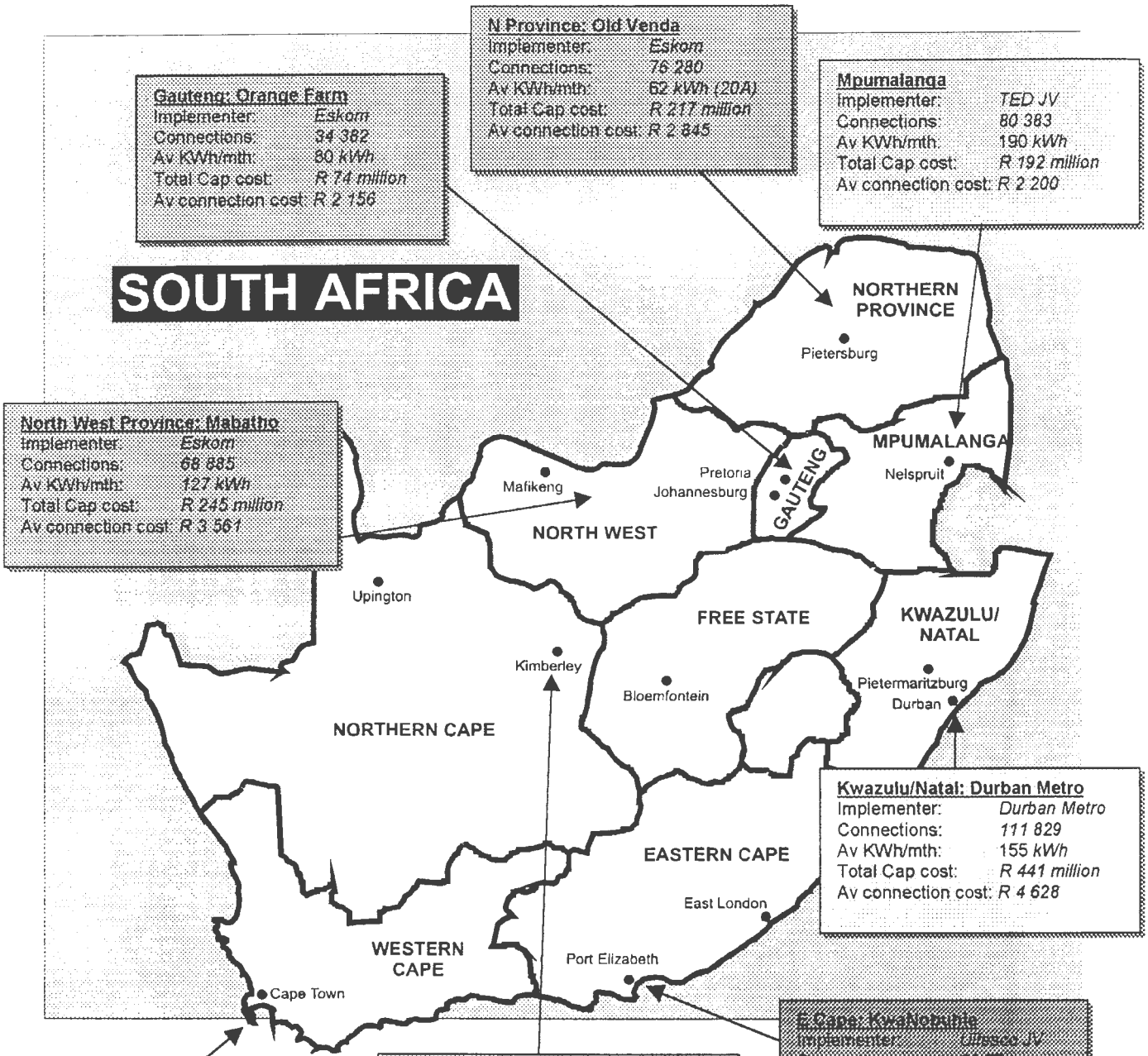
National Electrification Programme Evaluation

Sample site location and description



N Province: Old Venda
Implementer: *Eskom*
Connections: *76 280*
Av KWh/mth: *62 kWh (20A)*
Total Cap cost: *R 217 million*
Av connection cost: *R 2 845*

Gauteng: Orange Farm
Implementer: *Eskom*
Connections: *34 382*
Av KWh/mth: *80 kWh*
Total Cap cost: *R 74 million*
Av connection cost: *R 2 156*

Mpumalanga
Implementer: *TED JV*
Connections: *80 383*
Av KWh/mth: *190 kWh*
Total Cap cost: *R 192 million*
Av connection cost: *R 2 200*

North West Province: Mabatho
Implementer: *Eskom*
Connections: *68 885*
Av KWh/mth: *127 kWh*
Total Cap cost: *R 245 million*
Av connection cost: *R 3 561*

Kwazulu/Natal: Durban Metro
Implementer: *Durban Metro*
Connections: *111 829*
Av KWh/mth: *155 kWh*
Total Cap cost: *R 441 million*
Av connection cost: *R 4 628*

E Cape: KwaNobuhle
Implementer: *Ulilisco JV*
Connections: *20 574*
Av KWh/mth: *165 kWh*
Total Cap cost: *R 57 million*
Av connection cost: *R 2 791*

N Cape: Kimberley
Implementer: *Kimberley Munic.*
Connections: *3 181*
Av KWh/mth: *134 kWh*
Total Cap cost: *R 7.6 million*
Av connection cost: *R 2 463*

W Cape: Khayalitsha
Implementer: *PN Energy JV*
Connections: *34 884*
Av KWh/mth: *116 kWh*
Total Cap cost: *R 87 million*
Av connection cost: *R 2 498*

TOTAL SAMPLE

Total number of connections:	*430 398*
Average kWh/mth per household (weighted):	*132 kWh (in yr 2000)*
Total Capital cost:	*R 1 321 million*
Average cost per connection (weighted)	*R 3 213*

EXECUTIVE SUMMARY

The National Electrification Programme

The National Electrification Programme (NEP) Phase I commenced in 1994 and was completed at the end of 1999 at a total cost of about R7 billion. This target driven programme increased electrification from about 36% to 66 % nationally. Approximately three million households had been electrified by 1993, mostly in cities and towns. Approximately 64% of the total population had no access to grid electricity. The aim of Phase I was to provide access to electricity for an additional 2 500 000 households, mainly in previously disadvantaged and rural areas, as well as connecting all schools and clinics without electricity.

The NEP evaluation

- The South African Government commenced with Phase 2 of the National Electrification Programme in 2000. However, an evaluation of the first phase became necessary in order to draw lessons for planning and implementing the second phase.

The Department of Minerals (DME) and Energy and the Development Bank of Southern Africa (DBSA) agreed to undertake a joint evaluation. The bulk of the evaluation was subcontracted to the University of Cape Town's Energy and Development Research Centre (EDRC), under the management of the DBSA.

The purpose of the evaluation was to:

- document the programme's quantitative and qualitative achievements;
- investigate the development impacts;
- analyse strengths and weaknesses;
- identify lessons learned from the programme and selected sample projects.

National policy goals identified in the White Paper on Energy Policy were also used as the principal goals of the evaluation, including community welfare, economic development, sustainability and implementation efficiency issues.

EDRC evaluated projects in six provinces: Western Cape (Khayelitsha programme), Northern Cape (Kimberley), North West (Mmabatho area), Northern Province (old VEC programme), Gauteng (Greater Orange Farm programme) and KwaZulu-Natal (Durban Metro programme), and a seventh province, Eastern Cape (Kwanobuhle programme), was undertaken by DBSA. (Refer to the map for the geographical location of these provinces and projects). DBSA had also undertaken a detailed evaluation of the Transitional Electricity Distributor (TED) electrification programme in Mpumalanga Province in 1999, which was included in the evaluation.

These eight electrification projects evaluated represent all provinces except Free State and include two municipal projects, three Eskom projects (some of which were initially old 'homeland' utilities subsequently taken over by Eskom), and three projects carried out by joint ventures between Eskom and another organisation. They were selected with the hope that they would offer useful insights into the effectiveness of the different institutional arrangements, technical solutions, financial costs, and socio-economic benefits, of the national electrification programme. The eight programmes covered in the sample comprised over 430 000 households – approximately 17% of the total National Electrification Programme coverage.

Due to budget limitations, the evaluation relied heavily on the different distributors for the provision of data. However, data sourced through this method proved problematic, partly because of the time constraints of assigned distributor personnel to source the necessary data, but also because the data was often not available. In several areas, the evaluation was constrained as a result of this – none more so than in the area of financial evaluation.

Overall assessment

Overall, the NEP Phase 1 has been a noteworthy success, and the ambitious target of 2.5 million connections was achieved in the given timeframe (1994 to 1999). Eskom connected about 1.75 million households and schools, and municipalities made close to one million connections. This was in spite of fears that the ESI was too fragmented for such an effort. The programme provided an

international precedent in that electrification growth rates during the programme were amongst the highest in the world, and this was achieved without the external funding common in many large-scale electrification programmes in the developing world. Innovative approaches and technologies were pioneered, with several successes and many lessons. It is useful to summarise the performance of the NEP regarding the key questions around which the evaluation was undertaken.

Did the programme contribute to the welfare of communities?
Electrification clearly has improved welfare of households, although benefits are more limited in the many households where electricity is only used for lighting and media purposes. Other community-wide benefits include the reduction of fires from reduced paraffin light and candle use, and potentially reduced local and indoor air pollution where electricity is more extensively used for cooking and heating purposes. The welfare benefits are lower than expected, however, as consumption levels of around 350kWh per month were anticipated at the commencement of the project, while actual consumption is currently little over 100kWh per month for most households,[1] with correspondingly reduced benefits to users.

In addition to household-level benefits, clinic and school electrification has significant benefits for communities, resulting in improved health care service provision and enabling schools to become involved in evening adult education, as well as improving the efficiency of school operation where they are able to procure equipment such as photocopiers and computers.

Did the programme promote economic development?
Electrification is simply one factor in promoting economic development, and is generally not the most important one, particularly for small enterprises. Nevertheless, some small businesses clearly benefit from electrification. Examples are workshops, food retailers, and entertainment venues.

To achieve a much greater impact on economic development requires a broader strategy than electrification alone, and is likely to need coordination between organisations responsible for electrification, capacity building, and finance provision, amongst others.

Was the delivery of electricity sustainably undertaken?
From a financial perspective, the electrification programme does not appear to be sustainable, and it appears that even operational costs are not covered by revenue generated in many cases (although this could not be established with certainty in the evaluation due to a lack of detailed financial information). The latter implies that programmes will be a continuing drain on the economy rather than merely displaying 'slower than anticipated' capital recovery. This has serious implications for NEP sustainability in future, including the ability of distributors to continue to service existing areas adequately (quite apart from expanding into new areas).

Financial and economic indicators from the evaluation sample*

Total capital cost (R millions)	R 1 321 million
Average cost per connection (weighted)	R 3 213
Financial NPV per customer (weighted)	(R 1 023)
Economic NPV per customer (weighted)	R 146
Economic benefit: cost ratio (weighted)	1.0

* Note that, because of the lack of actual capital cost data from some programmes, these figures are a mix of apparently reliable figures and others of unknown accuracy.

Negative environmental impacts of electrification do not appear significant, and are likely to be outweighed by the positive impacts on settlement and indoor pollution. The programme thus appears to be environmentally sustainable. Generation emissions environmental impact is excluded from this assessment.

[1] The current weighted sample average consumption for the year 2000 is 132 kWh/month/household, and the estimated 20 year projection is 208 kWh/month/household.

Was the programme efficiently undertaken?

While the programme delivered according to the ambitious connection targets set, it did so at a higher average cost than the NER target, and system non-technical losses were often high. These may reflect inefficiencies. This must be balanced against considering the pioneering nature of the programme, with associated inexperience of the institutions involved (in terms of technology, scale of implementation, and community interactions), and it must be taken in account that some of the technology used had no extensive field testing, and that relations with communities were often difficult initially due to the political hangover of the apartheid government. From this perspective efficiency of implementation appears rather more impressive.

This study has identified five of the most significant lessons arising out of this evaluation.

- ***Lesson 1: The effectiveness of an institution's performance in respect of electrification is independent of the institutional structure, and the NEP achievements indicate strength in diversity***

All the institutions evaluated in this project effectively carried out electrification programmes and contributed to achieving the targets of the NEP. Each type of institution (Eskom, municipality, and joint venture) demonstrated relative strengths and weaknesses, or advantages and disadvantages, but none failed to meet their objectives. There was insufficient evidence to indicate that any one type of organisation was able to carry out the electrification more efficiently or less expensively than any other, taking into account the variety of circumstances of each project. Rather it appears that there is strength in diversity, and that diverse institutional structures have promoted the adoption of approaches suited to the differing situations around the country.

This lesson has significant implications for NEP Phase 2, since it indicates that electricity distribution industry restructuring need not be a constraint on further progress in electrification, just as it does not appear to have hindered the achievements of the institutions in NEP Phase 1.

It should be noted that the evaluation survey sample was small and that no weak municipalities were included. Also, the nature of Eskom has changed since the electrification programme was implemented and, being now liable for taxation as a company, it may take related decisions differently in the future. Therefore, using the assessed historical performance as a guide for the future must be done with great caution.

- ***Lesson 2: Most electrification is only financially viable with significant investment subsidies, and even then some networks need subsidies for subsequent operations***

Notwithstanding the uncertainty regarding the capital costs of several of the programmes, it is evident that most electrification is not financially viable for the distributor without subsidies and, at best, marginally economically viable. This lesson should be seen in the context of the significant broader benefits identified under Lesson 4.

The NEP was entirely funded from within the electricity distribution industry. Eskom received no subsidies and the municipalities received subsidies derived from Eskom revenues through the electrification fund. The evaluation project was unable to identify the size of the subsidies required for further electrification, as there were discrepancies regarding the methods of modelling and input data used by Eskom.

Connection fees payable by customers do not contribute significantly to financial viability unless they are large enough to be a barrier to electricity access for many poor households. NEP Phase 2 will need to balance these two concerns

Subsidies of the capital investment are a once-off cost, but non-viable operations of the networks requires on-going subsidisation, implying that existing projects will be a continued national economic drain. This poses a serious concern for the sustainability of future electrification programmes that will increasingly move into more financially marginal areas.

- ***Lesson 3: A wide range of technical alternatives for the electrification programme all have an important role in reducing the cost of electrification. These include the feeder technology, materials, capacity of the supply available to customers, metering and design standards.***

Pressure to reduce the costs of connections caused most distributors to adopt lower cost standards for the electrification networks, in many cases reducing the benefits of electrification delivered to the customers. Despite the cost pressures, there was relatively little technical innovation during the NEP.

Previously introduced innovations were implemented on a wide scale, but, in some cases, only when the cost pressures were applied.

Electrification costs can be reduced further by using single-phase systems, reducing the capacity of supply and not making allowance for possible future upgrading. However, the reduced supply capacity limits the benefits of electrification for the customers, preventing, for example, the use of electricity for cooking. There is no single supply capacity that is appropriate for all needs, and thus a range of options should be provided. NEP Phase 2 will need increased attention to technical cost reduction, through incentives or targets, balancing this with customer needs.

The evaluation found that prepayment meter failure is more widespread than is commonly known, resulting in expensive replacements and reduced customer service quality. Also, there are indications that prepayment metering may not have been as successful at reducing non-technical losses as was once thought. Appropriate metering options need to be re-evaluated in this regard.

- ***Lesson 4: Successful electrification requires as much focus on meeting community needs as on technical and financial issues***

Many of the broader economic benefits of electrification relating to community welfare are not quantifiable, yet from a national perspective are nonetheless critically important. Undertaking electrification with a predominantly technical and financial focus does not automatically meet many of these needs effectively.

Interactions and relationships between the recipient communities and the distributors have been variable, but there is consensus that community involvement in electrification planning and delivery is important. It is a key factor in addressing high non-technical losses. Strong community relationship with the distributor results in improved customer satisfaction and greater welfare benefits. While community committees are widely used, they often lack capacity to participate effectively in the electrification process, and some members feel that they should be paid for their travel costs and time.

Improving welfare benefits also means facilitating the provision of streetlighting, which is much valued by communities, yet is often not provided. Facilitating access to electricity by poor households in particular, as well as facilitating increased use by connected households, needs attention.

- ***Lesson 5: Achieving the desired impacts of electrification requires a broader approach to setting targets in terms of the benefits.***

Target-setting in future electrification needs to be more comprehensive than merely connection targets, in order to maximise impact and cost-effectiveness. Electrification is not an end in itself. It does not provide significant long-term employment within the sector. Electrification is necessary, but not sufficient on its own, to stimulate economic activity and improve the quality of life, and needs to be integrated with other services. Specific attention to promoting benefits is thus necessary. Target-setting and implementation guidelines in future should aim to maximise economic and social benefits while, at the same time, keeping the programme affordable for customers and the country. A logframe approach is proposed as an appropriate tool to allow the entire programme to be managed in a structured way to achieve the desired hi'-level policy goals. Outputs should include connection targets as with Phase 1, but should also consider cost-capping and technical and non-technical loss parameters to promote efficiency, as well as community involvement, community service provision and capacity building outputs. The importance of increased attention to community needs was evident from the Phase 1 evaluation. Support to economic activity and environmental outputs also should be included as clear objectives with associated outputs.

The estimation of non-technical losses provides an important indicator of operations management and cost-effective delivery, but needs a more statistically thorough and consistent approach across distributors. Current differences in measuring standards adopted and assumptions used reduce the usefulness of such figures, and sometimes they are simply not known.

Once the objectives and outputs have been made clear, firm reporting procedures need to be instituted to enable effective monitoring and management.

Conclusion

Although the NEP Phase 1 programme experienced inevitable difficulties and was not always as efficient as it might have been, it reflects a rare achievement from a national and international perspective. It is now important that lessons emerging from the NEP Phase 1 are properly included in Phase 2 planning and implementation – which will increasingly move into more marginal areas, and will thus be more financially, technically and institutionally demanding.

Strategic guidelines for the implementation of NEP Phase 2

The findings which are most critical to the effective implementation of NEP Phase 2 are summarised below.

- ***Diversity of institutional approach is a strength which should not be lost in NEP Phase 2.***

Institutional restructuring is not a constraint to further electrification and, in fact, diversity of structure, and thus approach, is a strength which allows for different approaches to implementation which best suit the varying conditions around the country. Restructuring initiatives should beware that such diversity is not stifled in the proposed move to large, similarly structured REDs.

- ***Clear, up-front financial planning of NEP Phase 2 is critical, identifying funding sources and subsidy levels.***

Electrification is in most cases not financially viable, and, in fact, revenues in many areas do not cover operating costs. This poses a serious threat to not only the sustainability of further electrification, which will increasingly move into more marginal areas, but also to the effective operation of existing systems. Clear up-front financial planning is critical for NEP Phase 2 to avoid moving into dangerously unsustainable situations, including the clarification of funding sources and subsidy levels required.

- ***The goals and outputs of NEP Phase 2 need to defined at the outset in a logframe or similar planning framework***

Outputs and implementation should be guided by this planning framework. The resulting targets will need to be more comprehensive than the simple connection targets used in Phase 1 (although this was effective given the electricity supply industry situation at the time). The following objectives and outputs should be included in the framework:

  - connection targets (including schools and clinics);
  - cost targets;
  - technical and non-technical loss targets;
  - community involvement and capacity building;
  - ongoing service provision to schools, clinics, and businesses; and
  - environmental management and impact monitoring.

- ***Further optimisation of costs and maximisation of benefits is possible and necessary for NEP Phase 2.***

In this regard, the following steps need to be undertaken:

  - Commission a study on metering feasibility, in the context of the higher prepayment metering costs which have come to light and the indications that they are not as effective at reducing non-technical losses as was previously thought.
  - Commission a study on optimum connection capacity ranges and charges. This evaluation shows that a choice of options needs to be provided at appropriate connection costs, and that users should not be constrained by connection capacity where they require more. The feasibility of providing a free current limited connection (e.g. 2.5A) needs to be explored, weighing up the social benefits and the cost implications. The implications for network capacity and costs need to be included in the assessment.
  - The merits and demerits of using 'blanket' or 'selective' electrification need to be further investigated. The former may be less financially viable, while the latter may bypass the poor

to some extent and thus have reduced social benefits. It is important to allow diversity of approach by distributors in this regard while balancing social goals and financial viability.

- Maximum use of cost-effective technical options such as single-phase systems should be promoted in NEP Phase 2.

- ***Meeting community needs must be an integral focus within the NEP Phase 2 electrification process.***

The following are important in this regard:

- Community participation, and, where necessary, capacity building, is to be a core part of distributor responsibilities.
- Vending stations need to be accessible in all areas, and standards are to be more specific in this regard.
- Streetlighting should be provided as a part of electrification – communities value streetlights.
- An investigation into the feasibility of providing appliance 'starter packs' should be undertaken. So far this has not been properly investigated.

- ***Improved data collection and reporting is required for NEP Phase 2.***

Distributors need to collect and report data to enable monitoring of programme performance relative to the specified outputs. Lack of such data was a significant constraint to the evaluation of NEP Phase 1. It was also found that data on individual programmes was often lost through regional aggregation, making evaluation more difficult. Measures should be put in place to see that this does not happen in the proposed move to larger REDs. Specific data to be collected and reported should be influenced by the overall objectives and outputs set for the programme, but should include the following:

- Financial information:
  - capital expenditure (connection costs, reticulation costs, bulk supply, vending stations, streetlights, meter replacement, other);
  - operating expenditure (energy supply, support and maintenance, other);
  - revenue for each electrification programme per year.
- Records of network design and construction should be maintained together with a register of physical assets, for monitoring and asset valuation as well as for subsequent network assessment and reinforcement planning.
- Further data reporting requirements will be dependent on the objectives and outputs defined for NEP Phase 2, and are likely to include information on non-technical losses, community interaction, and clinic and school electrification reporting.

The NER or DME should systematically collect and process the reported information in the light of the programme objectives and outputs set.

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Acknowledgements

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Chris Lithole – DME

Dr Isak Kotze and other NECC project Steering Committee members

Isaac Sokopo – Eskom Megawatt Park

Andre Kuhn – Eskom Western Cape Distributor

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Ntshaveni Nenguda – Eskom Northern Province

Deon Low – SALGA

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Abbreviations and acronyms used

abc	aerial bundle conductors
ADMD	after diversity maximum demand
BECOR	Boputatswana Electricity Corporation
Cost/conn	cost per connection
c/kWh	cents per kilowatt-hour
DBSA	Development Bank of Southern Africa
DCI	Data Collection Instrument
DME	Department of Minerals and Energy
EDI	electricity distribution industry
EDRC	Energy and Development Research Centre
EFA	'electricity for all'
EIRR	economic internal rate of return
GoSA	Government of South Africa
HV	high voltage
IDT	Independent Development Trust
IRR	internal rate of return (financial)
JV	joint venture company
KVA	kilovolt-amperes (power measurement)
KW	kilowatts (power measurement)
kWh	kilowatt-hour
LA	local authority
LV	low voltage
Metro	metropolitan council
Munic	municipality
MV	medium voltage
NECC	National Electrification Co-ordination Committee
NELF	National Electrification Forum
NEP	National Electrification Programme
NER	National Electricity Regulator
NPV	net present value
OEU	Operations Evaluation Unit (a unit within DBSA)
O&M	operation and maintenance
RDP	Reconstruction and Development Programme
REDs	regional electricity distributors
PN	PN Energy Services (Pty) Ltd – joint venture company
SA	South Africa
SADC	Southern African Development Community
TED	Transitional Electricity Distributor (Pty) Ltd – joint venture company
ToR	terms of reference
WTP	willingness to pay
VEC	Venda Electricity Corporation

1. Introduction

The national electrification programme implemented in South Africa between 1994 and 1999 targeted low-income households in both rural and urban areas previously deprived of access to electricity. Historically, households belonging to the minority white population relied almost exclusively on electricity for their domestic energy needs. The black majority relied on inferior and inconvenient fuels such as fuelwood, candles, batteries and paraffin, and electricity supply was not reliable even where it was available. The national utility, Eskom, responded to the changes in the political climate since the late 1980s by initiating the 'electricity for all' programme in 1991, and was joined by many of the local authorities. The Government of National Unity endorsed this electrification programme in 1994.

This report provides a synthesis of eight programme reports[2] that formed part of an evaluation of the national electrification programme undertaken in 2001.

Section 1 provides a background to the national electrification programme evaluation, outlines the evaluation purpose and objectives, the sampling, and the research methodology and its limitations.

Section 2 presents the evaluation findings and analysis. It is divided into three subsections including programme inputs, outputs and outcomes. The discussion in each subsection is organised around institutional, technical, financial, economic and environmental issues.

Section 3 concludes the report. It discusses the key issues identified during the evaluation, the lessons learned and their implications for the second phase of the electrification programme, and makes recommendations.

1.1 Background to the national electrification programme evaluation

Historically, service provision in South Africa was limited to established towns and areas of economic activity. Approximately three million households had been electrified by 1993, mostly in cities and towns. Approximately 64 per cent of the total population had no access to grid electricity. To address these inequalities, a six-year electrification programme endorsed by the Government of South Africa (GoSA) was implemented in 1994. The National Electrification Programme (NEP) Phase I was completed at the end of 1999 at a total cost of about R7 billion. This target-driven programme increased electrification to about 66 per cent nationally. The aim of Phase I was to provide access to electricity for an additional 2 500 000 households, mainly in previously disadvantaged and rural areas, and for all schools and clinics without electricity.

The GoSA commenced the New National Electrification Programme (NEP Phase II) from the beginning of 2000. However, an evaluation of the first phase became necessary in order to draw lessons for planning and implementing the second phase. Factors precipitating this evaluation, as highlighted by the National Electrification Co-ordination Committee (NECC), include:

- the decision that government will lead the new (Phase II) national electrification initiative;
- the proposed restructuring of the electricity distribution industry (EDI) into regional electricity distributors (REDS);
- indications that the target driven approach led to negative rather than positive returns on investment for Eskom and probably local authorities (Las) as well.
- the cost implications to electricity distributors and the South African fiscus of proceeding with the next phase on the same basis as Phase I; and
- the likely necessity for a subsidy to ensure agreed project returns are achieved in Phase II.

The SA Department of Minerals and Energy (DME) and the Development Bank of Southern Africa (DBSA) agreed to undertake a joint evaluation.[2] The bulk of the evaluation was subcontracted to the University of Cape Town's Energy and Development Research Centre (EDRC), under the management of the DBSA, commencing at the beginning of 2001.

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[2] See Programme Reports 1 to 8 in the 'References' section.

1.2 Evaluation purpose and objectives

The objective of the assignment was to conduct an evaluation of the investments made by Eskom and local authorities in the National Electrification Programme (NEP) Phase I: 1994-1999.[3] The purpose of the evaluation is to:

- document the programme's quantitative and qualitative achievements;
- investigate the development impacts;
- analyse strengths and weaknesses; and
- identify lessons learned from the programme and selected sample projects.

National policy goals identified in the White Paper on Energy Policy, as well as specific objectives of the evaluation listed above, were used as the principal goals of the evaluation. The core questions around which the logframe and workplan was structured were:

1. *How was the electrification programme undertaken?* – simple documentation of delivery, planning and implementation approach.
2. *Did the electrification programme achieve its initial objectives?* – comparison with delivery targets, timeframes and other stated objectives.
3. *Has the programme contributed to the welfare of communities?* – including household welfare (e.g. health), community services (clinics, schools, water), and security.
4. *Has the programme promoted economic development?* – considering small business growth, small-scale agriculture promotion, training of contractors, and job creation.
5. *Has the delivery of electricity been sustainably undertaken?* – environmental, institutional, and financial sustainability.
6. *Has the programme been efficiently undertaken?* – institutional (coordination amongst various players as well as distributor management), financial, and technical efficiency.

Ultimately the results of this evaluation will be used by DME and other stakeholders for making improvements to the Phase II National Electrification Programme, and advising SADC countries seeking assistance from SA regarding planning and implementing their own electrification programmes.

1.3 Sampling

Prior to the NEP evaluation, the DBSA had reviewed electrification projects that had benefited from its funding in different regions. DBSA also undertook a detailed evaluation of an electrification programme in Mpumalanga Province. This experience helped to build capacity to undertake such evaluations. The component of the overall evaluation undertaken by EDRC includes projects in six provinces: Western Cape (Khayelitsha), Northern Cape (Kimberley), North West (old BECOR area), Northern Province (old VEC programme), Gauteng (Greater Orange Farm programme) and KwaZulu-Natal (Durban Metro programme); a seventh province, Eastern Cape (Kwanobuhle), was undertaken by DBSA. (Refer to the map for the geographical location of these provinces and projects).

The eight electrification projects evaluated represent all provinces except the Free State, and include two municipal projects, three Eskom projects (some of which were initially old 'homeland' utilities subsequently taken over by Eskom), and three projects carried out by joint ventures between Eskom and another organisation. They were selected with the hope that they would offer useful insights into the effectiveness of the different institutional arrangements and technical solutions, financial costs and benefits, and other aspects of the accelerated national electrification programme. Important in this regard are proposals to change the electricity distribution industry (EDI) which, until now, has comprised the national utility (Eskom), and many local authorities. All the existing institutions were responsible for undertaking the electrification programme.

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[3] The Terms of Reference for the evaluation management team (DBSA) and the consultants (EDRC) are included as Appendix 1.

1.4 Research methodology and its limitations

The EDRC team comprised several specialists, each covering one or more of the sectoral areas of the evaluation: financial, economic, technical, environmental, institutional and socio-economic. The legal/regulatory aspects were excluded from the evaluation.

Analysis was based on the logical framework approach (logframe) approach to project design and analysis (described in the European Commission training handbook, 1999). A framework (the logframe) relating programme activities to the objectives, outputs and performance indicators of the electrification programme were developed as the basis for the evaluation. While logframes are designed primarily to guide decision-making, planning and evaluation around programme implementation, in this case the logframe was compiled retrospectively. The basic framework for the logframe approach is illustrated in Figure 1.

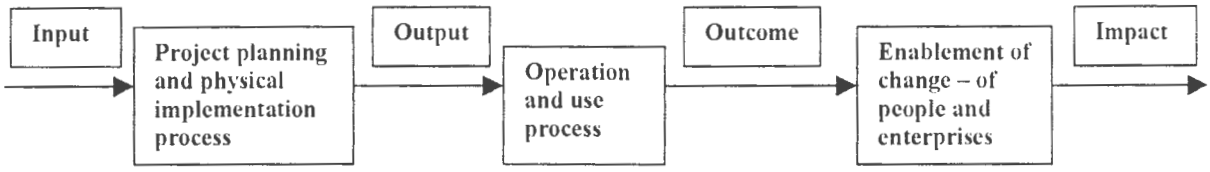

Figure 1: Logical framework of programme activities

As indicated in Figure 1, the inputs to an electrification programme include all the resources supplied to electrification projects, including all technical, institutional, social and financial resources. They are used to plan, design and construct the project, and are supplemented by innovation, standardisation and project control. The output is represented by a constructed project, ready for operation. An electrification project, for example, is usually evaluated in terms of the number of connections, cost and conformance with budget, programme and specifications. Traditionally, many projects are not evaluated beyond this stage. The outcomes of the project are the results of operations, including technical operations, revenue streams, and the meeting of social and institutional needs. Eventually, such programmes are implemented for the impact they are expected to have on society and the economy.

A programme like the NEP is conceived within the scope an overall objective, as defined in national policies regarding economic growth and quality of life. Based on the assumption that the other factors of development will be provided, the NEP is intended to effectively supply electricity to households, schools, clinics and businesses, to promote greater, more convenient and safer use of energy. This is the purpose of building projects and operating the networks. The evaluation of the NEP, therefore, is to assess the contribution of the planning, implementing and operation in the context of reaching the overall objectives of national development.

It should be noted, however, that the NEP was not planned, implemented or monitored in this way. The logframe was applied to the programme only for the purpose of evaluation.

The findings of the evaluation are presented in terms of the inputs, outputs and outcomes of the logframe. The assessment of impacts was not included in the evaluation assignment, as impacts can often be measured only ten or twenty years after projects are put into service.

Based on the logframe approach, an evaluation workplan was developed which identified tasks and assigned responsibilities among the evaluation team members. Data collection instruments (DCIs) were developed by each specialist and circulated among the team members, including DBSA, for comments. DBSA used the DCIs in the Eastern Cape and provided feedback to the EDRC team. The DCIs used are given in Appendix 3.

The approach agreed with DBSA was to send DCIs to previously identified officials of the relevant distributors in each evaluation programme, and these officials would take responsibility for providing the team with the specified data. In this regard, a letter from the DME requesting the co-operation of the officials concerned was sent to Eskom head office and the South African Local Government Association (SALGA). Initial contacts with the designated distributor officials were made telephonically by the evaluation team, during which time it was agreed that the officials would be given approximately two weeks for completing the DCIs. The EDRC team then visited the

distributor, meeting distributor staff, local authority staff and beneficiary groups, as well as visiting sites.

Although an evaluation of this nature is an important part of moving forward in Phase II of the NEP, all participants realised from the start that the resources allocated to this study did not match its national significance. For this reason, the bulk of the responsibility for information provision was assigned to the electricity distributors, and the programme and project resources available to EDRC was limited. In practice, most distributors were not able to provide the team with the necessary information in time, and their role in setting up beneficiary meetings was often limited. This was usually not due to unhelpful attitudes on the part of the distributor, but to time and other constraints.

The draft reports on each regional programme were distributed to the distributors, the DBSA and the DME for comment and checking of factual details. The identification of the issues and the formulation of recommendations was carried out by the EDRC and DBSA teams using various techniques.

The total outputs of the evaluation assignment comprise two programme evaluation reports compiled by DBSA, and six regional programme evaluation reports and this summary report compiled by EDRC. The findings of the summary report are based on the sample of eight programmes representing 17 per cent of the total connections made under the NEP, so that any data deficiencies in individual programmes have relatively little effect on the overall evaluation.

2. Evaluation findings and analysis

2.1 Programme inputs

2.1.1 The distributors

In exploring the effectiveness of institutional structure for electrification delivery, it should first be noted that the sample on which this evaluation is based cannot be considered representative in all respects. The institutions responsible for the electrification programme include Eskom distributors, municipalitiesm and private Eskom-linked joint ventures.

Eskom, established in 1927, owns and operates most of the generation in South Africa, all the transmission network and an extensive distribution system, including most of the rural areas. Seven distributors (previously five) carry out the distribution activity. Before commencement of its EFA initiative, Eskom only supplied customers who could pay most of the capital cost of a connection. By the commencement of the NEP in 1994, Eskom had approximately 1,3 million domestic customers[4] and the NEP target required this to be increased by approximately 140 per cent. Eskom could apply extensive procedures and standards for operations, project management and financial control to the NEP. It also had experienced staff (released from a declining programme of power station and transmission construction), and significant financial resources. Eskom embarked on a racial and gender equalisation programme at the start of the NEP. Therefore, Eskom internally had much of the institutional capability needed to participate in the NEP.

The electricity departments of many local authorities, established between 1888 and 1980, carried out most of the residential electrification implemented before the NEP. By their nature, the municipalities service the urban areas, but many also distribute electricity in adjacent rural areas. When a municipality is proclaimed in an area where Eskom already distributes electricity, Eskom retains the service rights. In addition, some municipalities have given their electricity rights to Eskom. Accordingly, there were approximately 450 municipalities distributing electricity in 1991, but the number has reduced to fewer than 250 as a result of the rationalisation of local authorities after 1994. At the commencement of the NEP, the municipalities already had over two million domestic customers[5] and the NEP target required this to be increased by less than 40 per cent. The two municipalities covered in this evaluation – Kimberley and Durban – are among the oldest, with over 100 years experience. They are both well established and have substantial capacity for electrification management and implementation. This might not apply in smaller or newer municipalities.

Three Eskom-linked joint venture (JV) companies were established during 1991-1994 to undertake electrification in specific areas. The concept was that they should be able to draw on the experience and resources of Eskom and the JV partners in the structure of a private company, not subject to the constraints applying to public utilities. It was also hoped that private JV companies would introduce innovation in the delivery of electrification to low-income households. The three JVs were not identical. Pambile Nombane (later PN Energy Services), belonging to Eskom and international utilities, was Eskom's agent for electrification in Khayelitsha, Western Cape. Kwanolee (later Uitesco) was a utility shared by Eskom, local business and the local authority in the Eastern Cape. TED in Mpumalanga was a utility owned by Eskom and community structures.

In addition to the differences in size and experience, the institutions that were evaluated in this project differed in various other ways including their approach to community involvement, target setting, reporting and technical standards and financial processes.

The electrification targets of the NEP had been established effectively in the deliberations of the National Electrification Forum (NELF) before the commencement of the NEP. NELF set a goal of 500'000 connections a year until 2000, at a cost of R1,2 billion annually. The connection target was subsequently revised to that shown in Table 1.

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4 Eskom made 1722937 household connections in the period 1994-1999 and had 3065863 domestic customers at end 1999. Source NER.

5 Municipalities connected 946408 households during 1994-1999 and had 3019863 domestic customers at end 1999. Source NER.

Table 1: Connection targets, NEP 1994

	1994	*1995*	*1996*	*1997*	*1998*	*1999*	*Total*
Eskom	250 000	300 000	300 000	300 000	300 000	300 000	1 750 000
Other	100 000	100 000	150 000	150 000	150 000	150 000	800 000
Total	350 000	400 000	450 000	450 000	450 000	450 000	2 550 000

(Eskom, 1995)

When the NEP commenced, the electricity activities of the municipalities within their own municipal boundaries were outside the jurisdiction of the Electricity Control Board which monitored all other electricity functions, including Eskom. The National Electricity Regulator (NER), the successor to the Electricity Control Board, was established in March 1995 under the Electricity Act (Act 41 of 1989 as amended) with authority to licence all electricity distributors.

Municipalities use a financial year from July to June and report most data accordingly, whereas Eskom and NER report data by calendar year. The different reporting periods used by the various institutions introduced some uncertainty in the evaluation.

2.1.2 Technical targets and standards

When *electricity-for-all* (EFA) activities started in 1991, there was acknowledgement of the need for changes to existing practice. For example, reports to the Durban City Council stated that appropriate technical solutions would have to be developed to overcome some of the problems foreseen. However, it appears the nature of the initial electrification target – 'to connect N domestic customers per year' – provided insufficient pressure to change standard methods and procedures. Pressure to change the standards only increased in 1995, when it was becoming clear that budgets (average connection cost was initially budgeted as R2400) were being significantly exceeded.

The main changes made to existing distribution practice for the NEP included the following:

- Most distributors adopted overhead feeders, where underground cables had been used widely in the past. Most distributors used bare conductors for the medium voltage (MV) feeders, although Eskom had installed pilot sites with covered conductor (overhead conductors with reduced insulation covering, supported on insulators) and intermediate voltage systems. Limited use was made of MV aerial bundled conductor cables (abc). Most distributors used abc for the low voltage (LV) feeders. Initially Eskom and most municipalities used LV abc of the French standard (phase conductors supported by an insulated neutral catenary), but Durban Electricity used the German standard (self supporting, equal phase and neutral conductors). Eskom later adopted the Scandinavian standard (phase conductors supported by a bare neutral catenary). The distribution industry did not reach consensus on the standard type and size of abc.
- Many distributors adopted prepayment meters for the NEP. These meters had been introduced several years earlier to reduce non-payment and allow customers to budget better for their energy consumption. NELF had reported that the costs of prepayment metering were comparable with conventional credit metering. The standard for prepayment meters evolved continuously during the NEP.
- Ready-boards, with a lamp, two or three socket outlets, and an earth leakage circuit breaker, were supplied to most customers. These avoided the need for costly house-wiring complying with the associated regulations.
- About half way through the programme Eskom reduced the standard sizes of its pole-top transformers, with a consequent effect on the network configuration. Towards the end of the NEP, greater use was made of single-phase networks to reduce costs. Few municipal distributors, if any, or JVs adopted single-phase systems.
- Designers progressively reduced the customer load the system would be able to supply. At the start of the programme most distributors provided 60 A connections and designed the networks to supply an after diversity maximum demand (admd, the average customer load at system peak) of about 3kVA. Eskom adopted a 20A capacity standard, allowing customers to select a 60A supply at premium cost, and later introduced a 2,5A capacity. Eskom also reduced the design admd, eventually to 0.4 kVA for 20A customers. Durban Electricity reduced the capacity of

electrification supplies to 40A. Industry guidelines for planning and design (NRS-023 and NRS-034) and quality of supply and service (NRS-048 and NRS-047 respectively) were developed.

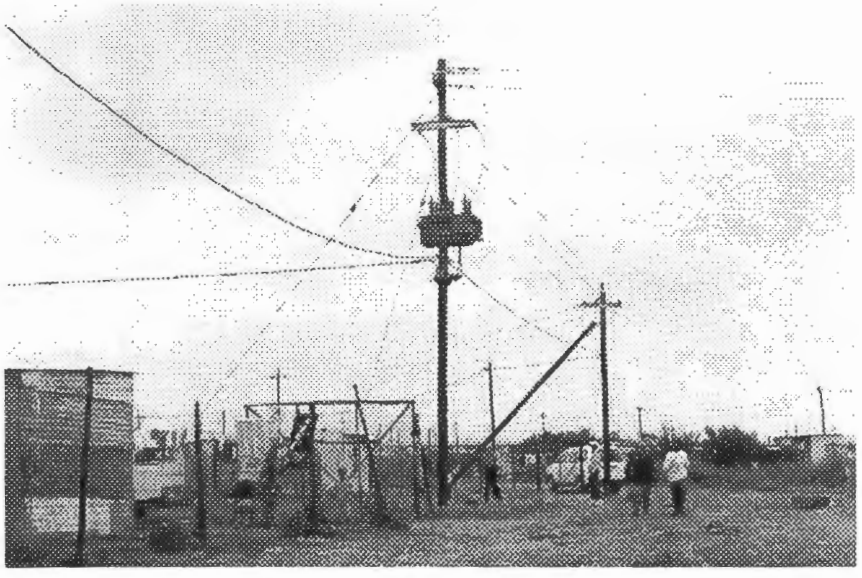

Figure 2: Bare MV and abc LV overhead conductors

Some distributors adopted a 'blanket' or 'saturation' policy to electrification, making supply available to every household in the electrification area. Eskom refined this approach by installing a prepayment meter limited to 2,5A supply at every household, uprating it to 20A when the nominal connection fee was paid – uprating required only a token to be issued for data entry into the meter. Other distributors adopted a 'targeted' approach, only connecting customers who applied and paid for a connection, and commencing the project when more than half the households in an area made application.

The project management and control processes changed during the programme, initially to ensure the numerical targets were met, but later to increase the financial control. In most cases, the distributors used conventional contractors or in-house construction teams to build the networks according to designs by own staff or consultants. Quality control of planning and design appears not to have been applied uniformly. Eskom introduced turnkey projects late in the NEP, but limited evaluation has been undertaken on this type of project implementation.

2.1.3 Financial resources and requirements

Both the financial and economic analyses done in this project used the model developed by EDRC, DBSA and Eskom for electrification project evaluations. The methodology is described in the *Handbook for the economic analysis of energy projects* (Davis & Horvei 1995). The following assumptions have been used for both financial and economic analysis:

Project life:	20 years
Financial 'break-even' IRR:	15.5%
Economic 'break-even' EIRR:	8% (urban), 6% (rural)

The financial evaluation assessed the financial demands of the programme against the financial investments made by the distributors, government and target customers. Against this backdrop, the aim of the financial evaluation was to assess the financial viability of the electrification programme in the long term. Key financial indicators, notably net present value (NPV) and internal rate of return (IRR), were used to measure financial viability. Other parameters contributing to financial viability are cost per connection, sources of funding, the amount of subsidy given to the distributor, and the level of payment. Financial viability is evaluated by weighing programme costs (capital, overhead, operation and maintenance) against its benefits (sales revenues and other revenue). The availability of data on these parameters is critical to the financial evaluation. Projects are considered viable if the NPV is positive, and/or the IRR exceeds 15.5% (nominal). This 15.5 percent is also the assumed financial discount rate, so that a project is expected to do better than if money was invested in financial markets.

2.1.3.1 Sources of funds for electrification

The funds for electrification were derived from within the EDI. Capital investment in the municipalities was funded directly from the electricity accounts or from loans raised. Eskom's investment was funded by revenue from electricity sales, of which approximately half is derived from sales to municipalities. After 1997, by agreement with the NER, a portion of Eskom's electrification levy was returned to municipalities in the form of capital grants.

2.1.4 Economic requirements

The economic evaluation draws on the financial analysis but adjust results to the appropriate (social) discount rate (urban economic discount rate of eight percent and rural discount rate of six percent). The economic analysis also considers customers' willingness to pay (WTP) for alternative energy services. Similar to the financial evaluation, the key economic indicators, notably NPV and economic internal rate of return (EIRR) were used to measure the economic viability of the electrification programme. Economic viability is evaluated by weighing programme costs (capital, overhead, operation and maintenance) against its benefits (sales, revenues). Projects are considered viable if the NPV is positive, and/or the EIRR exceeds eight percent for urban programmes, and six percent for rural electrification programmes. In addition to the above, the economic analysis includes consideration of user WTP for electricity compared with similar services from other energy sources.

It should be noted that this aspect of the report concentrates on quantitative analysis. Qualitative economic impacts on small enterprises, jobs, training and affordability are discussed elsewhere in the programme reports. WTP data tends to add economic benefit, since other energy services are typically more costly per unit of energy. However, better WTP data needs to be obtained in future studies.

2.1.5 Reaching the community

2.1.5.1 Community sectors electrified

The electrification programme aimed to meet the basic energy needs for low-income households in both rural and urban areas. In the urban areas, the challenge was to provide electricity to the mushrooming informal settlements, which are mostly characterised by poor housing materials such as corrugated iron, boards, and other scrap material (typical 'shack' structures). A further challenge for the electrification programme was to address the problems on non-payment for municipal services which can be traced back to the service boycotts of the 1980s that were part of the resistance movement. In general though, electrification of low-income households remained important for equity reasons, mainly redressing past imbalances in service provision policies.

Eskom generally adopts a 'blanket' electrification approach to reach connection targets efficiently and reduce the average cost per connection – as described in 2.1.2. The limited capacity (2,5 A) supply provides the opportunity for the poorest householders, who would otherwise not have been able to afford a connection fee, to gain access to grid electricity. In other areas such as covered by the TED programme in Mpumalanga and the old Venda Electricity Corporation (VEC) in Venda before Eskom took over, selective electrification has taken place. In the TED area the selection was based partly on identifying pockets where willingness to pay was shown to be high. The selective approach focuses on ensuring the financial viability of the programme by focusing on those who are likely to be significant users of electricity, and indeed the TED programme is the only one from amongst the sample where small positive financial returns may have been realised. Disadvantages of the selective electrification approach are that it appears to result in the poorest household groups being connected last, or not at all, and that electrification areas need to be revisited to identify new customers who can afford connections. This means that social goals such as improving access to electricity among the poorest, may not be effectively met by this approach. The advantage of selective electrification (with regular follow-up), however, is that it matches the economic development of the community and improves the financial viability of electricity utility operations. On the other hand, blanket electrification means that national resources subsidise immediate connection of poorer households, although this sometimes results in their being connected before they have the capacity to use and pay for electricity.

While Eskom distributors, including its associated JV companies, provide electricity to most types of informal houses, Durban Metro Electricity considered housing materials such as corrugated iron unsafe for electrification purposes; consequently customers who live in these dwellings were excluded from the EFA programme in this area. Although the evidence gathered by this evaluation is

far from conclusive, it is worth noting that no indications were found to suggest that electrification of corrugated iron houses resulted in more safety problems.

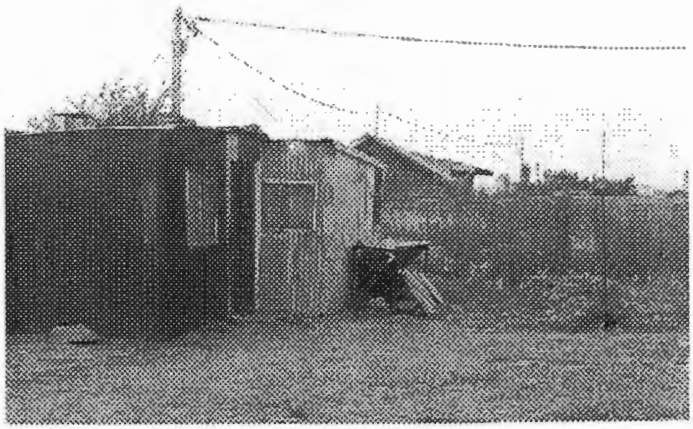

Figure 3: Electrified informal house

2.1.5.2 The value of community participation in electrification

Community involvement in electrification projects varies greatly in the form it takes, as well as in the effort invested in it by the distributor. Large differences in approach are apparent even within Eskom. In some areas, structured community involvement was extensively used in planning and implementation, while in others such involvement was much more diluted. In most cases, some form of co-ordinating electrification committee was established, or another committee used (such as Reconstruction and Development Committees), and relied upon for:

- connection prioritisation/scheduling;
- identifying local labour for use by the implementer;
- communication of implementation status to communities; and
- representing the community on issues of technology choice (mainly the connection capacity and metering options).

In some cases, as in the Northern Province, functions also included:

- identifying households or businesses for vending station establishment;
- communication on general use of electricity, including safety issues (sometimes via media campaigns);
- confirming willingness to pay in different areas;
- providing community liaison officers for permanent employment by the distributor; and
- acting as watchdogs regarding meter tampering and illegal connections.

In Kwanobuhle, Eastern Cape, the new Uitesco distributor engaged in extensive community interaction through local committees, and was able to reverse a situation of community resistance to one of mutual cooperation. In some areas (for example, Kimberley) community participation was achieved through existing formal channels – councillors were the primary interface between the municipality and the community – and in Durban community participation consultants were employed to facilitate close cooperation with communities. The TED distributor in Mpumalanga is partly owned by the Lowveld Electricity Trust, which incorporates community and local government representation. This facilitates community interaction, although electrification committees are also usually established in areas being electrified. Clearly, a variety of mechanisms can be used successfully for community participation, especially if they take into account the dynamic nature of community roles in social and political structures as they develop in SA.

2.1.5.3 Use of local labour

Local labour was used in the implementation of all programmes evaluated. Typically between 10 percent (e.g. Durban) and 24 percent (e.g. Orange Farm) of labour was drawn from local

communities. Labour was often sourced on a street-by-street basis (at the insistence of the community in one case); thus, when the contractor moved to new areas, local labour was replaced with people from the new area. In a few cases women were also employed as labourers. This use of local labour rarely led to permanent employment, limiting longer-term economic benefit for the communities.

2.1.5.4 Use of emerging contractors

In about half of the programmes evaluated, established contractors were used for implementation. However, several distributors used emerging contractors extensively. The outcome was generally positive but mixed, due to a lack of experience with this approach on both sides. Problems such as poor installation quality and irregular connection prioritisation occurred, though not frequently. Where the distributor provided training and ongoing support to these emerging contractors, the approach worked well for both parties. Possibly the most successful instance was with the TED distributor. Here 39 different local contractors were appointed, training was provided as a part of the appointment (at the well-established TED training centre), and regular interaction and structured support was provided. While TED incurred significant costs by adopting this approach, they considered it cheaper than using conventional contractors. In Kwanobuhle, where emerging contractors were also extensively used, training and ongoing support was also provided. However, the approach adopted by Uitesco was criticised because training courses were not accredited and ongoing maintenance contractors were contractually bound to work only for Uitesco. Their future business prospects are thus more limited.

2.1.6 Environmental evaluation

None of the programmes evaluated had formal environmental assessment or environmental management plans as part of the project processes. Environmental impact assessment was not widely applied in the electrification programme. Such assessment has been legally required since 1997. Environmental impacts were generally not considered in the planning and implementation activities for the electrification programmes, beyond thinking that electrification should improve quality of life and reduce deforestation. Criticism of the visual appearance of overhead systems, sometimes raised as an issue by communities, was considered by the utilities to be insufficient to justify using more costly underground distribution.

2.2 Programme outputs

2.2.1 Institutional differences

2.2.1.1 Joint ventures

Joint ventures have several advantages over other implementers, the most significant being their focus on single-service delivery in a limited service area. The significant assumption underlying the setting up of JV companies was that they would introduce innovative approaches to the delivery of energy services to low-income households. Generally though, it appears that technical and process innovation was minimal; instead, all the electricity distributors evaluated adopted similar approaches, as discussed earlier. Neither technical nor non-technical innovation was sufficiently substantial to be a pattern for adoption by Eskom.

2.2.1.2 Municipalities

One of the principal advantages of the municipalities undertaking electrification is that electricity delivery is integrated with the other services supplied by the local authority. One important result is that municipalities will typically install street lighting as a part of the electrification programme and recover costs through rates, whereas JVs and Eskom will not provide lighting unless the local authority pays the costs, which often does not happen. Also, the elected councillors who are part of the local authority structure provide a channel whereby user needs are communicated to the municipalities' electricity departments, and municipal issues are communicated to households. The two municipalities covered in this evaluation were generally efficient implementers, showing effective community involvement and even pioneering particular approaches (discussed elsewhere). However, not all municipalities may have comparable abilities.

2.2.1.3 Eskom

The achievements of Eskom in the National Electrification Programme are impressive. Eskom substantially met the target of 300 000 new connections per year (1 722 397 over six years) and also connected many schools. Furthermore Eskom has cross-subsidised the electrification programme from electricity revenues.

Compared with JVs and municipalities, Eskom has some disadvantages as a distributor. Being a large, primarily technical organisation, there is sometimes a tendency to look for technical solutions to all problems – for example, using prepayment meter technology to improve payment levels in low-income households. While this strategy enjoyed some success, this evaluation found indicators that it may not be the best approach (as discussed elsewhere). Also, in common with JVs, Eskom would not normally install street lighting in their areas of electrification, as they have no means to collect revenue for this service. Communities value street lighting, and Eskom's policy therefore limits the developmental benefits of electrification.

2.2.2 Technical achievements

The numerical targets of the NEP were substantially achieved. Eskom achieved slightly fewer than the planned 1 750 000 connections, and the municipalities significantly exceeded their target of 800 000 connections during the period 1994-1999, according to NER figures. In addition, 69 200 farmworker connections were made, 27 814 under Eskom's financial incentive scheme from 1997-1999.[6] However, the initial targets of the various organisations were not always achieved, and the differences were made up by other organisations. For example, Eskom internally reallocated connection targets among their distributors where shortfalls occurred, and Durban Electricity was unable to reach its initial targets for several reasons, including the destruction of houses during unrest and delays in township proclamation, but the shortfall was more than made up by other municipalities.

It has not been possible to assess completely the quality of the electrification projects. In most cases, the distributors have not needed to make significant modifications to the projects, indicating that the construction quality was adequate. However, there have been very high failure rates for the prepayment meters. Also, the design standards have been changed substantially or vary widely between the distributors, indicating that the initial designs generally, and designs in some projects, may have been unduly conservative. On the other hand, most staff were unaware of the performance of many of the Eskom systems designed using very low values of average demand, and so the systems may not be adequate.

Some communities resisted the introduction of 20A capacity limits on the supply. This was partly because they considered it their right to have connections equivalent to 'white' household standards and because it restricted their use of various heating appliances. However, the suitability of this standard became apparent as the low consumption levels and associated poor financial viability of the electrification programme were confirmed by experience. Fewer than five percent of customers elect to pay for a higher capacity supply. The suitability of the 2,5A load-limited supplies could not be assessed adequately in the evaluation.

The Durban Electricity project differed significantly from the other projects in that it provided a choice of start-up appliances to the customer, to encourage the use and consumption of energy. The customers generally appreciated the appliances, but the possible need for a slow cooker option as an alternative appliance was identified in discussions with the community.

Several distributors also offer customers a 'current limited' supply at no connection fee (typically 2.5A capacity). It appears that, while this may enable poorer households to obtain at least some form of connection, there is little enthusiasm amongst households for this option because of the constraints on applications of the energy.

2.2.3 Financial costs

The results from the quantitative analysis of financial and economic costs and benefits are summarised in Table 2.

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[6] If these farmworker connections are added to the other connections made by Eskom (1 722 937), this amounts to over the 1.75 million target – in which case it can be said that Eskom exceeded its target.

Table 2: Summary of project costs

	NW Prov Mmabatho	*N Prov (Venda)*	*W Cape Khayelitsha*	*N Cape Kimberley*	*Kz/NatalDurban*	*Gauteng Orange Farm*	*TED Mpumalanga*	*E Cape KwaNobuhle*
Connection nos 1994-99	68 885	76 280	34 884	3 181	111 829	34 382	80 383	20 574
Total capital cost (R millions)	245 m *	217m *	87m *	7.8 m	441m	74m	192 m	57 m
Average cost/ conn. (R)	3 561 *	2 845 *	2 498 *	2 463	4 628	2 156	2 200	2 781

* Actual capital costs for programmes in the NW Province, N Province and W Cape were not available, and were 'back-calculated' from average cost per connection. Financial and economic figures for these programmes therefore cannot be considered accurate.

The total costs of the NEP (as reported in the terms of reference) were Eskom R5bn+ and Local Authorities R2bn+ (with generally lower cost per connection). Figure 4 illustrates the costs per connection of the evaluated projects, compared with the NEP averages.

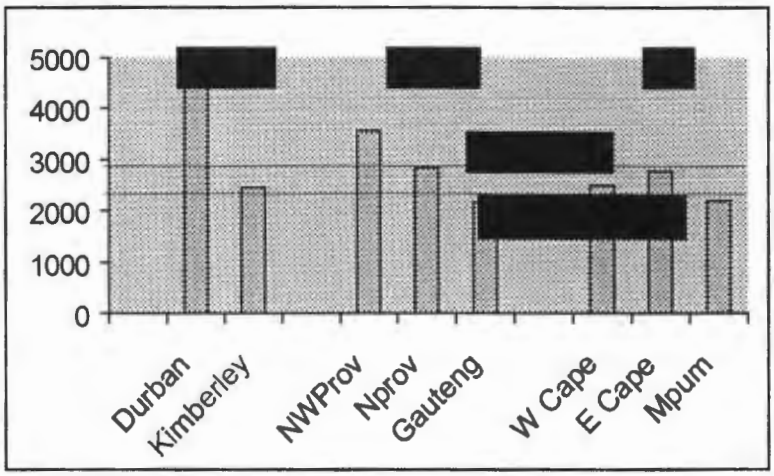

Figure 4: Cost per connection in Rands for evaluated projects[7]

The programmes evaluated in this sample mostly reported connection costs above the NEP target budget of 1994, but below the average cost achieved by the NEP. The costs reported by Durban Metro are significantly above the average cost for municipalities. Durban implemented 12 percent of municipal connections, incurring approximately 20 percent of the costs. Conversely, except for the NW Province, all the Eskom and JV costs are below the NEP average. These parameters indicate that the sampled programmes are not typical of the municipal or Eskom programmes, or that the cost reporting is unreliable for comparative analysis. Therefore it is not possible to draw conclusions from the differences between project costs.

The cost of electrification significantly overran budget in the early years of the NEP, with the average cost per connection exceeding R3000, and some connections being made at costs well over R6000. Connection objectives were defined in terms of both numbers and costs during the later years of the NEP, and these new targets were met in most cases.

2.2.4 Social aspects of project implementation

2.2.4.1 Integration of electrification and other services

In general, distributors do not electrify households where there is no security of tenure – i.e. no formal plot allocation. This applies mainly to urban areas, as rural settlements' land-use allocation and plot 'formalisation' rely more on historical use than on formal local authority planning and allocation. In Khayelitsha in the Western Cape, lack of coordination between local authorities and electrification implementers around settlement planning resulted in delays in electrification of some settlements which had grown outside of existing formal development plans. Such coordination

[7] The NEP 1994 target is in 1994 Rand value.

appears (at least within the sample of this evaluation) to be improved where the local authority is responsible for both electrification and settlement planning.

2.2.4.2 Vending stations as a means of promoting economic growth

Prepayment meter token vending stations are most commonly established in existing shops. Owners are sometimes required to provide some financial security before the station is installed. Typically, only established businesses can provide the necessary security, and thus small spaza-type shops may be excluded from the benefits of hosting such a station – a percentage of electricity sales and increased customer visits. In a few areas individual households chosen by the community have been used as vending station hosts. In the Northern Province programme, where this was tried, the distributor found it unsatisfactory due to security problems in homes and difficulty in communicating with them, and is moving away from this system. In Khayelitsha the service provider has successfully used private homes as vending points, thus enabling economic benefits generated by the prepayment system to be spread beyond just the established shops. This strategy may have been more successful here, compared with the Northern Province, because it is easier to monitor in higher density settlements such as Khayelitsha.

2.2.4.3 Looking after small businesses and community facilities

A distributor focus on household connection targets can result in reduced attention to providing the necessary ongoing services to small businesses and community facilities such as clinics and schools. The responsibility for this support is unclear where the utility uses an agent. Allocation of connection and ongoing service provision responsibilities for these critically important sectors need to be clear, and should rest with the distributor from the start of the programme.

2.2.4.4 Distributor and community satisfaction at their cooperation

In general, all distributors considered that community participation efforts they engaged in were very worthwhile, and clearly contributed to implementation success and customer satisfaction, although such processes could be tedious at times. In the Western Cape, where the implementing agent puts much effort into community relations, they considered this focus to be a bigger factor in reducing non-technical losses than prepayment metering. While community perceptions usually echoed the distributor's satisfaction at their participation, in two programmes the evaluators found that electrification committee members thought they should receive some remuneration for the time they spent in such meetings and in disseminating information to the communities, or at least for the travel costs incurred by them (sometimes distances travelled to meetings were great, as committees covered a large geographical area). These committee members noted that Eskom employees and consultants were paid, yet they were not. Sometimes they were asked to disseminate information on electricity benefits and safety concerns to their areas, and they felt that this was core distributor business for which they should be paid.

2.2.5 Environmental effects of the projects

Although this project could only conduct a superficial evaluation (often anecdotally), amongst the negative impacts considered were vegetation disturbance and soil erosion during construction of power lines, visual impact, consideration of impact of power lines on birds, HV line proximity to houses, and the increased pumping of groundwater.

In general the electrification programme has limited negative environmental impacts. The main impact often results from HV line and large substation construction, for which environmental impact assessments are usually done separately from electrification projects. Distribution and reticulation is low impact, and mostly within settlements. Visual impact was not considered a serious problem by distributors or communities. Increases in groundwater pumping due to electrification were not thought to be significant. In some areas, bird flappers were used to discourage birds from settling on powerlines. HV lines were usually kept away from households, but there were seldom clear policies in this regard, and in some cases such lines were very near to houses. Durban Metro Electricity is the only example encountered where a clear policy on this issue has been translated into operational procedure. HV lines are a concern to communities from a safety point of view (lines falling to the ground), as well as potentially from the negative effects on humans of strong magnetic fields (also emitted by transformers). Evidence on the latter impact is, however, considered inconclusive and is not widely accepted.

Discussion with electrified communities indicated that they perceived the benefits of electrification to be significant, including reduced indoor pollution and area lighting, where installed. Anecdotal evidence supports the view that electrification contributes to reduced indoor air pollution and improved health. Therefore, the overall environmental effects of electrification appear to be positive although they are not formally monitored.

2.3 Programme outcomes

2.3.1 Institutional achievements

Table 3 lists many of the characteristics of Eskom, JVs and municipalities as electrification implementing agents.

Table 3 Comparison of different types of electrification implementers

	Advantages	*Disadvantages*
Eskom	Facilitates consistent approach across country, and lessons and other info more easily disseminated. Can cross-subsidise losses. The only institution able to electrify on a huge scale. Possible savings on equipment due to volume of purchase. Can back up implementation with central research and innovation.	Sometimes too big – planning and design very separate from ops and loss control (feedback to design may not happen easily). Reduced integration of electrification delivery with other services – e.g. streetlighting is not supplied by Eskom unless funds are provided by the local authority. Sometimes have a technical focus – not always effective at community involvement & addressing 'social issues'. Eskom is not directly accountable to customers (as municipalities are).
Municipalities	Closer coordination between electrification and other service delivery (better integrated delivery). Streetlighting usually included in electrification – paid for via rates. Clear, formal accountability channels exist between the customers and their municipality. Access external subsidies for electrification. Although electricity is a ring-fenced operation, close support is available from other departments of the municipality.	Electricity departments of smaller munics may have limited capacity for electrification.
JV companies	Ring fenced operation – can facilitate evaluation and reporting. Clear accountability. Careful management and financial control. Potential for innovation. Potentially efficient implementers Little 'red tape'. Can be 'closer to the customer' than larger distributors.	Not obliged to embrace social goals (although they generally have). Not obliged to share information for evaluation & monitoring. Reduced integration of electrification delivery with other services (compared with munics) – streetlighting not included in electrification unless funded by local authority. JVs can be profitable where programmes are not (where set up as agencies, not distributors). JV brief may not cater adequately for non-residential customer base, resulting in unclear responsibilities in catering for community services and businesses. Where Eskom is a JV shareholder, the potential for non-transparent subsidies from Eskom support exists.

It must be recognised that Eskom's control of the JVs is substantial: they can only operate as Eskom's agents in areas defined by Eskom or in an area defined by the licensing process. Eskom has a large proportion of the shareholding and participates in the management through seconded employees, and Eskom determines the JV's revenue where the JV is an agent (as with PN Energy JV).

The manner in which agency JVs receive income is worth considering. An agency JV is paid a fee per connection by Eskom. This fee is re-negotiated periodically to ensure that it covers real costs, thus effectively ensuring JV profitability, even though the programme may not be profitable. While setting the cost per connection wisely may promote efficient operation of the JV, a strategy which de-links the income of the organisation responsible for implementation and O&M from programme revenue should be approached with caution.

Eskom was a significant shareholder in all the JVs covered in this evaluation, and often Eskom support or subsidisation of the JVs was not reflected in available JV financial information. Such non-transparent subsidies make actual performance of JV institutions less clear.

It appears that the JVs, particularly Uitesco and PN Energy, managed to reduce non-technical losses from high levels to more acceptable proportions. This is a significant achievement, but must be balanced by the relatively low losses reported by the municipalities. It appears that effective loss control depends partly on the dynamism and orientation of individuals within the institution and their closeness to the customers, and is not necessarily inherent in the structure of the organisation.

Eskom is sometimes further removed from the customers than municipalities and JVs (although community liaison undertaken by Eskom is very effective in some areas). This may be one reason for the Orange Farm programme still experiencing high non-technical losses (such high losses in Khayelitsha and Kwanobuhle were significantly reduced by the implementing JVs). As with JVs, Eskom is not directly accountable to their customers in the way that municipalities are – where communities can use their vote to choose their representatives and influence policies. It also appeared to the evaluators that Eskom was 'too big' in some respects. For example, one section was sometimes not aware of how to locate data elsewhere in the organisation, and feedback from operations and loss control sections to the planning and design sections was not effective.

2.3.2 Technical operation of the networks

Electrical energy consumption by households has been much lower than initially anticipated, with low monthly levels significantly below that needed for financial break-even. Actual average consumption is presented in Table 4. Limits on the capacity of a customer to consume electricity, particularly with the 2,5A supply, will reduce the scope for higher consumption levels to be achieved through the use of major energy appliances. However, the evaluation has not had sufficient resources to assess whether greater expenditure on the networks to provide 60A supplies could be recovered in the long term.

Table 4: Average energy consumption per household in the projects evaluated.

	NW Prov (Mmabatho)	*N Prov (Venda)*	*W Cape (Khayelitsha)*	*N Cape (Kimberley)*	*Kz/Natal (Durban)*	*Gauteng (Orange Farm)*	*TED (Mpumalanga)*	*E Cape (KwaNobuhle)*
Av kWh/ mth for 2000	127 kWh	62 kWh (20A)	116 kWh	134 kWh	155 kWh	80 kWh	190 kWh	165 kWh
Av kWh/ mth - 20 yr projection*	193 kWh	96 kWh (20A)	246 kWh	204 kWh	330 kWh	171 kWh	211 kWh	165 kWh

* Projections to 2014 (20 years from 1994) generally assumed 6% demand growth in urban areas and 3% in rural areas, but were influenced by experience and estimates of distributors. Note that consumption growth is often linked to localised economic conditions and other factors, thus trends in specific projects vary and may not be easily generalisable.

One result of the low consumption is that the networks will generally be very lightly loaded, even below the low demand values used in the design, and the quality of the voltage regulation should be good. The operating staff reported that there are few problems with low voltage and supply quality. Despite this, all the Eskom distributors and JVs used a relatively high figure of 10 percent of energy input as an estimate of the technical energy losses on the distribution networks. The balance of the technical loss is referred to as non-technical loss, arising from administrative errors and theft of electricity. The non-technical losses in a network are a good indicator of the quality of the operation

and management of the system. The non-technical losses identified in the evaluation are presented in Table 5. Clearly, the level of non-technical losses in several of the systems is at unacceptably high levels, affecting the financial viability and the technical performance of the networks. In general, it appears that the smaller distributors maintain better control of the non-technical losses, but factors such as unemployment and community wealth may have influenced the particular communities evaluated in different ways.

Table 5: Non-technical losses
*(expressed as a percentage of the energy sales to domestic customers)**

NW Prov (Mmabatho)	*N Prov (Venda)*	*W Cape (Khayelitsha)*	*N Cape (Kimberley)*	*Kz/Natal (Durban)*	*Gauteng (Orange Farm)*	*TED (Mpumalanga)*	*E Cape (KwaNobuhle)*
Approx 31%	No data	33.4%	8%	4.5%	163%	13.3%	8.6%

* Losses are calculated as total domestic losses over total domestic units sold, expressed as a percentage. Industrial and commercial non-tech losses are usually very small, thus most non-tech losses are attributable to the domestic sector.

Figure 5: Wood pole with LV abc conductor, pole top distribution box, photo cell switched street light and split meters suspended on the service connection cables

The prepayment meters have not performed as expected. A high proportion of them have failed, interrupting supply to the customers, losing revenue for the distributors, and requiring expensive labour and new meters to rectify the failure. Where figures were reported, between 40 percent and 60 percent of customer complaints were due to meter failure. The earlier versions using magnetic card input are being replaced with keypad technology, which are considered more reliable. Despite this change, the average life of the prepayment meters appears to be no more than ten years. The expected lifetime for electrical distribution equipment is 20 years or more; a need for replacement within that period would have to be incorporated in the project lifecycle costing. The cost of meter replacement exceeds the annual revenue received from many electrified households. The non-payment problems which prepayment meters were intended to overcome have also not been sorted out, as new types of 'split' meters are being installed to reduce electricity theft by tampering and bypassing of meters. It is not yet certain whether this will be effective as a general strategy, as distributors have less than two years experience with the new meters.

The evolution of technical standards during the NEP has resulted in systems for which the installation details and power delivery capacity are not uniform and are often unknown. Accurate

technical records were not available for several of the projects. This deficiency is likely to cause problems with the maintenance and uprating of the systems in future.

2.3.3 Financial and economic costs/benefits achieved

Table 6: Summary of key financial and economic indicators

	NW Prov Mmabatho	*N Prov Venda*	*W Cape Khayelitsha*	*N Cape Kimberley*	*Kz/Natal Durban*	*Gauteng Orange Farm*	*TED Mpumalanga*	*E Cape KwaNobuhle*
Financial NPV/cust (R)	(2 081)*	(1 164)*	(915)*	(447)	(1 482)	(1 777)	710	(242)
Economic NPV/cust (R)	(1 060)*	1 197*	(427)*	354	(100)	(703)	1 221	(217)
Econ Ben/cost ratio**	0.86*	1.20*	0.93*	1.06	0.99	0.84	1.19	0.96

* Actual capital costs for programmes in the NW Province, N Province and W Cape were not available, and were rather 'back-calculated' from average cost per connection. Financial and economic figures for these programmes therefore cannot be considered accurate.

** A ratio of greater than 1 indicates that the economic benefits outweigh the costs.

Overall, Tables 6 and 7 show that electrification in low-income areas is not financially viable. This is not news to those who have been involved in the National Electrification Programme. Initially, Eskom calculated that costs would be recouped should household consumption rise to around 350kWh per month on average over 20 years. Although the programme only started in 1994, it is obvious that consumption levels of around 150kWh per month are more realistic, potentially rising to around 200kWh per month over 20 years, with resulting under-recovery of revenue. At present, many households consume well under 100kWh per month.

Table 7: Summary figures for NEP sample evaluated: totals and weighted averages

Total number of connections	430 398
Average kWh per month per household (weighted)	132 kWh (in 2000) 208 kWh (20 year projection to 2014)
Total capital cost (R millions)*	R 1 321 million
Average cost per connection (weighted)*	R 3 213
Financial NPV per customer (weighted)*	(R 1 023)
Economic NPV per customer (weighted)*	R 146
Economic benefit: cost ratio (weighted)*	1.0

* Because of the lack of actual capital cost data from some programmes (discussed elsewhere), these figures are a mix of apparently reliable figures and others of unknown accuracy.

Table 7 shows that a financial loss of just over R1000 per connection can be expected for the programme as a whole. This does not reflect the full extent of the losses however, as subsidies helped to improve the profitability of some of the projects (Northern Cape, Orange Farm and Durban). Economically and taking out the external grants, the evaluation indicates that the investment is marginal, and may generate economic returns roughly equal to the investment. However, quantitative economic analyses are of necessity limited, and thus results need to be seen in the context of such limitations. Such limitations include a high sensitivity to discount rate, difficulties in including external and opportunity costs, and dealing with other market failures (see Davis and Horvei (1995) for a more detailed discussion on these issues). It should also be noted that the economic evaluation does not include benefits such as business growth, economic multiplier effects, and welfare benefits as a result of electrification, which are clearly also economic benefits – these are evaluated qualitatively only. In sum, these limitations mean that quantitative economic analysis tends to underestimate the value of social and environmental benefits, particularly if such benefits accrue in the future rather than now.

A most important limitation regarding the above is that actual capital costs for programmes in the NW Province, N Province and W Cape were not available, and were, rather, 'back-calculated' from average cost per connection. Financial and economic figures for these programmes therefore cannot

be considered accurate. This is unlikely to significantly influence the overall trends which emerge from the analysis of the entire sample, however, or the lessons which are drawn therefrom.

The financial and economic analysis model used in this evaluation also indicates subsidy levels, which would be required for financial 'break even'. These figures range between about 1c/kWh and 7c/kWh per customer per month. However, figures derived by Eskom in a separate analysis are much higher than these figures, and the reasons for the differences are not yet clarified. Overall it can be argued that the required subsidy figures remain debatable (see discussion below).

2.3.3.1 Eskom subsidies and other unknowns

Several factors affect the extent to which the cost-benefit analysis undertaken in this evaluation is realistic. As discussed elsewhere, the lack of accurate actual capital costs and the uncertainties in the inputs used to calculate 'required subsidies for break-even' are amongst these factors. In addition, some of the subsidies for electrification are not transparent. Some examples given by Davies (2001) include the following:

- The Eskom subsidy of TED for five years (approximately R15 million per year).
- The Eskom subsidy of KwaNolec/Uitesco, via absorbing the cost of faulty meters and compensating for resulting revenue losses, as well as carrying losses beyond a certain level (amounts are not known).
- A discrepancy exists in the cost of primary power used by Eskom for their electrification cost calculations (2c/kWh) and that charged to non-Eskom distributors (13c/kWh). This raises the question as to whether Eskom are subsidising their electrification programmes more than is apparent.

Eskom levies an electrification charge on every kWh sold by them, including sales to other distributors. Municipal distributors sold almost half of all electricity in South Africa, and thus it seems they would have contributed substantially to the total funds raised from the electrification levy.[8] Eskom uses the funds to subsidise rural electrification, and a proportion is passed on to the NER for reallocation in the form of grants to municipalities. The municipalities thus contribute an uncertain but significant amount towards the electrification fund, and have received some grants from the fund in return. This shuffling of money renders the actual financial feasibility of municipal electrification rather unclear.

2.3.3.2 National Electricity Regulator subsidies and household connection costs

Average connection costs for the different programmes evaluated vary substantially, with the lowest being around R2100 and the highest R4600 per connection. One of the main reasons for this is the physical characteristics of the settlements electrified (for example Durban Municipality had estimated connection costs of about R10 000 per household on some of their more inaccessible, dispersed projects), but also are affected by the efficiency of the implementing institution and the technology choices made. Access to external grants also affects the cost per connection. Because of this range of influences, no clear conclusions emerge. However, the range of connection costs encountered does reflect the variety of conditions faced and, to some extent, explains the range of approaches taken by different distributors around the country.

NER provides grants for non-Eskom distributors (municipalities and JVs) to connect houses in low-income areas. These are awarded on the basis of the estimated number of connections that the distributor will make in a particular year (Davies 2001). However, sometimes subsidies were insufficient for the actual number of households connected, and thus the distributor had to carry the shortfall. Where the distributor adjusted the connection cost according to the subsidy received, having some connections not subsidised is problematic for the distributor as well as for the customers if increased costs are passed on to them. This was the case in Durban, where Metro Council policies required the electricity department to charge cost-related connection fees. When subsidies were received, reduced effective capital costs were passed onto the user in the form of lower connection charges.

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[8] This is an implicit levy – i.e. generated by an overcharge to non-electrification customers – not an explicit charge per kWh. The exact level of the levy (per kWh for example) is thus not clear.

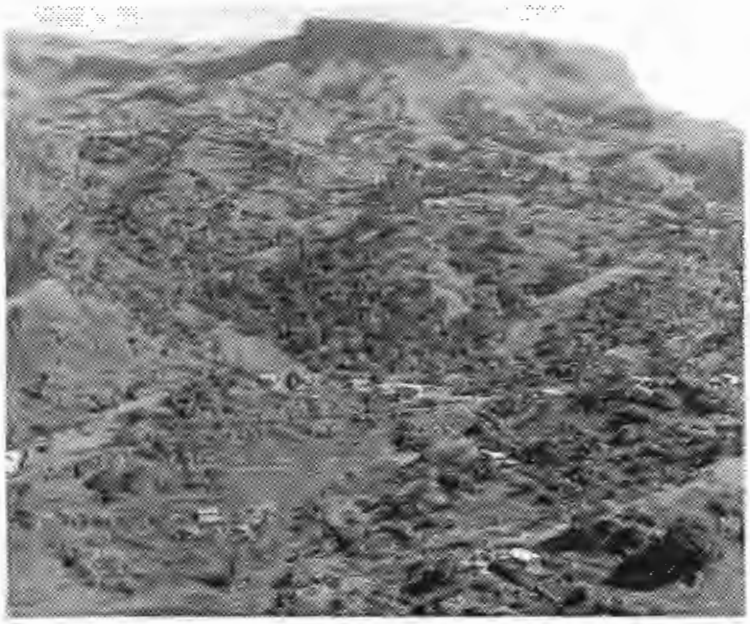

Figure 6: Very low density settlement

Figure 7: High density areas typical of many distribution areas

2.3.4 Social effects of electrification

2.3.4.1 Effectiveness of pre-payment meter technology in curbing social problems

In light of non-payment for electricity and other municipal services, the EDI adopted the pre-payment meter technology throughout the NEP. Although this type of metering is expensive, involving vending system establishment, it was nevertheless considered a highly appropriate technology for low-income household electrification, mainly because it was assumed that it would address non-payment problems in these areas – a technical solution to a social problem. In addition to curbing the non-payment problems, another assumption was that the use of pre-payment meters would reduce or even alleviate the need for site visits by distributor staff which were part and parcel of credit meter usage (i.e. regular meter readings for billing purposes). The technology was initially considered very successful in achieving these aims, and there was substantial international interest in applying such meters to low-income electrification in other countries. However, the findings from this research are that pre-paid meters require regular monitoring, while the meter units themselves

are expensive, especially considering their limited life span. This evaluation also found clear indications that prepayment meter failure was on a greater scale than was originally anticipated.[9]

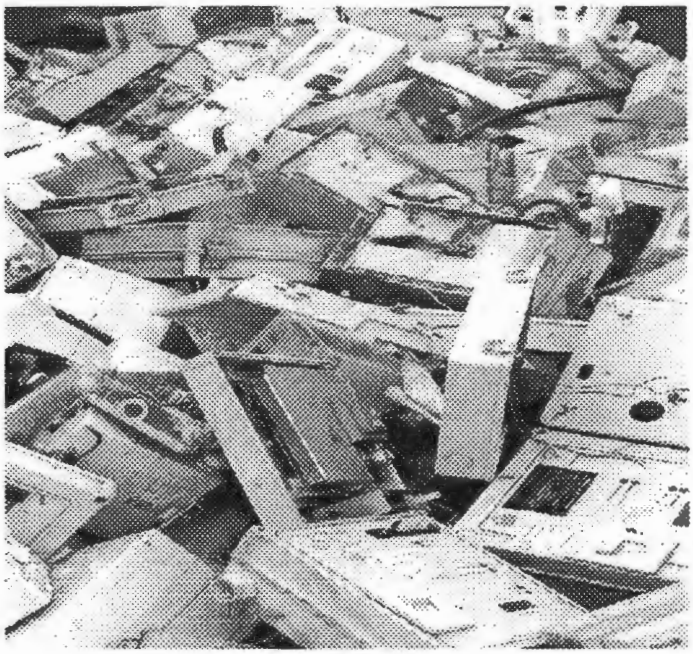

Figure 8: A container full of discarded prepayment meters

2.3.4.2 Meter tampering and bypassing

In all programmes evaluated, prepayment meter tampering was found to be a problem, and distributors expressed serious concerns about this issue. As a result, distributors have had to propose alternatives to address this problem. Strategies adopted include the placement of pre-payment meters outside the dwellings rather than inside to facilitate meter inspection (mostly in Eskom areas). Furthermore, other distributors, such as Durban Metro Electricity and Uitesco in the Eastern Cape, have introduced split meters, where a part of the meter is mounted on the pole to allow easy inspection whilst the householders still keep the conveniences of the meter unit. In contrast, the placement of the meter unit outside the dwellings means that users become less aware of how they are using electricity and of how much remains, and results in much inconvenience to the user, particularly in the evenings.

2.3.4.3 Illegal connections, electricity theft, and penalties

Theft of electricity via illegal connections is also often a problem. This is common in areas where there are unconnected informal settlements surrounding areas which are connected to the grid. Unelectrified households sometimes connect illegally in these cases. For instance, in Durban it was reported that illegal connections are done at night but disconnected during the day when the officials are likely to visit the areas, making it difficult to trace. Although there is anecdotal evidence that this practice is sometimes fatal, it seems that fear of death has not managed to deter people from making illegal connections.

For meter tampering or bypassing, distributors typically impose fines of between R200 and R1000 on offenders. Eventually the meters are confiscated from repeat offenders (typically more than two offences). Kimberley municipality however, has taken a different approach in their relatively small electrification programme (3000 households). They simply educate the customer and normalise the meter without imposing any penalties. They also reward the reporting of electricity theft. Similarly, PN Energy Services' and Uitesco's success in reducing meter tampering is largely due to their concerted efforts to establish a healthy relationship with the community. It can be argued, though, that this 'soft' approach may not be easy to replicate in larger areas. The involvement of community structures in the Lowveld Electricity Trust, which is a part owner of the Mpumalanga TED distributor, also appears to have been a factor in limiting non-technical losses in this programme. All

[9] See the individual programme reports for substantiating details (see References).

of these examples highlight the importance of community participation in effective system operation.

2.3.4.4 Prepayment meter contribution to user awareness

The one significant outcome of the use of prepayment meters is that low-income households with limited budgets are able to manage their electricity consumption to match their resources. As such, the meters help educate householders regarding electricity consumption of different appliances.

2.3.4.5 Electrification of important community services: schools and clinics

There are indications that school and clinic electrification contributes to improvements in services delivery by these facilities, but the impacts are very complex and depend on other inputs, including the provision of equipment and training of staff (Borchers & Hofmeyr 1997). It is easier for clinics and hospitals to provide 24-hour service due to improved lighting, and reliable electricity supply is important for vaccine storage, high-powered lighting for surgical procedures, sterilisation, and suction pumps. In addition, it improves the quality of nurses' accommodation, which plays an important part in maintaining a high quality of service, particularly in rural areas. However, in one instance it was found that the clinics had to keep back-up generators due to the frequency and duration of power outages. Extended periods without power for refrigeration results in spoiling of expensive vaccines. For benefits to be fully realised in clinics, the quality of supply is important.

In a few cases it was reported that electrification of schools had enabled Adult basic education and training courses to be run after hours. Electrified schools were able to use equipment such as computers, fax machines and photocopiers. In several cases the community also had access to these facilities. The benefits of including schools in the electrification programme are thus significant. However, the schools encountered by the evaluation were generally in urban areas, and the situation in rural areas may be different due to different access to equipment.

In some cases, electrification was driven by a focus on the number of households connected, with little attention given to facilities such as schools and clinics. In some areas the distributor did not know whether schools were connected or who was responsible for customer service for these connections. The institutional arrangements for clinics and school electrification nationally probably complicated matters: the Independent Development Trust was responsible for clinic and hospital electrification in many areas, and the Department of Education as well as Eskom for school electrification. The end result was that current responsibilities for O&M as well as customer service for such facilities is sometimes unclear.

2.3.4.6 Stimulation of economic growth through electrification

This study could not explore this question in any depth. However, several other studies have been done in this area locally and internationally (e.g. Foley 1990; Borchers & Hofmeyr 1997), and the now widely known conclusion is that electricity does help to stimulate business establishment and development, but is not the most important input into this process, and therefore alone it is likely to result in limited economic growth. Factors such as business skills development, financing availability and access to markets are more fundamental to business development. However, certain businesses are clearly dependent on electrification, and many others benefit from the availability of electricity. Workshops are able to use much more effective electric tools, hair salons use electric clippers, small and large shops can install effective electric refrigeration and thus supply an increased range of goods, electric lighting enables businesses to stay open longer, and bars can obtain video entertainment games and TV, and offer cool drinks from their electric refrigerators (gas refrigeration is not considered as convenient or effective). The anecdotal evidence gathered in this evaluation generally supports these findings. Although not common, in one programme a small appliance repair business was encountered.

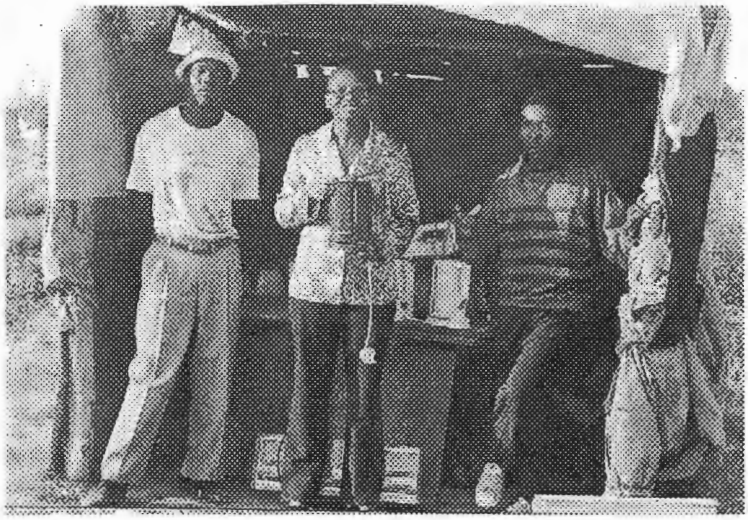

Figure 9: Roadside appliance repair business

In the Orange Farm programme, Eskom supported a local business development centre. Equipment was donated, and groups of people trained in activities such as bread-making, welding, sewing and juice-making (about 60 people in total). A few businesses are still in operation, although those interviewed say they do not make any profit. It seems the impact of this initiative on local economic development was limited.

Electrification is not good news for all businesses, however. It needs to be kept in mind that it also results in reduced business, or even closure, for certain ventures. Examples are paraffin-vending[10] and battery-charging operations.

2.3.4.7 Ongoing community consultation

Community participation usually revolves around construction. Continued community/distributor interaction regarding issues of ongoing service delivery is limited, or is handled through distributor customer support centres. In the Northern Province Eskom receives regular feedback on customer satisfaction by commissioning surveys every two months. This is rare.

2.3.5 Environmental effects of electrification

The positive environmental impacts of electrification appear more significant than the negative ones. Although the evaluation team was unable to substantiate the claims, in many cases distributors reported that fuelwood harvesting and use had reduced, and indoor and local (outdoor) air pollution had diminished. The use of electric lighting does decrease candle and paraffin use, which reduces incidences of fires in informal settlements. However, it is known that multiple energy use continues in electrified communities, and in one programme it was thought that there was no impact on fuelwood use (TED programme). The extent of these benefits of electrification is thus not clear. Formal monitoring of key benefits should take place in selected areas around the country.

[10] Paraffin vending does not disappear, however, as mixed fuel use continues in electrified households. However, electricity usually displaces paraffin as a lighting fuel at least, thus reduced paraffin sales in electrified areas can be expected.

3. Issues identified in the evaluation

Before identifying the key issues and conclusions and proposing recommendations, it is important to recognise that this evaluation encountered significant data gaps in several individual programmes. Before outlining the nature of the data gaps, it is important to note that gaps in detailed programme information in most cases does not prevent the extraction of the main lessons from the evaluation, as these are based on observations from the full range of programmes covered in the sample.

While planning information was often detailed and intact, information generated during or after the implementation of the programme was not easily obtainable. Amongst the most notable gaps was actual capital expenditure for different programmes. While distributors typically had macro-scale capital expenditure data for whole regions, information on capex per programme was either missing or not accessible by them. This was the case in the Northern Province, NW Province and Western Cape programmes evaluated. Here the financial analyses had to use 'average capital cost per connection' information provided by the distributors and numbers of connections to 'back calculate' the total programme cost. Financial results are thus of limited value in these cases and cost per connection could not be validated in any way. Cost information other than capex was also often not available, or of uncertain validity (operating costs, revenues, etc).

While the above data gaps were largely found in the Eskom programmes, where data on specific programmes was often lost though aggregation into Eskom Regional figures, they were not limited to these programmes.

Another surprising information gap was the lack of 'as-built' drawings – in other words, the actual assets in the field were often unknown. One of the consequences is that area managers have little idea of existing system capacity and limitations. This makes evaluation as well as network reinforcement planning more difficult.

Similarly, distributors conducted social feasibility studies in some areas, but there were few social impact studies conducted after electrification, making the social evaluation difficult, and largely dependent on spot interviews conducted by the evaluation team within the limited time period of this evaluation.

Despite the data limitations, this section identifies the key issues raised by this evaluation.

3.1 Achievements

The NEP exceeded the target number of connections during the period 1994-1999. The success in connecting new customers was achieved despite assertions that the goals could not be achieved by a fragmented EDI. The achievement provides a national and international precedent, and pioneered novel approaches, technologies and institutional arrangements. The success indicates that the strategy was effective and the industry structure, if indeed inappropriate, was not a constraint.

The goals of cost and operations management related to the connections target had not been clearly defined, so that it is not possible to evaluate the achievements in these respects. However, corrective action was taken when it was realised that costs were significantly above the generally 'budgeted' figures.

The NEP lacked a logical framework (or similar planning conceptualisation) linking the overall objectives of the programme with the actual project construction, or outputs. Therefore, the programme's achievements of viable electricity network operation and social and economic enhancement cannot be shown to be as successful as the construction project management. The absence of broad development concepts in the electrification targets may underlie their successful achievement. The targets were defined unambiguously, and the industry had the necessary funds, other resources and committed leadership to reach them. More complex objectives might have hindered progress.

3.2 Viability and targets

3.2.1 Financial and economic viability

Financially, the electrification programme cannot be viable within the EDI without subsidisation. Where electrification is directed to very poor communities, subsidies are needed for both network construction and ongoing operations and maintenance. It is thus possible that the NEP is becoming

an ever-increasing financial drain on the economy, in which case its sustainability is seriously threatened. However, the actual subsidy level of the programme is uncertain.

A quantitative economic cost-benefit analysis indicates that the programme has been a marginal investment in economic terms. In terms of its greater socio-economic benefit, however, electrification has important benefits. The analysis undertaken here underestimates the economic benefits through low willingness to pay, not quantifying social benefits sufficiently and not including external costs. These are benefits that government should continue to promote.

Distributors face a wide range of terrain, community, and settlement density characteristics, resulting in a large range of programme costs per household and contributing to greatly varying financial NPVs for programmes. Although it is clear that some subsidisation is required, there is a substantial discrepancy between the subsidy levels estimated during this evaluation and those estimated by Eskom, which needs to be clarified. A lack of information, particularly actual capital expenditure, affected significantly the reliability of the financial and economic analyses in three of the evaluation areas. In addition non-transparent subsidies built into the financial flows within Eskom and the EDI as a whole make the actual financial viability of electrification less clear. It seems from the consumption levels that a break-even point estimated at the beginning of the NEP is unlikely even after 20 years, which has negative implications for cost recovery.[11]

The proposed introduction of a 'poverty' tariff (free basic electricity allowance) will increase the effective losses on operations of the electricity networks, especially on those that are already not financially viable, unless tariffs are carefully structured to recover costs in another way. It becomes necessary to identify the nature of the subsidies for electrification: are they subsidies of the investment capital or the operating costs? At present it does not appear that subsidies have been applied to the Eskom networks, and the network operation is not viable when the investment costs are included. On the other hand, many of the municipalities have received investment subsidies, as a once-off payment, improving the financial viability of network operation at relatively low levels of consumption. One of the problems of operating subsidies is that they can be discontinued or phased-out, leading to customer unhappiness or financial failure of the utility.

3.2.2 Effectiveness of connection targets

Setting national connection targets was an effective means of promoting mass electrification; however, it may not have led to cost optimisation in many instances. Measures that promote cost-effectiveness and efficiency should have been given greater emphasis (e.g. connection cost capping, non-technical loss and consumption promotion target-setting and reporting). The programme demonstrated that technical innovation was not adopted until cost limits were put into effect, although most of the technology changes were available at the beginning of the programme. The role of market forces through competition for implementation could not be explored adequately in this limited survey, but could promote cost-effective and innovative solutions. However, since electrification is presently not a financially attractive proposition, any moves towards competitive bidding for implementation will need to be combined with suitable subsidy packages.

It is noteworthy that many of the measures for potentially improving the financial sustainability of the electrification programme revolve around improved service delivery to customers and greater community involvement.

3.2.3 Blanket or selective electrification

It seems appropriate to have one consistent policy regarding blanket or selective electrification, and apply this nationally. Blanket electrification appears to be more appropriate as it better supports social goals, although selective electrification would be more likely to improve the financial viability of operations. This latter approach was used by the TED distributor, and over time found that an increasing proportion of the population requested connections. However, it needs to be noted that this approach may not necessarily connect all households over time, and could even widen the gap between the poor and more affluent households if not implemented carefully. The different financial implications of each approach could not be analysed in this limited study.

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[11] 350kWh per month per household was initially estimated to be the financial 'break even' consumption (since capital cost is recovered as a component of the kWh charge). Estimates undertaken in the financial analysis of this study using observed trends suggest that around 150 kWh per month per household may be a more realistic average, with 200kWh per month a longer-term maximum for the programme.

The advantage of Eskom's blanket provision of 2.5A connections is that it permits electrification on a large scale, enabling the poorest to get connected, while reducing the cost per connection of the network – thereby serving social and financial investment goals. Connection charges can be kept affordable (well below R300) for a standard supply, and it may be feasible to do away with them completely for the very lowest levels of supply (2,5A), as has been done in at least two cases. The extra financial consequences of free limited-capacity connections may be insignificant compared with the present approaches.

3.2.4 Non-domestic electrification

Given the importance of education and health facilities in communities, allocation of connection and ongoing service provision responsibilities for these customers should be clear. It makes sense for this to rest unambiguously with the distributor from the start of the programme. Any connection targets set for the distributor should include at least clinic and school connections. However, close co-ordination will be needed to ensure the targets set are appropriate for the health and education facilities planning by those responsible agencies. Otherwise facilities may be connected, but responsibility for wiring not be clear, nor the supply of electrical equipment to enable the full benefits of electrification to be realised.

3.3 Appropriate technologies

3.3.1 Innovation

It is evident that the distributors did not introduce innovative technologies until they were forced to do so by financial constraints. Most of the technologies applied in the NEP had been innovations in preceding years, including abc cables, prepayment meters and current-limiting. The rural Eskom projects evaluated made little use of single-phase systems, even though the projects were constructed relatively late in the NEP. There would appear to be significant scope for relatively reducing costs in the next phase of the NEP, compared with the first. However, many of the rural areas most easily electrified have already been supplied, and future electrification is likely to be equally expensive, even with greater application of appropriate technologies.

A greater level of innovation was evident in the processes than in the technology of electrification, such as providing 'blanket' availability in rural areas, widespread employment of community labour, and the supply of appliances to new customers. It should be recognised also that a target-based approach to electrification was itself innovative, and that apparent deficiencies in defining those targets are typical of any innovation.

3.3.2 Capacity of supply

There is substantial disagreement over the most appropriate capacity of supply to electrification customers. The trend amongst the electricity distributors is to limit the power capacity available to low-income households, demonstrated by a shift from 60A to 40A, 20A or 2,5A capacity. The higher the capacity, the greater the costs of the physical infrastructure, but the less significant the constraint on the customers' uses of electricity. Some communities objected to restrictions on their supply capacity for political reasons (wanting the same supply as historically electrified customers). Others wanted larger capacity supplies because the load-limited (2,5A) supplies prevented them from using high-energy appliances. Clearly the capacity of supply affects both distributor and customer.

The cost of the distribution system is affected by the design parameters. The use of generous design parameters, adequate for possible later upgrading of supply capacities, reduces the savings from restricting customer capacity. The intended benefits for customers, the cost of the network and the tariffs are all linked, and a change in any one affects the others.

Durban Metropolitan Electricity adopted an approach aimed at quickly increasing electricity consumption of new customers, by providing starter packs of appliances, to improve the financial and economic viability. Eskom also provided such starter packs in some areas, and success were apparently mixed. This approach appears preferable to improving financial viability by reducing costs and benefits to a low level via supply capacity limits, but may not be appropriate where customers have very small capacity to use electrical energy because of financial or practical constraints. Later in the NEP, the Durban distributor reduced the capacity of supply to 40A while retaining the starter pack concept.

3.3.3 Prepayment metering

It is known that the costs of prepayment metering systems are high. It is also clear that there are significant benefits to the user in terms of budgeting for electricity. However, the extent of the problems of prepayment meter failures experienced around the country is such that it is no longer certain whether the benefits outweigh the costs. Do they really increase payment levels? Do they reduce revenue collection costs? This evaluation could not answer these questions definitively, but indicates clearly that prepaid metering alone is not enough to reduce losses, and needs to be combined with good customer service and relations.

Where prepayment metering is used, vending stations must be accessible to all households. In some rural areas the distances to vending stations are very large. Standards should be reviewed in this regard, identifying maximum acceptable distances, taking into account travel routes and modes. For example, a limit of no more than five kilometres along roads and paths might be adopted.[12] Communities need to know what they can expect from service providers, and need to know whom they can contact about this – the NER probably needs to expand its role in this respect.

Some respondents suggested that conventional meters might be used effectively rather than prepayment meters. Increased community participation may be feasible in conventional meter reading, payment monitoring, electricity theft reporting, and customer education. This may be cost-effective and promote community liaison and the distribution of economic benefits into the community. On the other hand, further technological advances in prepayment meter technology have already been announced, with new benefits. Premature standardisation in the dynamic area of prepayment metering could be costly in the long term, but a lack of standards is also expensive.

3.4 Affordability and pricing

The poorest households struggle to acquire appliances and use electricity for more than the most basic services such as lighting and media. Two different approaches to this problem are evident. Durban Metropolitan Electricity enhanced the new customers' capacity to use electricity by providing appliances. Other distributors explored the use of less expensive infrastructure, and some provided current-limited supplies as an option for those households who cannot afford to pay connection fees but are able to pay the costs for basic consumption. Indications from this evaluation are that connection costs of around R300 are not widely affordable. In the Western Cape, the electrification agent found that many families could not afford even the nominal connection charges of R150, and thus allowed them to pay this charge off over time, with apparent success.

3.5 Institutional effectiveness

The sample of projects and institutions could not identify a single most cost-effective approach to electrification, especially as the infrastructure established for the projects differs widely in context and in the capacity to supply electricity.

3.5.1 Strength in diversity

The institutional analysis has shown that all the distributors involved in the electrification programme have their strengths and weaknesses which makes it difficult to suggest which institutional arrangements are best suited for the electrification of low income households.

It is clear from this evaluation that established larger municipalities can be effective implementers of electrification, but the performance of small, newer municipalities has not been assessed.

Some evidence suggests that Eskom is not always able to establish a close working relationship with communities compared with municipalities and JVs in the sample evaluated. Possibly Eskom's large size, technical focus and separation from municipal/political accountability reduces the ease with which it can get close to the customers. In other words, local authorities, private-utility joint venture initiatives and Eskom distributors may all have their place. An aspect clearly arising from the evaluation is that it can be effective to make comparisons between the various organisations, based on their differences. In effect, there is competition between them, even though they supply customers in segregated areas. Such strength in diversity directly contradicts the justification of

[12] The current NRS standard (NRS-047) states that prepayment vending stations should be within 5km of every customer, and one for every 2000 customers, *where practical (* Note that Eskom uses their own standard, not the NRS ones).

reorganising the electricity distribution industry into a small number of similar organisations (the REDs). In this light it is also worth noting the impressive overall achievement of NEP Phase I connection goals in spite of the fears that the ESI was too fragmented. This is consistent with World Bank findings that an effective implementing structure is a basic requirement for electrification, but an exact institutional structure does not appear to be critical (Barnes & Foley 1998).

3.5.2 Reporting systems

Substantial national resources have been, and will continue to be, allocated to electrification. It is important to be able to evaluate, and thus optimise, the impact of this investment, yet this evaluation project found it difficult to obtain the necessary data to do this. Even with the present distributor boundaries, evaluation of programmes has been problematic due to lack of disaggregated data. The implementation of larger distributors, with new boundaries, could exacerbate the problem. Unless the collection and reporting of data is given attention, the situation may worsen with re-regulation and reorganisation of the distribution industry into very large distributors.

In general, the evaluation found limited understanding of the inter-related aspects of development. Specialisation of task should enable greater efficiency, but possibly at the cost of lower effectiveness. The collection and use of appropriate information is an important factor in integrating the specialised sections of an organisation.

The existing distributor reporting systems to monitor project and programme performance (outputs of the construction projects) only measured limited indicators of performance. They were unsuitable for measuring and managing the outcomes and impacts of the NEP. Strengths exhibited at project level did not carry through to the management of an institution's contribution to the overall programme objectives.

The management of the operation of the electricity networks requires information about the efficiency of operation and the quality of supply. In particular, non-technical losses are an indicator of how well the system operation is being managed. A wide range of attention to non-technical losses was identified. The method of assessing the non-technical losses as the residue after assumed technical losses are deducted is poorly understood. In general, the reporting for technical operations management was of poor quality – if available – indicating weaknesses in this function in most distributors.

3.5.3 Joint venture companies and agents

There are several advantages to using JVs for implementation of electrification in small, focused project areas. However, separating domestic and non-domestic electrification appears to have left community facilities such as clinics, schools and small businesses without active ongoing support in some cases (although this did not only apply to JV-implemented programmes).

JVs evaluated in this project included two distributor JVs and one implementing agent for the distributor. JVs are separate, private legal entities and are not obliged to provide information such as that requested of them in this evaluation project, despite being partly owned by Eskom. The right to withhold information was made clear to the evaluators one case, although there was co-operation. The situation could arise where it becomes difficult to evaluate the use of national resources routed through JV companies. A means to ensure this does not happen should be considered, such as requiring a distributor to ensure disclosure obligations are clarified in the JV founding documentation.

The implementation of electrification projects by agents of a distributor appeared to be characterised by a lack of information at a later stage. In all cases where agents are used for implementation the distributors must take responsibility for ensuring adequate records are provided and maintained. One implementing agent JV (as opposed to distributor JV) evaluated was remunerated on a basis which de-linked their income from programme revenue. The JV can thus be profitable while the programme is not. It seems logical to have income and programme revenue generation linked somehow to promote cost effectiveness of JV operations.

While the JVs covered in this evaluation supported social goals – often very effectively – they are under no formal obligation to do so, and thus the situation could arise where social aspects of implementation are given inadequate attention.

3.6 Community participation

There appears to be no best model for community participation in electrification programmes. Approaches vary according to programme size, availability of formal channels for community interaction (e.g. councillors), community structures in place, and strengths and weaknesses of community members. Strong community participation appears to play an important role in reducing non-technical losses of programmes, thus improving financial viability.

3.6.1 Community liaison

Effective community participation is clearly important in ensuring that users' needs are met, and requires more attention and resources in many areas. Having dedicated, trained staff members to ensure this happens has been effective in the smaller distributors (municipalities and JVs), and may be appropriate in other distributors. Community involvement could be given greater priority in Eskom by making it more visible in their management structures. Community interaction by the TED distributor in Mpmalanga was facilitated by community structures being represented on the Lowveld Electricity Trust – a part owner of the distributor.

Some staff in the distributors mentioned that they found community participation tedious. This is partly due to the fact that committee members often had little knowledge of the electrification process, constraints and participants. This could limit the usefulness of meetings with community committees, and could also mean that distributors, often under pressure to deliver, may have undue influence at meetings to achieve the desired results. The capacity of community members participating in such committees needs to be increased to ensure that they represent the interests of their communities effectively and are able to engage meaningfully with utilities and contractors involved.

In several instances community members are required to invest significant time participating in such committees, as well as incurring travel expenses. They also sometimes feel that they are being asked to do Eskom's core work, such as information dissemination to the communities, without remuneration.

3.6.2 Employment

The way local labour has been used has seldom led to permanent employment. Communities often want people to be employed in their area, even if it is for short periods. This works well for unskilled work; however, it is important that some skills transfer also takes place. Where a project is of a reasonable size, or a number of projects are close together, a small number of people in an area could be trained to do more highly skilled work during construction.

In general it appears that extensive use of emerging contractors is feasible and clearly beneficial to the local community in the short term, but requires concerted effort and resources on the part of the distributor. In most cases, however, the construction employment has not carried over into the operational phases, because the number of employee-months required is significantly smaller.

It was suggested that more extensive house-wiring would contribute to meeting customers' needs and promote employment. The marginal benefit contributed by such activity and additional investment is unlikely to be economic, and would raise issues of responsibility for safety and monitoring compliance with safety regulations. The suggestion is important, in that it indicates perceptions that electrification is perceived as a source of employment, rather than a factor supporting other development activities.

3.6.3 Vending stations

In Khayelitsha, the distributor used households as vending stations to spread activity to those parts of the community not yet economically active. Experience of security reported in Durban and Venda indicates that vendors should be more substantial than households. Further, Eskom has experienced problems collecting all the money from dispersed vending stations where cash flow problems sometimes lead to informal 'borrowing' of the money received for tokens.

The most important criteria for the vending stations appear to be that they are accessible to people, provide good service, and are able to keep the money securely. There may be scope for variations in policy within these constraints, but the various distributors have not identified a single best policy.

Figure 10: Queueing for electricity at a vending station

3.7 Increasing the benefits of electrification

Several distributors reported problems with the integration of electrification planning and township proclamation and servicing planning. The problems appear to be less severe in municipalities, where most of these functions are situated in the same organisation. It is likely that integration will become more difficult when the REDs are established, because a single RED will be required to deal with planning authorities in many separate organisations, including different local and provincial authorities.

Communities place a high value on public lighting as a benefit of electrification, but only municipal distributors provide it directly. In other areas, public lighting has been disconnected, after vandalism or theft of electricity from the supply feeder, because the distributor is not responsible for providing lighting and institutional co-operation is needed to implement repairs and other remedies.

There does not appear to be a coherent policy regarding the contribution of electrification to economic enterprises. Although there are examples of support for business projects, their effectiveness does not appear to be monitored.

3.8 Environmental impact

Attention to environmental issues amongst distributors is very mixed, and at times appears inadequate. The negative environmental impacts of electrification do not appear to be significant (generation coal burning environmental issues are ignored here). Reported positive impacts of electrification include reduced indoor and local pollution, and reduced wood harvesting, but distributors generally do not monitor these impacts formally.

4. Lessons and recommendations from the evaluation

4.1 Overall assessment of NEP Phase 1

Overall, the NEP Phase 1 has been a noteworthy success. The programme achieved the connection targets that were set in the timeframe given. This was in spite of fears that the ESI was too fragmented for such an effort. The programme provided an international precedent in that electrification growth rates during the programme were amongst the highest in the world, and this was achieved without World Bank funding common in many large-scale electrification programmes in the developing world. Innovative approaches and technologies were pioneered, with several successes and many lessons. Four of the most significant lessons arising out of the evaluation undertaken in this project have been discussed in the previous section. In conclusion, it is useful to summarise the performance of the NEP regarding the key aspects of national policy goals which shaped the evaluation process.

4.1.1 Has the programme contributed to the welfare of communities?

Electrification clearly has improved welfare in households, although benefits are more limited in the many households where electricity is only used for lighting and media purposes. Other community-wide benefits include the reduction of fires from reduced paraffin light and candle use, and potentially reduced local and indoor air pollution where electricity is more extensively used for cooking and heating purposes. However, the welfare benefits are lower than was anticipated at the commencement of the electrification programme, as much higher consumption levels were anticipated with correspondingly increased benefits to users.

In addition to household-level benefits, clinic and school electrification has significant benefits for communities, resulting in improved health-care service provision and enabling schools to become involved in evening adult education as well as improving the efficiency of school operation where they are able to procure equipment such as photocopiers and computers. Realising the educational benefit does of course mean that the necessary equipment and resources to undertake evening classes needs to be available, which is dependent on factors other than electrification.

Communities value streetlighting where provided for security reasons, but this is often not a standard electrification service delivered.

Recommendations are made elsewhere on improving welfare benefits of electrification.

4.1.2 Has the programme promoted economic development?

As has been stated, electrification is simply one factor in promoting economic development, and is generally not the most important factor, particularly for smaller enterprises. Nevertheless, some small businesses clearly benefit from electrification. Examples are workshops, where more efficient electrical equipment may be used, food retailers, where superior electric refrigeration becomes and option, entertainment venues, where night lighting, drinks refrigeration and TV and video games may be used, and service providers such as hair salons, which also benefit from the use of electrical equipment. To achieve a much greater impact on economic development requires a broader strategy than electrification alone, and is likely to need coordination between organisations responsible for electrification, capacity building, and finance provision, amongst others.

4.1.3 Has the delivery of electricity been sustainably undertaken?

From a financial perspective, the electrification programme does not appear to be sustainable, and it appears that even operational costs are not covered by revenue generated in many cases (although this could not be established with certainty in the evaluation due to a lack of detailed financial information). The latter implies that electrification programmes are a continual drain on the economy rather than merely displaying 'slower than anticipated' capital recovery. This has serious implications for NEP sustainability in future, including the ability of distributors to continue to service existing areas adequately, let alone the ability to expand into new (and mostly more marginal) areas.

Aside from the financial unsustainability, the general performance of institutions involved in electrification suggests that their structure, management and location arrangements are sustainable, and the diversity of institutions may in fact be a strength of the NEP, as discussed elsewhere.

Negative environmental impacts of electrification do not appear significant, and are likely to be outweighed by the positive impacts on settlement and indoor pollution. The programme thus appears to be environmentally sustainable. Generation emissions environmental impact is excluded from this assessment.

4.1.4 Has the programme been efficiently undertaken?

While the programme delivered according to the ambitious connection targets set, it did so at a higher average cost than the NER target, and system non-technical losses were often high. These may reflect inefficiencies. This must be balanced against the pioneering nature of the programme with associated inexperience of the institutions involved (in terms of technology, scale of implementation, and community interactions), and must consider that some of the technology used had no extensive field testing, and that relations with communities were often difficult initially due to the political hangover of the apartheid government. From this perspective, efficiency of implementation appears more impressive. Nevertheless, efficiency improvements are considered possible, and have been proposed elsewhere in this report.

4.2 Five lessons from the evaluation

The NEP has been evaluated in the context of the logical framework approach normally used for programme implementation. Accordingly, the evaluation takes a holistic view which was not current at the start of the NEP. The specific experience of NEP 1 will not be repeated in NEP 2 because development is a dynamic process, and circumstances have changed. However, it is useful to identify the lessons that can be drawn from the experience of NEP 1, for use in guiding NEP 2 and similar programmes.

- ***Lesson 1: The effectiveness of an institution's performance in respect of electrification is independent of the institutional structure, and the achievements indicate strength in diversity.***

All the institutions evaluated in this project effectively carried out electrification programmes and contributed to achieving the targets of the NEP. Each type of institution (Eskom, municipality, JV) demonstrated relative strengths and weaknesses, or advantages and disadvantages, but none failed to meet their objectives. Institutions that integrate electrification in a broader development framework, are responsive to customer needs and can deliver at scale are all required for the complex process of electrification. Further, there was insufficient evidence to indicate that any one type of organisation was able to carry out the electrification more efficiently or less expensively than any other, taking into account the variety of circumstances of each project.

It should be noted that the survey was small and that no weak municipalities, about which so much concern has been expressed, were included in the survey. Also, the nature of Eskom has changed since the electrification programme was implemented and, being now liable for taxation as a company, may take similar decisions differently in the future. Therefore, using the assessed historical performance as a guide for the future must be done with great caution.

This lesson has significant implications for NEP 2, since it indicates that EDI restructuring need not be a constraint on further progress in electrification, just as it does not appear to have hindered the achievements of the institutions in NEP 1.

It further appears that the operations management of the electrification networks benefits from having relatively small, focussed teams, close to the communities and with access to performance data which has not lost its detail through aggregation. It is also important that the responsibility for supplying different types of customers within the same area should not be split, as this has sometimes resulted in inadequate ongoing service provision to important sectors such as health, education and business.

Integration of electricity and other service provision is an advantage that municipalities display over other distributors, and this can facilitate improved coordination of electrification and other urban development planning. Lack of coordination in this respect in some cases lead to unnecessary delays in electrification of settlements in NEP Phase 1. With electrification responsibility potentially moving to REDs, such coordination will need special attention.

Although JVs are established and operate in different ways, potential problems arising from more extensive use of JVs for implementation are that they are not necessarily obliged to embrace social goals, nor report on details of their operation, which may make assessing the cost-effectiveness of

the public money invested difficult. Also, it is necessary to link programme revenue with JV revenue, which is not always the case – this ensures continued attention to operations and maintenance, and creative thinking to maximise ongoing programme financial viability.

Recommendations linked to institutional performance

The EDI demonstrated strength in diversity in achieving the electrification targets of NEP 1, and the advantages of this diversity should be preserved in the proposed restructuring of the EDI.

Continuing with the next phase of the NEP does not require the industry to be restructured first. NEP 2 should concentrate instead on defining the overall objective of the programme, providing the context for decisions regarding the purpose of constructing and operating electrification networks and connecting customers.

In addition to household connections, distributors should be unambiguously responsible for implementing and operating supplies of electricity to clinics and schools, but in co-operation with the institution responsible for paying for wiring and electricity consumption.

Special attention will be needed to ensure the integration of electrification and land servicing under the proposed new electricity industry structure.

Where JVs are adopted, a mechanism is needed to link the JV's revenue to programme revenue. Mechanisms to ensure JVs embrace social objectives should be in place. JVs should be required to report publicly the same information as other distributors for monitoring purposes.

- ***Lesson 2: Most electrification is only financially viable with significant investment subsidies, and even then some networks need subsidies for subsequent operations.***

Notwithstanding the uncertainty regarding the capital costs of several of the programmes, it is evident that most electrification is not financially viable for the distributor without subsidies and, at best, marginally economically viable (this lesson should be seen in the context of the significant broader benefits identified under Lesson 5, which implies that the broader economic benefits are significant, but are difficult to properly include in such an analysis).

The NEP was entirely funded from within the EDI. Eskom received no subsidies and, later on in the programme, the municipalities received subsidies derived from Eskom revenues through the electrification fund. A substantial portion of this fund was derived from municipal sales, although amounts are unclear. The subsidies were not clearly defined in NEP as 'free money' as for most subsidies. Therefore, the effect of whether a subsidy addresses investment or operating costs is not distinct. The evaluation project was unable to identify the size of the subsidies required for further electrification, as there were discrepancies regarding the methods of modelling and input data used by Eskom and that obtained by the evaluation team.

Subsidies of the capital investment are a once-off cost, but non-viable operations of the networks requires on-going subsidisation, implying that existing projects will be a continued national economic drain. This poses a serious concern for the sustainability of future electrification programmes that will increasingly move into more financially marginal areas.

Connection fees payable by customers do not contribute significantly to financial viability unless they are large enough to be a barrier to electricity access for many poor households. NEP Phase 2 will need to balance these two concerns, but across-the-board connection fee increases are unlikely to be an appropriate way of improving programme financial viability.

Most of the financial pressure has been directed at the initial cost of investment. Future electrification areas will be more expensive to supply than in NEP 1 because the least viable areas were given low priority. The demonstrated non-viability of the electrification projects will have to be considered in establishing the targets and subsidies for NEP 2.

Recommendations linked to financial viability

All the participants must agree on the cost/benefit model for analysis, the process of calculating the subsidy needed for electrification, and the size of the funding and subsidies for the continuation of the NEP.

A distinction should be made between the subsidisation of capital and operating expenditures, and allocation of subsidies should be clear in distributor records.

Capital investment subsidies need to be relatively stable to avoid fluctuations in connection charges creating negative public perceptions (in one case connection charges were linked to subsidies received).

This evaluation indicates that it is preferable to offer consumers a choice of supply options rather than provide only a standard capacity of supply to all consumers. This can improve financial viability in reducing the provision of unnecessary capacity. Furthermore, it makes sense to require of more affluent households who want to use a lot of power to pay a significant connection fee, as this ensures cost recovery from consumers who can afford it, thereby targeting subsidies more effectively.

The targets and constraints to be included in NEP 2 should be directed to improving the cost-effectiveness of the electrification programme, on a scale that is affordable to customers and the country (see Lesson 5 for further discussion on target-setting).

The introduction of new subsidies for electricity consumption by poor customers (EBSST or poverty tariffs) will need to be done in a manner or on a scale that does not impose too high a financial burden on an already potentially unsustainable programme.

The DME or NER should implement standard reporting of actual costs and revenues per programme – see Lesson 5 for details.

- ***Lesson 3: A wide range of technical alternatives for the electrification programme all have an important role in reducing the cost of electrification – these include the feeder technology, materials, capacity of the supply available to customers, metering and design standards.***

Pressure to reduce the costs of connections caused most distributors to adopt lower cost standards for the electrification networks, in many cases reducing the benefits of electrification delivered to the customers. Despite the cost pressures, there was relatively little technical innovation during the NEP. Previously introduced innovations were implemented on a wide scale, but, in some cases, only when the cost pressures were applied.

Electrification costs can be reduced further by using single phase systems, reducing the capacity of supply and not making allowance for possible future upgrading. However, the reduced supply capacity limits the benefits of electrification for the customers, preventing, for example, the use of electricity for cooking. There is no single supply capacity that is appropriate for all needs, and thus a range of options should be provided. NEP Phase 2 will need increased attention to technical cost reduction, through incentives or targets (see Lesson 5), balancing this with customer needs.

The evaluation found that prepayment meter failure is more widespread than is commonly known, resulting in expensive replacements and reduced customer service quality. Also, there are indications that prepayment metering may not have been as successful at reducing non-technical losses as was once thought. Since prepayment metering is a relatively expensive option, especially when considering the cost of establishment and operation of vending stations as well as the apparently short lifetime of meters, appropriate metering options need to be re-evaluated at this point.

Recommendations linked to technology issues

The financial targets for further electrification should be sufficiently severe to promote the greatest possible use of cost-saving technologies, even if the rate of electrification has to be retarded to allow the methods to be brought into widespread use.

An investigation of appropriate metering is justified, examining the costs, benefits and scope for community participation. A combination of prepayment metering and community involvement in monitoring activities may be a feasible way forward. However, it is important that the reliability of prepayment meters is improved.

There is scope in the electrification programme to offer customers a range of supply capacities, at appropriate prices, and allow the customers to make the choice. A consistent policy should be adopted regarding electrification approach (i.e 'blanket' or 'selective'). This policy should not be prescriptive so as to stifle diversity necessary to match differing local conditions (found to be one of the strengths of NEP 1), but at the same time should not allow the poor to by bypassed in the pursuit of financial viability. Blanket electrification with free 2.5A connection should be further evaluated in this regard. The need for connection capacities to be upgradable to meet the changing needs of

households should be investigated. The appropriate capacities, approaches and costs need to be reviewed in the context of the overall objectives and intended impact of further phases of the NEP.

- ***Lesson 4: Successful electrification requires as much focus on meeting community needs as on technical and financial issues***

Many of the broader economic benefits of electrification relating to community welfare are not quantifiable, yet from a national perspective are critically important. Undertaking electrification with a predominantly technical and financial focus does not automatically meet many of these needs effectively.

Interactions and relationships between the recipient communities and the distributors have been variable, but there is consensus that community involvement in electrification planning and delivery is important. It is a key factor in addressing high non-technical losses. Strong community relationship with the distributor results in improved customer satisfaction and greater welfare benefits. While community committees are widely used, they often lack capacity to participate effectively in the electrification process, and some members feel that they should be paid for their travel costs and time.

Improving welfare benefits also means facilitating the provision of streetlighting, which is much valued by communities yet is often not provided. Facilitating access to electricity by poor households in particular, including vending station accessibility, as well as facilitating increased use by connected households needs attention.

The stimulation of economic development, particularly for small businesses, requires coordination between a range of players beyond the electricity distributor.

Reccommendations linked to community welfare benefits

Future programmes should ensure that improved service delivery to customers and greater community involvement receive adequate attention.

Mechanisms to ensure that public lighting is installed in all appropriate electrification projects should be established.

Facilitating appliance acquisition has a potentially important role in increasing the benefit of electrification to communities, and should be further explored in future electrification projects.

Capacity building of community structures consulted or used by the distributors should be formally undertaken as a part of electrification programmes (lessons from the Department of Water Affairs community water committee capacity building strategy may be valuable in this regard).

Remuneration to at least cover travel costs for electrification co-ordination meetings should be paid to attending community members, and possibly also for information dissemination work they undertake on behalf of the distributor.

Use of local emerging contractors should be continued in future programmes, but necessary training and support measures to ensure successful partnerships should be clarified, possibly in the form of guidelines.

Distributors should monitor the effectiveness of electricity supplies to economic enterprises in electrification areas and implement policies to increase the contribution made by electricity to promoting economic activity. Coordination with other relevant organisation in this regard is useful (e.g. around finance provision and business capacity building).

The possibility of providing free connections to poor customers, with a severely limited capacity, should be investigated further, as it supports greater access to electricity.

It may be feasible to provide households with different startup package options, including free connections and appliance and housewiring options, and recover the costs in instalments.

Vending stations must be accessible to households, and the NER should consider developing more effective national guidelines in this regard.

- ***Lesson 5: Achieving the desired impacts of electrification requires a broader approach to setting targets in terms of the benefits.***

Significant achievements in mass electrification were achieved in NEP 1 through a focus on simple, unambiguous targets for numbers of connections. Understanding of the complexities of

electrification, for example of the marginal viability, has increased. Informed by the experience, target setting in future electrification will be more complex.

Electrification is not an end in itself. It does not provide significant long-term employment within the sector. Electrification is necessary, but not sufficient on its own, to stimulate economic activity and improve the quality of life, and needs to be integrated with other services. It must be remembered that the analysis undertaken here underestimates the economic benefits through low willingness to pay, not quantifying social benefits sufficiently and not including external costs. There is much anecdotal evidence that electrification leads to reduced indoor air pollution and hence to better health, but this benefit has not been adequately monitored or quantified. Although not financially viable, there are substantial socio-economic benefits that are not easy to quantify in the financial and economic viability analysis. These benefits should not be ignored because they are difficult to quantify or to be achieved through direct target setting.

This evaluation has pointed to areas where electrification approaches could be adapted to improve cost-effectiveness and benefits. However, it appears that further effort needs to be directed to establishing the targets and constraints for further electrification to obtain the greatest economic and social benefits while, at the same time, keeping the programme affordable for customers and the country. A logframe approach is proposed as an appropriate tool which will allow the entire programme to be managed in a structured way to achieve the desired hi-level policy goals. Outputs should include connection targets as with Phase 1, but should also consider cost-capping and technical and non-technical loss parameters to promote efficiency, as well as community involvement, community service provision and capacity building outputs. The importance of increased attention to community needs was evident from the Phase 1 evaluation. Support to economic activity and environmental outputs also should be included as clear objectives with associated outputs.

The estimation of non-technical losses provides an important indicator of operations management and cost effective delivery, but needs a more statistically thorough and consistent approach across distributors. Current differences in measuring standards adopted and assumptions used reduce the usefulness of such figures, and sometimes they are simply not known.

Once the objectives and outputs have been made clear, firm reporting procedures need to be instituted to enable effective monitoring and management.

Recommendations linked to programme objectives and target setting

The objectives of the NEP need to be clearly defined in terms of the extent of electrification appropriate for the country, the rate of implementation, the associated cost and the required benefits or impact. All the other activities and results of NEP processes will be evaluated according to their contribution to meeting the high level policy, and allow the entire programme to be managed. Use of the logframe approach to project and programme evaluation is strongly recommended.

As the electrification programme moves into more economically and geographically marginal areas, it is important that targets continue to be set by government. However, such targets should be coupled with measures to promote cost effective delivery.

Systematic reporting of achievements at both output and outcome level is required for effective programme management. The logical framework approach, or other similar system of assessing projects in the context of broader development objectives, should be used to identify the reporting needs of future programmes.

A standard procedure for calculating losses should be used, and results included in distributor information reporting for both management and regulatory purposes.

In defining the objectives and outputs of Phase 2, the following should be catered for:

- connection targets (including schools and clinics);
- cost targets;
- technical and non-technical loss targets;
- community involvement and capacity building;
- ongoing service provision to schools, clinics, and businesses;
- environmental management and impact monitoring.

Specific data essential for monitoring, evaluation and planning that was found to be lacking in this evaluation. The following should be included in distributor reporting requirements:

- Financial information:
    - capital expenditure (connection costs, reticulation costs, bulk supply, vending stations, streetlights, meter replacement, other);
    - operating expenditure (energy supply, support and maintenance, other);
    - revenue for each electrification programme per year.
- Records of network design and construction should be maintained together with a register of physical assets, for monitoring and asset valuation as well as for subsequent network assessment and reinforcement planning.
- Further data reporting requirements will be dependent on the objectives and outputs defined for NEP Phase 2, and are likely to include information on non-technical losses, community interaction, and clinic and school electrification reporting.

The NER or DME should systematically collect and process the reported information in the light of the programme objectives and outputs set.

Environmental impacts should be the subject of further study as they are closely related to the overall objectives of the electrification programme.

All distributors should establish environmental management systems and ensure that staff are trained and responsibilities allocated accordingly. Eskom should ensure that their national environmental policy is implemented at the distributor level.

Both adequate statistical metering and suitable processes are needed to manage and respond to non-technical losses.

4.3 Conclusion

Although the NEP Phase 1 programme experienced inevitable difficulties and was not always as efficient as it might have been, it reflects a rare achievement from a national and international perspective. It is now important that lessons emerging from the NEP Phase 1 are properly included in Phase 2 planning and implementation – which will increasingly move into more marginal areas, and will thus be more financially, technically and institutionally demanding.

5. Strategic guidelines for planning and implementing NEP phase 2

Although the detailed recommendations listed earlier in this section of the report are all important, the findings which are most critical to the effective implementation of NEP Phase 2 are summarised in this section:

- ***Diversity of institutional approach is a strength which should not be lost in NEP Phase 2.***

Institutional restructuring is not a constraint to further electrification, and in fact diversity of structure, and thus approach, is a strength which allows for different approaches to implementation which best suit the varying conditions around the country. Restructuring initiatives should beware that such diversity is not stifled in the proposed move to large, similarly structured REDs.

- ***Clear, up-front financial planning of NEP Phase 2 is critical, identifying funding sources and subsidy levels.***

Electrification is in most cases not financially viable, and in fact revenues in many areas do not cover operating costs. This poses a serious threat to not only the sustainability of further electrification, which will increasingly move into more marginal areas, but also to the effective operation of existing systems. Clear up-front financial planning is critical for NEP Phase 2 to avoid moving into dangerously unsustainable situations, including the clarification of funding sources and subsidy levels required.

- ***The goals and outputs of NEP Phase 2 need to defined up-front in a logframe or similar planning framework***

Outputs and implementation should be guided by this planning framework. The resulting targets will need to be more comprehensive than the simple connection targets used in Phase 1 (although this was effective given the ESI situation at the time). The following objectives and outputs should be included in the framework:

- connection targets (including schools and clinics);
- cost targets;
- technical and non-technical loss targets;
- community involvement and capacity building;
- ongoing service provision to schools, clinics, and businesses;
- environmental management and impact monitoring.

- ***Further optimisation of costs and maximisation of benefits is possible and necessary for NEP Phase 2.***

In this regard, the following needs to be undertaken:

- Commission a study on metering feasibility in the light of the higher prepayment metering costs which have come to light, and the indications that they are not as effective at reducing non-technical losses as was previously thought.
- Commission a study on optimum connection capacity ranges and charges. This evaluation shows that a choice of options needs to be provided at appropriate connection costs, and that users should not be constrained by connection capacity where they require more. The feasibility of providing a free current-limited connection (e.g. 2.5A) needs to be explored, weighing up the social benefits and the cost implications. The implications for network capacity and costs need to be included in the assessment.
- The merits and demerits of using 'blanket' or 'selective' electrification need to be further investigated. The former may be less financially viable, while the latter may bypass the poor to some extent and thus have reduced social benefits. It is important to allow diversity of approach by distributors in this regard while balancing social goals and financial viability.
- Maximum use of cost-effective technical options such as single-phase systems should be promoted in NEP Phase 2.

- ***Meeting community needs must be an integral focus within the NEP Phase 2 electrification process.***

The following is important in this regard:

- Community participation, and, where necessary, capacity building, is to be a core part of distributor responsibilities.
- Vending stations need to be accessible in all areas, and standards are to be more specific in this regard
- Streetlighting should be provided as a part of electrification. Communities value streetlights.
- An investigation into the feasibility of providing appliance 'starter packs' should be undertaken. So far this has not been properly investigated.

- ***Improved data collection and reporting is required for NEP Phase 2.***

Distributors need to collect and report data to enable monitoring of programme performance relative to the specified outputs. Lack of such data was a significant constraint to the evaluation of NEP Phase 1. It was also found that data on individual programmes was often lost through regional aggregation, making evaluation more difficult. Measures should be put in place to see that this does not happen in the proposed move to larger REDs. Specific data to be collected and reported should be influenced by the overall objectives and outputs set for the programme, but should include:

- Financial information:
  - capital expenditure (connection costs, reticulation costs, bulk supply, vending stations, streetlights, meter replacement, other);
  - operating expenditure (energy supply, support and maintenance, other);
  - revenue for each electrification programme per year.
- Records of network design and construction should be maintained together with a register of physical assets, for monitoring and asset valuation as well as for subsequent network assessment and reinforcement planning.
- Further data reporting requirements will be dependent on the objectives and outputs defined for NEP Phase 2, and are likely to include information on non-technical losses, community interaction, and clinic and school electrification reporting.

The NER or DME should systematically collect and process the reported information in the light of the programme objectives and outputs set.

It is again important to note that several other important recommendations are made in the previous sections of this report. While this detail is omitted in this summary, these recommendations should not be overlooked in strategising around the implementation of NEP Phase 2.

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1 Mavhungu J, Winkler H, Qase N & Gaunt T, 2001. National Electrification Programme Evaluation – Interim outcomes report: Northern Cape (Greater Kimberley). University of Cape Town: Energy and Development Research Centre.

2 Mavhungu J, Winkler H, Qase N & Gaunt T, 2001. National Electrification Programme Evaluation – Interim outcomes report: North West (Mmabatho). University of Cape Town: Energy and Development Research Centre.

3 Qase N, Gaunt T & Winkler H, 2001. National Electrification Programme Evaluation – Interim outcomes report: Durban Metro. University of Cape Town: Energy and Development Research Centre.

4 Qase N, Winkler H, Mavhungu J, Tyani L, Gaunt T, Thom C & Borchers M, 2001. National Electrification Programme Evaluation – Interim outcomes report: Western Cape (Khayelitsha). University of Cape Town: Energy and Development Research Centre.

5 Qase N , Gaunt T, Winkler H & Mavhungu J, 2001. National Electrification Programme Evaluation – Interim outcomes report: Gauteng (Orange Farm). University of Cape Town: Energy and Development Research Centre.

6 Afrane-Okese Y, Winkler H, Mavhungu J, & Gaunt T, 2001. National Electrification Programme Evaluation – Interim outcomes report: Northern Region (old Venda). University of Cape Town: Energy and Development Research Centre.

7 DBSA 2001. Outcomes Evaluation of Bank Investment in the Kwahobuhle Electrification Programme: Eastern Cape. Development Bank of Southern Africa, Operations Evaluation Unit.

8 DBSA 1999. Process and preliminary impact evaluation on the Bank investment in the Transitional Electricity Distributor TED (Pty) Ltd, Mpumalanga Electricity Supply Programme. Development Bank of Southern Africa, Operations Evaluation Unit.

APPENDIX 1

Detailed terms of reference

TERMS OF REFERENCE FOR THE APPOINTMENT OF EVALUATION MANAGEMENT TEAM AND CONSULTANTS

GOVERNMENT OF SOUTH AFRICA:

DEPARTMENT OF MINERALS AND ENERGY (DME)

EVALUATION OF THE SA NATIONAL ELECTRIFICATION PROGRAMME (NEP), 1994-1999

ASSIGNMENT NO.:

JANUARY 2000

Prepared by:
Evaluation Management, Operations Evaluation Unit,
Development Bank of Southern Africa

Contact Persons:
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1. INTRODUCTION

At the end of 1999 the Government of South Africa (GoSA) completed the implementation of the National Electrification Programme (NEP) Phase I (1994-1999) at a total cost of about R7 billion. From the beginning of 2000 the GoSA will commence the New National Electrification Programme (NEP Phase II). A national evaluation of Phase I is to be conducted by the SA Department of Minerals and Energy (SA DME) in 2000 which will be managed by the Operations Evaluation Unit of the Development Bank of Southern Africa.

2. BACKGROUND

The Electrification Distribution Industry (EDI) in South Africa has until now been comprised of a national utility, the Electricity Supply Commission ESKOM, and Local Authorities (LAs), comprised of 400 municipalities represented by the South African Local Government Association (SALGA).

Historically, service provision was limited geographically to established towns and areas of economic activity. By 1993 approximately 500 000 households had been electrified (385 000 by ESKOM) mostly in cities and towns close to the established electricity grid and with higher housing densities. At the end of 1993 access to grid electricity was approximately: 36% of the total population; 50% of the urban population; and 12% of the rural population. More than 15 000 rural schools had no access to electricity.

In 1994 the democratic Government of South Africa (GoSA) launched the Reconstruction and Development Programme (RDP) which called for an accelerated and sustainable National Electrification Programme (NEP) based on previous work done by the National Electrification Economic Study (NEES).[1] The RDP electrification target was accepted by the EDI members (ESKOM and LA distributors) and undertaken in terms of an unwritten Compact with Government.[2] The aim of Phase I was to provide access to electricity for:

- an additional 2 500 000 households (500 000 per year: ESKOM 350 000, LAs 150 000);
- mainly in previously disadvantaged and rural areas; and
- all schools and clinics without electricity.

Despite the size of the programme and the resources that would be needed, a decision was taken to implement Phase I as an accelerated Presidential Lead Project towards the RDP.

In terms of the Compact, the EDI had to electrify new areas, in existing or new townships and in traditional rural areas, located further from the existing grid and with lower housing densities. The target for existing schools and clinics was also increased by the new government's parallel initiative to build many new schools and clinics.

- ESKOM's component of the Compact was 1 750 000 connections distributed across the whole country, but mainly in rural areas. Some of these projects were very expensive due to their remoteness and lack of infrastructure. Consumption of electricity in such areas also proved to be lower than estimated, adding to the cost of the whole programme. However, by the end of 1999 ESKOM had met its electrification target of 1 750 000 domestic connections and had provided additional connections to rural clinics and schools, at a cost of R5 billion +.
- The LA's component of the Compact was 750 000 connections mainly in urban areas, with generally lower costs per connection and much higher electricity consumption, at a total cost of R2 billion +.

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[1] "The establishment of the National Electrification Forum (NELF) led to, amongst others, the creation of a series of scenarios under the mantle of the National Electrification Economic Study (NEES) to examine the implications of the electrification of South Africa. Scenario 2 of this study provided the guidelines for the Reconstruction and Development Programme (RDP)". Mare, P: 1998

[2] "The Reconstruction and Development Programme – A Policy Framework" produced by the African National Congress in 1994 states on page 33 that: "An accelerated and sustainable electrification programme must provide access to electricity for an additional 2,5 million households by the year 2000, thereby increasing the level of access to electricity to about 72% of all households". (It was estimated by NEES that 58% of households in the country would be electrified on meeting the target set.) Mare, P: 1998 .

A primary focus of the effort has been on achieving connections at least cost. The initial electrification planning assumptions included financial viability and sustainability. To achieve this the programme was funded interchangeably by:

- an industry mark-up of an implicit levy contained in the ESKOM tariff on electricity sales;
- transferring R300 million per annum from ESKOM to the National Electricity Regulator (NER) for allocation to LAs

(Note: an audit of the grant to the NER is presently being conducted by DBSA.)

However, the assumptions related to consumption were optimistic and as yet have not reached the levels necessary to ensure viability. The ongoing cross-subsidisation of the targeted customers by other electricity customers represents a price burden of up to 8% to the other electricity customers.

3. NEED FOR THE EVALUATION

The need for the evaluation was identified by the National Electrification Co-ordination Committee (NECC) and stems from:

- the achievement of the Reconstruction and Development Programme (RDP) targets;
- the release of the Government of South Africa's Energy White Paper (DME,1998: *White Paper on Energy Policy for Republic of South Africa)* ;
- the fundamental decision that government, not ESKOM, will lead the new (Phase II) national electrification initiative in the future;
- the proposed restructuring of the Electricity Distribution Industry (EDI) into regional Electricity Distributors (REDS);
- the cost implications to Electricity Distributors and the SA fiscus of proceeding with the next phase on the same basis as Phase I;
- the likely necessity for the GoSA (not the EDI) to provide a full, or partial, subsidy to ensure agreed project returns are achieved in Phase II;
- the conversion of ESKOM to company status; and
- the fact that the target driven approach led to negative rather than positive returns on investment for ESKOM (and probably Local Authorities as well).

With the Phase 1 target met, and based on the latest 1996 census figures, the country will in fact be 70% electrified by the end of 1999. In terms of delivery and social upliftment, the electrification programme is already being considered a success because the capacity to deliver has been established. The New National Electrification Programme (NEP Phase II) is commencing in 2000 with 4 million homes still to be electrified, mainly in rural areas, particularly the Eastern Cape and Kwazulu Natal Provinces. Phase II will move deeper into rural areas where average costs per connection will be higher and the impact on the EDI's finances will be greater. Non-grid electrification is also under consideration.

According to the the DME an evaluation is considered necessary at this stage to:

- establish lessons learned, not only from a technical and financial perspective, but also concerning wider development aspects of the programme;
- establish, inter alia, what electricity is used for, the kind of consumption, how to recoup a profit, degree of subsidisation and sales volumes anticipated;
- re-direct the Phase II programme on the basis of an analysis of what has happened, the strong and weak points, lessons learned and what to improve and avoid in the next phase.

4. EVALUATION OBJECTIVE

To conduct an evaluation of the investments made by ESKOM and Local Authorities (LAs) in the National Electrification Programme (NEP) Phase I: 1995-1999. The purpose of the evaluation is to: document the programme's quantitative and qualitative achievements; investigate the development impacts; analyse strengths and weaknesses; make some comparisons with other comparable international electrification programmes; and identify lessons learned from the programme and selected projects. The evaluation will be used by DME and the other stakeholders for: making

improvements to the new National Electrification Programme (NEP Phase II) commencing in 2000; and advising SADC countries seeking assistance from SA about planning their own electrification programmes.

5. SCOPE OF WORK

Particular attention will first be given to reconstructing the expanded strategic objectives of the programme based on what actually happened during programme planning and implementation, including:

- the original RDP objectives (quantitative connection targets);
- how ESKOM and the LAs proceeded with planning and implementation within the Compact with Government; and
- DBSA's integrated economic development requirements for the Bank's investments in selected projects in the ESKOM Electrification Programme.
- Added to this will be:
- the policy objectives subsequently outlined in the Energy White Paper; and
- what the NECC and the DME need to know to inform the planning of Phase II.

The evaluation will then be conducted taking into consideration the strategic objectives derived from the above. The evaluation will be divided into three phases:

Phase I: Strategic Assessment Framework and Key Programme Data Collection
This phase will focus on detailing the assessment methodology through preparation of:

- a strategic assessment framework (LOGFRAME type) relating program activities to key strategic objectives, outputs and performance indicators; and
- a work plan identifying, listing and scheduling tasks and assigning responsibilities among the Evaluation Team members.

Phase 2: Fieldwork on Development Impact Evaluation
This phase will include the assessment of program performance based on achievements on the ground and field documentation of impacts. Evaluation Team members will visit a sample of projects made by the Team in consultation with the Electricity Distributors, from the seven ESKOM Regional Offices and the LAs in the nine provinces.

Phase 3: Drafting and Presentation of Report
A preliminary report will be submitted to NECC, DME, DBSA, ESKOM and SALGA for review and comments. A final report integrating comments and suggestions, as well as a summary document for publication, will be submitted to the NECC and DME after all comments are received. A presentation of the findings and recommendations of the evaluation will be made to the NECC , DME and DBSA. A presentation to a wider audience will also be arranged. A final working session will be held with DME to discuss the integration of findings and recommendations in the operational strategies of the New National Electrification Programme (NEP Phase II).

6. TIME FRAME AND REPORTING REQUIREMENTS

Assuming that the above estimated evaluation budget can be fully resourced, the review should take about five months (20 weeks) as follows:

- Preliminaries including consultant appointments: 2 weeks
- Logframe development and Key Project Data collection 3 weeks
- Fieldwork 7 weeks
- Data analysis and synthesis 2 weeks
- Report writing and reviews 4 weeks
- Presentations 2 weeks

Team member and consultant inputs should be presented in Windows 95 Office 98 and sent by email to: mary@dbsa.org

Submissions on hard copy and disc (if necessary) should be delivered to:

> NEP Evaluation Management, Room 1137, Operations Evaluation Unit, Development Bank of Southern Africa, Lever Road, Midrand (tel +21 +11 313 3911).

The final report will consist of 2 volumes:

- Volume I: Assessment of the NEP Phase I Programme
- Volume II: Review and Assessment of ? Selected Projects

30 copies and an electronic copy in Word 98 will be delivered to DME by the Evaluation Management for distribution to stakeholders as determined by the DME and DBSA. The reports will be endorsed: "Restricted Distribution: The contents of the evaluation report may not be disclosed without authorisation of the SA Department of Minerals and Energy and the Development Bank of Southern Africa.")

7. GENERAL

The evaluation will commence one month after:

- the signing of the Evaluation Management contract with DBSA;
- the provision of adequate financial resources (according to the proposed budget); and
- the appointment of the consultants.

APPENDIX 2

Data collection instruments

The following is a set of the data collection instruments issued to the distributor for Khayalitsha. The other distributors were sent the same documents.

National Electrification Programme Evaluation Project

FINANCIAL AND ECONOMIC EVALUATION DATA REQUIREMENTS

Western Cape: Greater Khayelitsha Electrification Programme

Responsible evaluation team members:

Harald Winkler
harald@energetic.uct.ac.za, tel (021) 650-2521

Lwazikazi Tyani
lwazikazi@energetic.uct.ac.za, tel (021) 650-2832

(ALL PRICES EXCLUDING VAT)

Note: use household (HH) and customer (cust) interchangeably

All costs and benefits must be collected for all five years (or the life of the project)

Project name: _____

Province: _____

Urban / rural: _____

Customer service region: _____

Eskom SACS region: _____

MTS sub-station: _____

Project start date: _____

Date of evaluation: _____

Evaluation done by: _____

Capital expenditure (Capex)
Connection costs

1.1. What was the cost per customer per tariff, for each year of the programme (Rands)? E.g. 1994, 95, 96, 97, 98, 99. Fill in Table 1 (attached)

1.2. Was there an additional cost to the distributor for wiring or a Readi-board? (R / customer)

1.3. How many new connections under each tariff (20A, 60A, business) were made each year (number)? Fill in Table 1

1.4. What was the total capital cost for new connections, in each year (R/yr)?

2. Are bulk supply and reticulation costs accounted for separately from the average connection costs? *If yes, answer 2.1 and 2.2, if no, proceed to question 3.*

2.1. What were the bulk supply costs for the project (c/kWh), broken down for each year (R/yr)?

2.2. What are the costs of reticulation (R/stand)?

2.3. Were any capital grants received for the programme? If so, please state amount per year.

3. Did the programme fund the installation of streetlights / high masts?

If yes, answer the sub-questions, otherwise proceed to question 4.

3.1. Were streetlights or high masts installed?

3.2. If so, what was the number of streetlights / high masts installed, in each year (number)?

3.3. What was the capital cost per light / mast (R / unit)?

3.4. What is the average cost per light / mast?

4. Schools and clinics connected

	Schools	*Clinics*
Number		
Cost per connection		

5. Was there any other capital expenditure, in each year (R/yr)?

Operational expenditure (Opex)

6. What were the supply costs, derived from wholesale price times purchases, in each year (R/yr)?

7. What was the support and maintenance costs, in each year?

If the categories below are not appropriate, indicate how total support and maintenance costs were calculated.

7.1. What were the support costs per customer, in each year (R/month) ?

7.2. What were the administrative costs, in each year (R/month) ?

7.3. What were the marketing costs, in each year (R/month) ?

7.4. What were the costs to operate and maintain streetlights / high masts (R/month) ?

8. Were there any additional operating costs (R/month) ?

9. Were there conversions to pre-paid systems?

9.1. Number of conversions:

9.2. Cost per conversion:

Revenue and tariffs

10. What was the average consumption per customer in each tariff, per month ? – Fill in table 2 (attached)

11. What were the tariffs charged to customers? Fill in table 2 (attached)

If the data for the above two questions is not available, answer the two below:

12. What was the overall revenue from sales, in each year (R/yr)? Fill in table 2 (attached)

13. What was the minimum and maximum consumption per customer per tariff over the period?

14. What growth rate do you project from the present forward?

15. What was the connection fee per customer in each tariff class (R/customer)? – Fill in Table 2 (attached)

16. What was the revenue from streetlights / high masts, in each year ?

17. Was there any additional revenue, and if so, how much in each year (R/yr)?

18. Is the revenue substantially dependent on a few large customers? (use your judgement) Please name them and estimate their total contribution to total revenue.

Losses

19. What was the level of payment for sales, in each year (%)?

20. What were the non-technical losses (%)?

Costs and benefits for the customer

21. Was there an additional charge for wiring or a Readi-board (R/HH)?

22. What were the average customer sales per tariff per year (R/HH-month)? Fill in Table 2 (attached)
23. What was the average income per household per month (R/HH- month)?
24. What was the average expenditure on non-electric fuels per household per month (R/HH-month)?

Financial statements

Obtain full set of annual financial statements (income statement, balance sheet, cash flow etc) detailed with notes and auditor's reports. These should provide answers to the following questions, if not, they need to be followed up.

25. What was the debt/equity ratio in each year of the project?
26. In terms of liquidity analysis, what was the ratio (current assets / current liabilities)?
27. Were any external loans taken out to finance project implementation? if yes, what was the interest rate and the annual repayments?
28. What was the book value (residual financial value) of assets at the end of the projects
29. Customer breakdown (split of customers between domestic, commercial, industrial) in value and volumes for the different periods. List of major clients. The dependency on a single client needs to be determined.

Projections, planning and forecasting

30. What initial financial planning was undertaken prior to project implementation (if any)?

    30.1. What were the key assumptions and viability criteria used in planning?...

        30.1.1. numbers of connections
        30.1.2. kWh use patterns per user
        30.1.3. capital cost per user
        30.1.4. total capital cost, broken down by (% breakdown is fine):
            30.1.4.1. material and equipment
            30.1.4.2. construction labour
            30.1.4.3. transport
            30.1.4.4. design and direct construction administration
            30.1.4.5. finance charges and overheads
        30.1.5. revenue estimates
        30.1.6. bad debt provisions
        30.1.7. O&M costs
        30.1.8. Other costs.....

    30.2. Were these criteria met in practice? Please specify actual values compared with the planned values for above categories.

31. Is there a management feedback system to evaluate cost-benefit status of the project compared with original projections and estimates? - if so, please describe.
32. Are there any projections at present for the next 5, 10 and/or 15 years regarding the viability (cost-benefit) of the project? - if so, please provide details.
33. What are the key determinants of project viability in your opinion around which sensitivity analyses should be done (i.e. which factors have you found are critical to successful cost-recovery in practice)?

34. Do you have any information on household income levels compared with electricity payments in the areas covered- i.e. willingness to pay? (Or are you aware of such information held by others?) – please give details or references.

TABLE 1: Capital expenditure

Capital Expenditure		*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
Pre-paid Meters < 8A	Connection cost						
	Number of new connections						
	Total capital cost						
	Cost of reticulation						
Pre-paid Meters 20A	Connection cost						
	Number of new connections						
	Total capital cost						
	Cost of reticulation						
Pre-paid Meters 60A	Connection cost						
	Number of new connections						
	Total capital cost						
	Cost of reticulation						
Conventional Meters 60A	Connection cost						
	Number of new connections						
	Total capital cost						
	Cost of reticulation						
Business [Please provide info. per category of customer]	Connection cost						
	Number of new connections						
	Total capital cost						
	Cost of reticulation						
Farmers [Please provide info. per category of customer]	Connection cost						
	Number of new connections						
	Total capital cost						
	Cost of reticulation						

TABLE 2: Revenue

Revenue		*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
Pre-paid Meters < 8A	Average consumption						
	Tariff charged						
	Connection fee						
	Sales revenue						
Pre-paid Meters 20A	Average consumption						
	Tariff charged						
	Connection fee						
	Sales revenue						
Pre-paid Meters 60A	Average consumption						
	Tariff charged						
	Connection fee						
	Sales revenue						
Conventional Meters 60A	Average consumption						
	Tariff charged						
	Connection fee						
	Sales revenue						
Business [Please provide info.per category of customer]	Average consumption						
	Tariff charged						
	Connection fee						
	Sales revenue						
Farmers [Please provide info. per category of customer]	Average consumption						
	Tariff charged						
	Connection fee						
	Sales revenue						

National Electrification Programme Evaluation Project

SOCIO-ECONOMIC EVALUATION DATA REQUIREMENTS

Western Cape: Greater Khayelitsha Electrification Programme

Responsible team member: Cecile Thom
cecile@energetic.uct.ac.za tel (021) 650-2829

Project name: _____

Province: _____

Customer service region: _____

Project start date: _____

Date of evaluation: _____

Evaluation done by: _____

1. Availability of documented data

1. What information is available on the effect of electrification on social and other services in the area (particularly health, education, water supply and telecommunications)?

   1.1. Have any studies been undertaken?

   1.2. Does the utility have information on schools, clinics etc which have been electrified?

   1.3. Have any Customer Satisfaction Surveys been conducted in the programme area? If so, what were the main findings?

2. Community involvement in the electrification process

2.1. Were end-user communities involved in the *planning and prioritisation* of electrification projects? If so,

2.1.1. How was community participation structured?

2.1.2. What did their participation entail?

2.1.3. To what extent were women involved in the activities identified above?

2.1.4. What problems were experienced?

2.1.5. What worked well?

2.2 Which end-users' energy needs were considered during electrification planning:

2.2.1 Households

2.2.2 Agricultural needs

2.2.3 Water supply needs

2.2.4 Other (clinics, schools etc)

2.3 Were end-user communities involved in the *implementation* of electrification projects (including construction)? If so,

2.3.1 How was community participation in the implementation process structured?

2.3.2 To what extent were women involved in implementation activities?

2.3.3 What problems were experienced?

2.3.4 What worked well?

2.4 Are end-user communities involved in a structured way in addressing ongoing issues related to electricity services (for example, ensuring service and supply quality, addressing non-payment)? If so,

2.4.1 What does their ongoing involvement entail and how is it structured?

2.4.2 To what extent are women involved in these activities?

2.4.3 What problems are being experienced?

2.4.4 What works well?

3. Infrastructure and development planning coordination

3.1 Have any other infrastructural and service development projects been undertaken in the area in the period 1994-1999? (e.g. water supply, sanitation, telecommunications, roads, clinic building, school building, postal services, local government offices)

3.2 Was there any co-ordination of electrification planning with other services? If so, please specify how this worked.

3.3 Was there any co-ordination with broader development plans for the area (such as development corridors, long-term settlement growth planning etc)? If so, please specify how this worked.

4. Electrification of different facilities/users

4.1 How many end-users in the following categories (best estimates where exact figures are not available) have been electrified:

4.1.1 Households

4.1.1.1 In formal urban areas

4.1.1.2 In informal urban areas

4.1.1.3 In high density rural areas

4.1.1.4 In areas where electrification was not 'economically viable'

4.1.1.5 Households registered as poor for Equitable Share subsidies

4.1.1.6 Of different income levels

4.1.2 Businesses

4.1.2.3 Small businesses

4.1.2.4 Medium and large businesses/industries

4.1.2.5 Small farmers

4.1.2.6 Commercial farms

4.1.3 Social services

4.1.3.1 Schools

4.1.3.2 Clinics/health centres/hospitals

4.1.3.3 Community halls

4.1.3.4 State-funded welfare centres

4.1.4 Infrastructure/services

4.1.2.3 Water supply schemes

4.1.2.4 Government offices

4.1.2.5 Telecomm sites

4.2 Are there end-users in these categories which have not been electrified, although they are located in the project area? If so,

4.2.1 Which are these?

4.2.2 What is the estimated total number of potential customers in the area?

4.2.3 Why have some not been connected?

4.2.4 Will they be connected in the future?

5. Affordability issues

5.1 What percentage households cannot afford the connection costs (e.g. % of households who do not take connections)?

5.2 What percentage of households had to be disconnected because they could not pay for the electricity service?

6. The type and quality of service provided

6.1 Is there any assistance with house wiring (e.g. advice on low-cost but safe methods, access to materials, training)?

6.2 What metering options are provided?

6.3 Do the pre-payment meters provided operate with tokens or keyboards?

6.4 Do the prepayment meters have a display, which shows the exact number of units available?

6.5 Are there any mechanisms to assist with appliance purchase (e.g. free appliances, or financing schemes)?

6.6 What information on electricity is provided to *new consumers* (e.g. on efficient and good quality appliances; efficient and safe use of appliances, cost of electricity vs other fuels)?

6.6.1 How is this information provided to customers (nature of education, information and/or demonstration programmes)? *(Get copies of materials such as pamphlets, posters, tariff brochures etc)*

6.7 Is there *continued marketing* of the electrification within the target communities (i.e. to existing customers)? How is this done?

6.8 At which kind of outlets (e.g. general stores) do customers pay for electricity and/or buy prepaid tokens?

6.9 What is the maximum distance that customers have to travel to these?

6.10 What are the business hours of these outlets?

6.11 Where can customers make enquiries or report problems (vending stations, walk-in centres, call centres)?

6.12 What is the maximum distance that customers have to travel to these?

6.13 How many queries/problems are generally lodged per month?

6.14 How long does it take on average to respond to the queries/problems?

6.15 What training is provided to people at vending stations who deal with customer queries?

6.16 What is the ratio between customers and service staff members in the utility/distributor?

7. Non-payment/ tampering with meters

7.1 Is non-payment a significant problem in the area?

7.2 How has the issue of non-payment of electricity been dealt with?

7.3 Have you experienced any problems with tampering/bypassing of meters?

8. Appliances in households

8.1 Have any studies been done in the project areas on appliance acquisition in electrified communities? If yes,

8.1.1 Which appliances (including lights) are most common?

8.1.2 Where do people purchase their electrical appliances?

8.1.3 Do they purchase new or second-hand appliances?

8.1.4 What do they do with broken of faulty appliances?

8.1.5 Are there any appliance repair services within the communities? How many are they?

8.2 For what income-generating purposes do households commonly use electricity?

9. Electrification of social services

9.1 Clinics

9.1.2 What electrical equipment has been provided to clinics in the area?

9.1.3 What are the purposes for which electricity is used by the clinics?

9.1.4 Do the clinics provide 24-hour and emergency services?

9.1.5 Do the clinics have vaccine fridges?

9.1.6 Have clinic staff been provided with electrical/energy appliances for their personal needs?

9.1.7 Is the electricity supply sufficiently reliable, or is there is a need for a standby generator?

9.2 Schools

9.2.1 What electrical equipment have been provided to schools in the area?

9.2.2 What are the purposes for which electricity is used by the schools?

9.2.3 Are evening classes offered at the schools?

9.2.4 Does the school offer audio-visual, distance- and computer-based teaching?

9.3 Water provision

9.3.1 Has the availability of electricity helped the supply of water to the area?

10. Social benefits of electrification

10.1 Have any studies been done in the area concerning improvements in the quality of life of the electrified communities and socio-economic status of communities since electrification? What were:

10.1.1 Changes in households' energy expenditure

10.1.2 Improved quality of energy services

10.1.3 Access to new energy services

10.1.4 Improved security

10.1.5 Improved health, safety (from hazards/pollutants)

10.1.6 Improved income generating opportunities

10.1.7 Improved services (health, education, telecommunications, water)

10.1.8 How different groups in the community have been affected, including women, youth the poorest and the elderly?

11. Economic benefits of electrification

11.1 Have any studies been undertaken on the effect of electrification on economic activity in the area?

11.2 Does the utility have records of businesses and other income generation activities which have been established since electrification?

11.3 If possible provide information on:

11.3.1 How many businesses (formal and informal, if available) existed in the area before electrification?

11.3.2 How many businesses (formal and informal) currently exist in the area?

11.3.3 What percentage of these are commercial, service and manufacturing enterprises (rough estimate)?

11.3.4 What percentage of these are micro-enterprises (up to four employees), small (5-100 employees), medium (101-200 employees)?

11.3.5 Do all these businesses have access to electricity?

11.3.6 What are the main uses of electricity in these businesses? What in particular do the manufacturing businesses use electricity for?

11.3.7 Are there any businesses, which could not have existed without electricity?

11.3.8 Have any businesses significantly expanded their operations, and/or increased their turnover/profit since electrification?

11.3.9 Have any businesses closed down since electrification?

11.3.10 What are the biggest problems faced by entrepreneurs wanting to establish businesses in the area?

11.3.11 Are there any small business support programmes in the area which provide training, access to credit, and advice?

National Electrification Programme Evaluation Project

INSTITUTIONAL EVALUATION DATA REQUIREMENTS

Western Cape: Greater Khayelitsha Electrification Programme

Responsible evaluation team members:

Justice Mavhungu
justice@energetic.uct.ac.za, tel (021) 650-2420

Prof Trevor Gaunt
ctg@eng.uct.ac.za, tel (021) 650-2810

Project name: _____

Province: _____

Customer service region: _____

Project start date: _____

Date of evaluation: _____

Evaluation done by: _____

1. The implementing organisation

1.1. Describe the nature of the organisation responsible for undertaking electrification in this area (general description, ownership/shareholding, etc)

1.2. What is the composition of the Board of Directors or equivalent structure? (if relevant)

1.3. Provide information on its basic organisational structure (e.g. organogram)

1.4. Was this organisation responsible for electrification from the start in this area? If not, please specify:

1.4.1. when the organisation/distributor was established, and why

1.4.2. the name of the originally responsible distributor.

1.5. What is the organisation's policy regarding confidentiality of financial and other information?

2. Links with national planning/policy

2.1. How were national electrification policies and targets communicated to the organisation/distributor?

2.2. What were the main policies and targets coming from a national level?

2.3. Did your organisation provide feedback to the national level regarding targets etc? How was this done?

2.4. Was this 'national to regional' communication flow / coordination effective? Please comment, particularly with regard to future improvements.

3. Local government coordination & role

3.1. Is local government a part of the implementing organisation?

3.1.1. If yes, specify:

3.1.1.1. level of local government official involved

3.1.1.2. responsibilities within the organisation

3.1.2. If no, clarify:

3.1.2.1. whether they have any structured involvement in the programme, and what this is.

3.2. Is the above an effective co-operational method with local government? Please give pro's and con's and suggest improvements for future programmes.

4. Objectives of programme

4.1. What programme implementation targets/objectives existed (milestones, performance indicators, etc):

4.1.1. nationally imposed

4.1.2. within the distributor

4.2. Did the project (as planned and constructed) meet all its targets/objectives?

4.3. If not, what objectives could not be achieved, and why?

4.4. What objectives were modified during the project? When did this occur?

4.5. What new objectives were identified during the project? When were these adopted?

5. Management of implementation

5.1. Who did the implementation? (external/local contractors, the utility/distributor, etc)

5.2. How were objectives/targets translated into implementation plans? (contractual agreements, internal workplans, etc)

5.3. How was feedback to the distributor management provided on progress regarding meeting targets/objectives? (regular progress reports, meetings, etc)

5.4. Did this feedback (if any) allow suitable corrective action to be taken if necessary?

5.5. If local contractors were used, did they satisfy the timeframe requirements of implementation in general?

5.6. Please comment on the suitability of a distributor/organisation structured in this way to *undertake electrification implementation* (pro's and con's), and provide suggestions for improvements to help future programmes. Please be specific on any problems experienced.

6. Sustainable service provision

6.1. Which individual has overall responsibility for the successful operation and maintenance of the completed programme?

6.2. Describe the different management staff involved in operating and maintaining a 'completed' project (maintenance, revenue collection, etc).

6.2.1. How is this responsibility allocated in different areas within a progrogramme/region?

6.3. Please comment on the suitability of a distributor/organisation structured in this way to *operate electrification programmes over the long-term* (pro's and con's), and provide suggestions for improvements to help future programmes.

7. Capacity building

7.1. Would you say that the way electrification was implemented and the way programmes are operated allowed for substantial capacity building of management-level staff from previously disadvantaged backgrounds?

7.1.1. How can this be improved in future programmes?

National Electrification Programme Evaluation Project

ENVIRONMENTAL EVALUATION DATA REQUIREMENTS

Western Cape: Greater Khayelitsha Electrification Programme

Responsible team member: Harald Winkler
harald@energetic.uct.ac.za, tel (021) 650-2521

Project name: _____

Province: _____

Customer service region: _____

Project start date: _____

Date of evaluation: _____

Evaluation done by: _____

1. Environmental issues and performance

- Has the project led to reduced use of fuel wood and hence to reduced deforestation?
  - Is there any evidence of reduced deforestation ?
  - Are there any sustainably managed woodlots?
- Has vegetation been removed in construction infrastructure
  - Is there any evidence of soil erosion associated with power lines or other infrastructure?
- Has water use increased due to more use of electric water pumps?
  - Is there evidence of increased water pumping, e.g. for irrigation.
- Have air pollution levels been reduced ?
  - Are outdoor / ambient levels of SOx, NOx, particulates being measured? If so, what are they? (or is any such information held by others?)
- Has indoor air pollution decreased?
  - Is this being monitored in any way?
  - Is use of wood, coal and paraffin indoors continuing? (or are there any studies on this issue?)
  - Has in the incidence of respiratory disease decreased (ask distributor's community development / liaison staff, failing which ask them to enquire at a local clinic or hospital, or get an interview with a health worker)
- Are HV lines close to communities (preferably >400m away)?
- Are 'bird flappers' in place on power lines?

2. Conformance with environmental laws, regulations and procedures

- Has approval been obtained for the project i.t.o. the EIA regulations ?
  - A letter from DEAT / provincial environmental department
- Does the distributor have an environmental policy?
  - If yes, obtain the document
  - Is there a mechanism for updating the policy?
  - Was this used to guide the electrification projects in question?
  - Did the projects conform to the policy requirements? Were there problems in meeting these requirements?

- Does the distributor have environmental plans, either strategic or annual?
- Does the distributor have an environmental management system?
  - If yes, is it ISO 14001 compliant, or does it meet internationally-agreed standards?

3. Resources allocated to environmental protection

- What amount has been set aside in the budget for environmental issues (R/yr)?
- Are the responsibilities for environmental management clearly defined?
  - Who has responsibility for environmental management?
  - Have staff with environmental responsibility been trained?
    - Obtain training records
  - Do staff know what the environmental policy of the distributor is? (Ask a few workers)
- Does the distributor have any staff whose job description includes environmental issues?
  - Number of staff
    - full time dedicated
    - part of the time
  - Job description / key responsibilities
    - Do they know what environmental impacts may be associated with every aspect of their operation?
    - How do they track their achievement of objectives and targets?

National Electrification Programme Evaluation Project

TECHNICAL EVALUATION DATA REQUIREMENTS

Western Cape: Greater Khayelitsha Electrification Programme

Responsible team member: Prof Trevor Gaunt
ctg@eng.uct.ac.za tel (021) 650-2810

Project name: _____

Province: _____

Customer service region: _____

Project start date: _____

Date of evaluation: _____

Evaluation done by: _____

Broad question 1: What outputs were achieved by the project?

1.1 What physical indicators of connections achieved and cost incurred?

	1994	1995	1996	1997	1998	1999	2000
Number of domestic customers connected in the programme?							
Number of households in project area not connected?							
Total households in area							

Number and category (= *or <25 kVA*) of non-domestic customers connected?	1994	1995	1996	1997	1998	1999	2000
Institutional (police, schools, clinics, pumping, etc)							
Commercial (business)							
Industry							
Number and category (*>25 kVA*) of non-domestic customers connected?	1994	1995	1996	1997	1998	1999	2000
Institutional (police, schools, clinics, etc)							
Commercial (business)							
Industry							

Length of **MV** feeder in reticulation?							
Length of **LV** feeder in reticulation?							

Number of transformers installed?							
Total capacity of transformers installed? [kVA]							

Was blanket or targeted connection policy adopted?	Blanket / Targeted	
Describe if the above policy changed during the period		
What time (range and mean) elapsed between customer making application and switch on?	Mean [days]	Range [days] – min/max
Describe if these times changed during the period		

What institution was responsible for providing the bulk supplies?	
At what voltage is the bulk supply received?	
Was bulk supply (new or reinforcement) needed?	No / Yes
If yes, provide details of line lengths, rating, upgrading, voltage regulators, etc and timing	

What institution was responsible for providing the link feeders?	
Typical length [km] per project	
Typical capacity [kVA-km] of link feeders	

Is street or area lighting installed?	Yes/No
If yes, what type?	High mast / Street lighting / Both
What authority was responsible for installing the lighting?	
Luminaire rating [W]	
Total number of luminaires installed	
Total number of lighting poles (not including reticulation poles)	
What lighting standard was adopted?	

1.2 What project quality was achieved? On time, in budget, to specification?

When was the project started?	
… and completed?	
Were all milestone dates met?	Yes/No
If applicable, what milestone dates were missed, and what caused the delays?	
Did project comply with preliminary project plan and standards without changes being made during construction?	Yes / No

If changes were made, what were they and why were they needed?	
Have modifications have been needed after commissioning?	No / Yes
If yes, what were they and why were they needed?	

Broad question 2: How well was the project planned and implemented?

2.1 How was technical planning undertaken?

What technical planning and design guidelines, methods or software were used?	
Was planning and design by utility in-house, consultant or construction contractor? If design policy changed during the programme, describe the nature and reasons for the change.	
Was formal quality check of planning and design carried out and the results recorded? - by whom?	No / Yes, recorded by:
Were design reports prepared and approved for every stage of the programme (each sub-project)? If no, explain how the design was assessed and approved.	Yes / No

2.2 Were planning and design parameters appropriate?

What planning and design parameters were adopted for: • source voltage? [kV] • voltage variation? [% above and below nominal voltage at customer] • customer loads? [characteristic admd in kVA or A (specify)] • average domestic consumption [kWh/customer/month]	
What customer circuit breaker ratings were offered to customers?	
If circuit breaker rating alternatives were offered, what proportion of each rating was expected at the planning and design stage?	
What was the basis of choice of the planning and design parameters?	
If changes were made in the planning and design parameters during the programme, describe the nature and time of the change and the reason for it.	
What are the most significant differences between the design parameters and the conditions experienced?	

2.3 What technologies were adopted?

Were single-phase systems considered?	Yes/No			
If so, what was the result?				
Total lengths of feeders (lines and cables) **[km of feeder]** in programme Type of insulation	bare	covered	abc	cable
MV 3-phase [km] MV 2-phase [km] MV SWER [km]				
LV 3-phase (4 or 5 wire) [km] LV bi-phase or dual-phase [km] LV single phase and neutral [km]				

Proportion of various types of customer services connections	% of total service connections
• Overhead service connections and service entry through wall or roof	
• Overhead service connections and service entry by underground cable	
• Underground service connections and service entry	

Total numbers of meters?	Three phase	Single phase
• Prepayment		
• Credit		
• Current limiting		

2.4 How well was the project constructed and commissioned?

What proportion [%] of construction was	1994	1995	1996	1997	1998	1999	2000
• by utility in-house teams?							
• conventional contractor?							
• local labour intensive teams?							
Person-days worked by local labour, as proportion of total labour input?							

Number of persons recruited and trained from community?	1994	1995	1996	1997	1998	1999	2000
• line construction							
• service connections							
• house wiring							
• appliance repair							

No of construction persons employed by utility post-construction? (in 2000)	
Were existing trained electrical manpower within 15 km of project area employed in the project?	Yes/No
If yes, how were they selected?	

2.5 What innovations were made?

What new technologies, techniques, project processes, materials, etc were adopted in this project?	
How were proposed innovations formally reviewed in this project/programme?	

2.6 What standardisation was achieved or attempted?

From where were project standards sourced?	
What changes were made to standards during the project/programme?	
How were changes to standards monitored?	

2.7 What problems arose/lessons learned?

What difficult technical problems arose during the projects and how were they solved?	
What lessons were learned from the projects?	

2.8 Project context?

What proportions [%] of the programme are:	100%	What is the distributor's definition of these terms?
• urban?		
• peri-urban?		
• rural?		
• deep-rural?		

Broad question 3: What outcomes are being achieved?

3.1 Affordable and sustainable operation and use

In what condition is the technical infrastructure, taking into account its age?	
What is the expected remaining lifetime of the installation, with reasonable care and maintenance? [Years]	
What will impose the limit on the life of the system?	
During 2000 how many [number of] customers were: • newly connected? • disconnected and recovered? • temporarily disconnected and re-connected?	
Total number of customers in programme/project area at end-2000?	
How do the tariffs in the programme area compare with neighbouring Distributor areas?	
How far away is the boundary? [km]	
Does the Distributor consider this a "successful" project? Justify.	Yes / No. Justification:

3.2 Quality of supply, service and safety

Compliance with QOS standards (NRS 047 and 048)	Required?	Demonstrated by testing?	Records kept?
	Yes / No	Yes / No	Yes / No

Safety since projects commissioned?	1994	1995	1996	1997	1998	1999	2000
Number of electrical accidents reported?							
Number of persons injured?							
Number of fatalities?							

Outage data during **2000**:				
Total number of outages?				
Average outage duration? [minutes/year/customer]				
Customer-hours lost by outages?				
Complaints received of: [number during 2000]:	Low voltage	Interruptions	Meter failure	Other? (Describe typical complaints)
Customer satisfaction with electrification?				
How is customer satisfaction assessed?				

Broad question 4: How efficient and effective is the operation and use of the electrification facilities?

4.1 Post-programme operation, maintenance and extension by the utility

What organisation is now responsible for the system operation, maintenance and extension?	Name:
What is the nature of the organisation, eg local authority utility, community or contractor?	
Has the system been extended since the projects/ programme completed? If yes, how many further customers have been connected?	No / Yes …
Have customers been upgraded since the projects/programme completed? If yes, how many and to what?	No / Yes …
Was the technology/design choice able to meet users' changing needs?	Yes / No-describe:
How does the technology facilitate extension or upgrading of the system?	
What significant problems have arisen in operating the system (efficiency, skills, costs, etc)?	
What significant problems have arisen in maintenance?	
What alternatives have been considered for changes to the operation, maintenance and extension? Why have these not yet been implemented?	

4.2 What cost recovery activities?

By what processes is energy supply managed?		
Total energy sales during 2000 [MWh]		
What is the extent of losses compared with sales?	***technical losses***	***non-technical losses*** (theft of service and administrative error)
[%] of ***energy sales***		
On what is this information based?		

APPENDIX 3

Key data sheets for evaluated programmes

Durban Metro Electrification Programme: KEY DATA SHEET

Initial stated programme objective
"The electrification for all programme short term and long term objectives respectively were to: Provide appropriate electrical infrastructure to the less developed areas in the Greater Durban area. Through this initiative, the long term objective was to improve the standard of living of the urban residents, thereby facilitating a more effective participation in the economic activities in the urban region and reducing the impact of urbanisation on the environment in the sub-region.

Institutional responsibilities	
Distribution rights	Durban Metro Electricity
Implementing agent	Durban Metro Electricity
Local authority	Formerly Durban Metro City Council now, Durban Unicity

Household connections (initial target = 168 000 hhs by 1996)						
Period	*1994/5*	*1995/6*	*1996/7*	*1997/8*	*1998/9*	*1999/00*
Connections	24 632	22 432	19 468	16 622	16 302	11 992
Cumulative connections	24 632	47 064	66 532	83 154	99 456	111 448
Average monthly demand/Hh	110 kWh	113 kWh	126 kWh	131 kWh	138 kWh	146 KWh

Financial and economic indicators			
Average cost/conn	R4 628	*Total capital cost for programme*	R517m
Financial NPV	-R165,7m	*Economic NPV*	-R11m
Financial IRR	8.8%	*Economic IRR*	7.7%
Subsidy required	R8m or R5.98 per customer/month		

Technical information			
Tech losses	3% (approx.)	*Metering*	Prepayment, with split meters currently in use
Non-tech losses (% domestic sales)	4.5 % (approx.)	*Connection capacity*	60A / hh, later reduced to 40A/hh
Electricity vending	Applicants with collateral and security, mostly shop owners	*Reticulation*	Mostly MV bare conductor, LV ABC (GERMAN), Overhead service connection.
Design ADMD	1.5kVA	*Lighting*	Street lighting is part of the project

Strengths and weaknesses	
Strengths	*Weaknesses*
• Vending from local businesses supports entrepreneurship and improves security	• Programme not financially or economically viable without subsidisation
• Low non-technical losses (4,5 % of sales)	• Low consumption limiting social benefit
• Appliances supplied with the connection have boosted consumption	• System overdesigned for household needs (60A supply initially)

Orange Farm Electrification Programme: KEY DATA SHEET

Initial stated programme objective
"To provide urban infrastructure in support of the economic development of Khayelitsha as part of the Greater Cape Town Metropolitan area and thereby both raise the standard of living of the communities and contribute to the protection of the environment."

Institutional responsibilities	
Distribution rights	Eskom
Implementing agent	Eskom Central Region
Local authority	Transvaal Provincial Administration, now

Household connections						
Period	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
Connections	3468	2714	834	879	2075	5378
Cumulative connections	22523*	25237	26071	26950	29025	34403
Average demand/ mnth/hh	45 kWh	50 kWh	51 kWh	80 kWh	72 kWh	30 kWh

* - connections were made prior to 1994

Financial and economic indicators			
Average cost/connection	R 2156 (approx)	*Total capital cost for programme (7 yrs)*	R 74.14 million (approx)
Financial NPV	-R61 103 000	*Economic NPV*	-R24 186 000
Financial IRR	2% (15.5% required)	*Economic IRR*	4.3% (8% required)
Subsidy required	R74.14 million (6.5c/kWh or R6.87hh/mth)		

Technical information			
Tech losses	~ 4%	*Metering*	Prepayment
Non-tech losses (% domestic sales)	~163%	*Connection capacity*	60A / hh
Electricity vending	Community nominated households	*Reticulation*	Daisy chain (now using 'maypole')
Design ADMD	1.5kVA / hh	Lighting	Not included

Strengths and weaknesses	
Strengths	*Weaknesses*
• Eskom Central Region was efficient and generally met its annual targets • The utility realised the need to involve the communities in the electrification process, and although this was done a few years after starting with the programme, this good relationship with the community has contributed to the success of the programme • Eskom supplies all the customers in Orange Farm and this facilitates planning, and ensures clarity of responsibilities • Eskom supports small business development not only with electricity but with other critical needs often expressed by small business enterprises such as business skills development, and other business related training	• Programme not financially or economically viable • Low consumption limiting social benefit • Little information available from Distributor on some programme aspects – limiting proper evaluation • Lack of wiring has limited the use of electricity in electrified households especially for lighting purposes. • Lack of financial assistance with regards to appliance acquisition means that only few households can afford to use electricity • Separation of street lighting from general electrification by Eskom Central Region has resulted in duplication of lines, resulting in unnecessary spending of public money • The utility has been negatively affected by meter-tampering, consequently, they have had to install new meters on the outside, thereby reducing the benefits of metering units in enabling customers to know which appliances consume more energy.

Greater Kimberley Electrification Programme: KEY DATA SHEET

Initial stated programme objective
"To support the socio-economic development of deprived communities in 10 prioritised urban and rural settlements within the Greater Kimberley customer service region through the upgrading of electricity supply and internal reticulation, thereby improving people's quality of life."

Institutional responsibilities	
Distribution rights	Kimberley City Council (KCC)
Implementing agent	KCC through the Electrical Sub Directorate
Local authority	Greater Kimberley Local Authority since 1994/5 capital budget year

Household connections (initial target = 12 000)						
Period	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Connections		963	796	300	569	553
Cumulative connections		963	1759	2059	2628	3181
Av kWh/mth	Uncertain- av. of 48kWh/mth for total period, but research indicates 135 kWh in 2000					

Financial and economic indicators			
Average cost/connection	R2,463	**Total capital cost for programme**	R7,833,938
Financial NPV	-R1,421,000	**Economic NPV**	R1,127,000
Financial IRR	11.8%	**Economic IRR**	9.5%
Subsidy required	R60,285 (1.0c/kWh or R1.58/hh/month). These numbers should be understood in the context of existing NER and CMIP subsidies to KCC		

Technical information			
Tech losses	10%	**Metering**	Prepayment
Non-tech losses (% domestic sales)	Not known (8% figure given by KCC)	**Connection capacity**	60A / household
Electricity vending	Municipal offices, vending stations, pay points.	**Reticulation**	Daisy chain (now using 'maypole')
Design ADMD	2kVA / household	**Lighting**	Included (hi-mast)

Strengths and weaknesses	
Strengths	**Weaknesses**
• KCC was efficient and met targets cost-effectively • Programme was financially viable given the subsidies received, and economically viable • KCC embraced social goals • No connection fee approach avoids the problem of connection cost affordability	• No community involvement in planning and implementing • Vending stations are not run by the community thereby denying the opportunity a little economic benefit from operating vending stations • Low consumption limiting social benefit

Venda Electrification Programme: KEY DATA SHEET

Initial stated programme objective
"To support the economic development of mainly high density rural settlements in the old Venda Area through the provision of affordable and sustainable electricity thereby improving the quality of life."

Institutional responsibilities	
Distribution rights	Eskom
Implementing agent	Eskom Distributor – Thohoyandou Area
Local authority	Thohoyandou-Malamulele, Makhado, Mutale, Watervel

Household connections						
Period		*1996*	*1997*	*1998*	*1999*	*2000*
Connections	Eskom took over in 1996 – no data from before this	2 480	5 453	4 000	63 439	24 497
Cumulative connections		2 480	7 933	11 933	85 372	109 869
Average demand/ month / hh (kWh)	Prepaid 20A:	55	57	58	60	
	Prepaid 60A:	150	155	159	164	
	Conventional 60A:	250	258	265	273	

Financial and economic indicators*			
Average cost/connection	R2 845	**Total capital cost for programme**	R217 million (approx)
Financial NPV	-R88 782 000	**Economic NPV**	R91 323 000
Financial IRR	0.5%	**Economic IRR**	13.1%
Subsidy required	R4.09 million (3.3c/kWh or R4.07/household/month)		

* - actual capex not available, therefore values back-calculated from average connection costs given. Data thus not accurate

Technical information			
Tech losses	unknown	**Metering**	Prepayment
Non-tech losses	unknown	**Connection capacity**	60A / household 20A/household (since 1999)
Electricity vending	General stores	**Reticulation**	unknkown
Design ADMD	unknown		

Strengths and weaknesses	
Strengths	**Weaknesses**
• Vending stations have been a source of income generation for some households. • Electrification has also generated a lot of business activities like bakeries, welding, sewing, photocopying shops, and hair beauty saloons. • Electrification has also contributed to the improvement in the welfare and security of the community.. • Very good relationship between Eskom and the community leadership has contributed a lot to	• Billing was found to be a problem as well as unplanned power outage. • Lack of wiring has limited the use electricity in electrified households, especially for lighting purposes. • Lack of financing mechanism for appliance purchase has also limited the use of electricity amongst low-income electrified households. • Some contractors were not following set-down guidelines, especially the black economic

the success of the electrification programme. • Good communication amongst community structures has helped in diffusing wrong perceptions about the electrification process. • The economic benefits of the electrification programme were substantial, despite the project not being financially viable. Economically, the returns were significantly above the threshold value	empowerment groups. • Some contrators were not going to the right leadership and this often led to misinformatilon that created problems between certain leaders and the communities. • It was learnt that black economic empowerment contractors who do not win tenders for contracts are the ones involved in illegal electrical connections. • There was a report of slow response by Eskom to electrification applications in some cases. • Many communities have problems with the Eskom condition that about 80% of the households must have reliable employment before a paying point is allowed in the community. This has led to restricted number of pay points leading to high transportation costs in getting access to prepaid cards. • Sometimes personal interests of certain leaders were overriding the interests of the broader communities. This has led to inequitable share of electrification amongst communities, for example, 5 out of the 9 wards in the Mutale Municipality have no electrified household at all.

Mmabatho Electrification Programme: KEY DATA SHEET

Initial stated programme objective
"To support the economic development of various formal and informal towns and rural settlements in the North-West Province through the provision of affordable and sustainable electricity thereby improving the quality of life."

Institutional responsibilities	
Distribution rights	Eskom
Implementing agent	Eskom Distributor – North Western region
Local authority	Central District Council

Household connections						
Period	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
Connections	Eskom took over in 1995 only	12 899	13 300	12 141	9 316	21 229
Cumulative connections		12 899	26 199	38 340	47 656	68 885
Average demand/ month / household		104kWh	104kWh	84kWh	120kWh	124kWh

Financial and economic indicators (NB – see note*)			
Average cost/connection	R 3,561 (approx.)	**Total capital cost for programme**	R 245 million (approx.)
Financial NPV	-R143,383,000	**Economic NPV**	-R72, 997, 000
Financial IRR	2.5% (15.5% required)	**Economic IRR**	2.1% (6% required)
Subsidy required	R4.94 million (3.8c/kWh or R5.98/household/month)		

* - actual capex data was not available, so figures reported here are back calculated, and thus not accurate

Technical information			
Tech loss	10% (estimate.)	**Metering**	Prepayment
Non-tech losses (% domestic sales)	uncertain	**Connection capacity**	60A / household
Electricity vending	General stores	**Reticulation**	Daisy chain (now using 'maypole')
Design ADMD	1.5kVA / household		

Strengths and weaknesses	
Strengths	**Weaknesses**
• Mmabatho programme was efficient and met targets cost-effectively • Mmabatho embraced social goals • There appears to have been some economic benefit (small buwsiness growth) from electrification	• Programme not financially or economically viable • Community is not centrally involved in planning and implementing • Low consumption limiting social benefit • Little information available from Distributor on some programme aspects – limiting proper evaluation

Khayelitsha Electrification Programme: KEY DATA SHEET

Initial stated programme objective
"To provide urban infrastructure in support of the economic development of Khayelitsha as part of the Greater Cape Town Metropolitan area and thereby both raise the standard of living of the communities and contribute to the protection of the environment."

Institutional responsibilities	
Distribution rights	EskomEskom
Implementing agent	PN Energy Services (Pty) Ltd – joint venture company owned by EskomEskom, Electricite de France, and East Midlands Electricity.
Local authority	Tygerberg Municipality since 1996 – before this Lingelethu West Council

Household connections (initial target = 33000 hhs by 1997)						
Period	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
Connections	23 334	10 145	152	755	186	312
Cumulative connections	23 334	33 479	33 631	34 386	34 572	34 884
Average demand/ mnth/hh	47 kWh	47 kWh	71 kWh	97 kWh	103 kWh	109 kWh

*Financial and economic indicators**			
Average cost/conn	R 2368 (approx)	*Total capital cost for programme*	R 87 million (approx)
Financial NPV	-R40 056 000	*Economic NPV*	-R12 265 000
Financial IRR	7.8% (14% required)	*Economic IRR*	6.3% (8% required)
Subsidy required	R1.44 million (2.3c/kWh or R3.44/hh/mth)		

* - actual capex data was not available, so figures reported here are back calculated, and thus not accurate

Technical information			
Tech losses	4% (approx)	*Metering*	Prepayment
Non-tech losses (% domestic sales)	Uncertain - approx 33%	*Connection capacity*	60A / hh
Electricity vending	Community nominated households	*Reticulation*	Daisy chain (now using 'maypole')
Design ADMD	1.5kVA / hh		

Strengths and weaknesses	
Strengths	*Weaknesses*
• PN Energy Services was efficient and met targets cost-effectively • PN embraced social goals • Non-technical losses were reduced from 80% on 1994 to approx 5% in 2000 • Community involvement in planning and implementing • Innovative PN vending system increasing connection cost affordability • Vending from nominated households, thus economic benefit to community members •	• Programme not financially or economically viable • Low consumption limiting social benefit • Little information available from Distributor on some programme aspects – limiting proper evaluation • PN is a private company, so they can withhold some information necessary for evaluation. • System over-designed for household needs (60A supply) • Division of household and other customer responsibilities may result in schools, clinics and businesses not receiving adequate support

Mpumalange and Kwanobuhle Programmes: KEY DATA SHEETS

		TED: MPUMALANGA	KWANOBUHLE : E CAPE
Date Evaluated		**September 1999**	**April 2001**
Initial stated programme objective			
Narrative Description of Output Objective (Outcome Objective not stated)		To ----supply electricity to the areas of Nsikazi, Nkomazi and Mswati, Mpumalanga - for the electrification of households and commercial in existing/ new developments, with supporting infrastructure for electricity distribution to previously unelectrified areas.	To provide urban infrastructure in support of the economic development of KwaNobuhle as part of the Nelson Mandela Metropolitan Municipality and thereby both raise the standard of living of the communities and contribute to the protection of the environment.
Est. Pot. Users		160 000	21 000
Location		urban and rural	Urban
Institutional responsibilities			
Distribution Rights		TED (Pty) Ltd	Uitesco
Implementing Agent		TED (Pty) Ltd	Eskom (Phase I) and Uitesco (Phase II)
Local Authority		Mpumalanga Province	Uitenhage TC (now NMMM)
Total capital cost of electrification programme			
Rm		R192,1 million	R57 634 million
Implementation			
Years		1990 to 1999	1991 to 2000
% Electrified		50%	100%
Electrification planning strategy			
Approach		Target/market driven electrification	Blanket electrification
Connection Rate **houses/1000 persons/year**		14	14
Meeting Basic Energy Needs of the Disadvantaged: A) Number of Connections			
Households		80 383	20 574
Schools		0	15
Clinics		0	6
Total		80 383	20 723
Meeting Basic Energy Needs of the Disadvantaged: B) Access Costs to Consumer			
Real Connect-ion Fee	**Fee**	R65	R80
	Ready Board	R258	R 0
	Total	R323	R80
Tariff for pre-paid 60 Amp		33,4 cents / kWh	32 cents / kWh
Average Monthly Usage		211kWh/mth	165 kWh
Average Electricity Purchases/m		R 70 / m	R53 / m
Formal House Wiring		R2 500	Labour R2 000, materials R, Coc R, Total
Meeting Basic Energy Needs of the Disadvantaged: C) Supply Costs to Distributor			
Average cost/connection		R2 200	R2 781
Metering		Conventional and pre-payment	Pre-payment metering: extra capital and installation costs @ R300 per point, replacement of ready Boards R476 each
Vending		TED	Uitesco and some businesses

	TED: MPUMALANGA	KWANOBUHLE: E. CAPE
Date Evaluated	September 1999	April 2001
Improving Energy Governance: A) Shareholding and Board Membership		
Shareholding	LET 50% Eskom 50%	3 equal shareholders: UTC, Midlands Chamber of Industry, Eskom
Directors	LET 4 Eskom 4	2x Eskom, 2 x MCI, 4 x UTC: Total 8

Improving Energy Governance: B) Sources of Funds					
Private Sector	nil		MCI	R 2m	Equity
DBSA	R162,7m	Loans	Eskom	R 2m	Equity
Eskom	R3m	Equity	Uitesco	R 5,2m	Equity
NER	R40m	Grant	UTC	R 1,2m	Grants
LA	R29m	assets	UTC (NER)	R17,7m	Grants
			DBSA	R29,4m	Loans
Total	**R234.7m**		**Total**	**R57,6m**	

Improving Energy Governance: C) Financial Parameters			
	Estimate	Actual ('98)	
Gearing (in %)	71	70	
Current Ratio	2,5:1	1,52:1	
Quick Ratio	0,9:1	1,4:1	
Solvency Ratio	N/A	1,36:1	
IRR	15-19	21	

Improving Energy Governance: D) Loss Control		
TLs	10%	9,65%
NTLs	8%	7,81%
Improving Energy Governance: E) Outages		
Av. Duration, Hours Lost	High but complies with NER 047/048	Very low: 4 mins 8.4 seconds average in 2000 2 385 hours 56 minutes (Total ESA)

	TED: MPUMALANGA		KWANOBUHLE: E. CAPE	
Date Evaluated	September 1999		April 2001	
Improving Energy Governance: F) Technical Design				
Design ADMD	1.2kVA / hh		2.0kVA / hh	
Connection Capacity	60A / hh		60A / hh	
Reticulation	Single cable service connection		Single cable service connection	
Stimulation of Economic Productive Capacity: Key Economic Indicators				
EIRR	Actual 11%	Estimated 9,6%	Actual 3,7% 6% required	0,9 Estimated 15,6%
Benefit-Cost Ratio	Actual 1,19	Estimated 1.15	Actual 0,96	Estimated 1,6 (discount rate 6%)
NPV per customer	Actual R1 221	Estimated R907	-R217 (Discount rate 6%) -R4 666 000	
Stimulation of Economic Productive Capacity: Employment Creation and Capacity Building				
Jobs on Construction	156 (not gender affirmative)		100 (not gender affirmative)	
Emerging Contractors	58 (not gender affirmative)		7 established with Maintenance Contracts (not gender affirmative)	
Stimulation of Economic Productive Capacity: SMME's Using Electricity				
Small farmers	sugar irrigation (NIEP)		NA	
Electricity linked ? enterprises	numerous in Nsikazi		numerous	
Registered Electricians	1		0	
Electrical Repair	0		0	
Environmental Sustainability				
Mitigation	None		Yes: PCB disposal Visual impacts in Phase II	No: visual impacts in Phase I
EMS	No – reliant on Eskom		No – reliant on Eskom	

STRENGTHS AND WEAKNESSES			
TED: MPUMALANGA		KWANOBUHLE: E. CAPE	
Evaluated September 1999		Evaluated April 2001	
Strengths	**Weaknesses**	**Strengths**	**Weaknesses**
Low capital cost per connection High average consumption Low losses TED was efficient and met targets cost effectively Ownership by the community reduced losses, increased payment levels Community involvement in management Community input to development Large number of BEE contracts issued Significant empowerment by local training and administration assistance to emerging contractors High rate of new connections High payment levels (>95%)	No financial support from surrounding developed areas Long lines and rural areas causes too many power failures Constant, high quality management and design needed to keep the network efficient and meet growing demand. TED has ceased functioning due to illegal take over by Eskom	Uitesco was efficient and met targets cost-effectively Uitesco embraced social goals Non-technical losses were reduced from 40% in 1994 to approx 7% in 1999 Community involvement in planning and implementing Innovative loss control system increasing revenue Uitesco able to provide all details and costs as the operation is "ring fenced"	Programme not financially or economically viable Low consumption limiting social benefit Poor empowerment strategy

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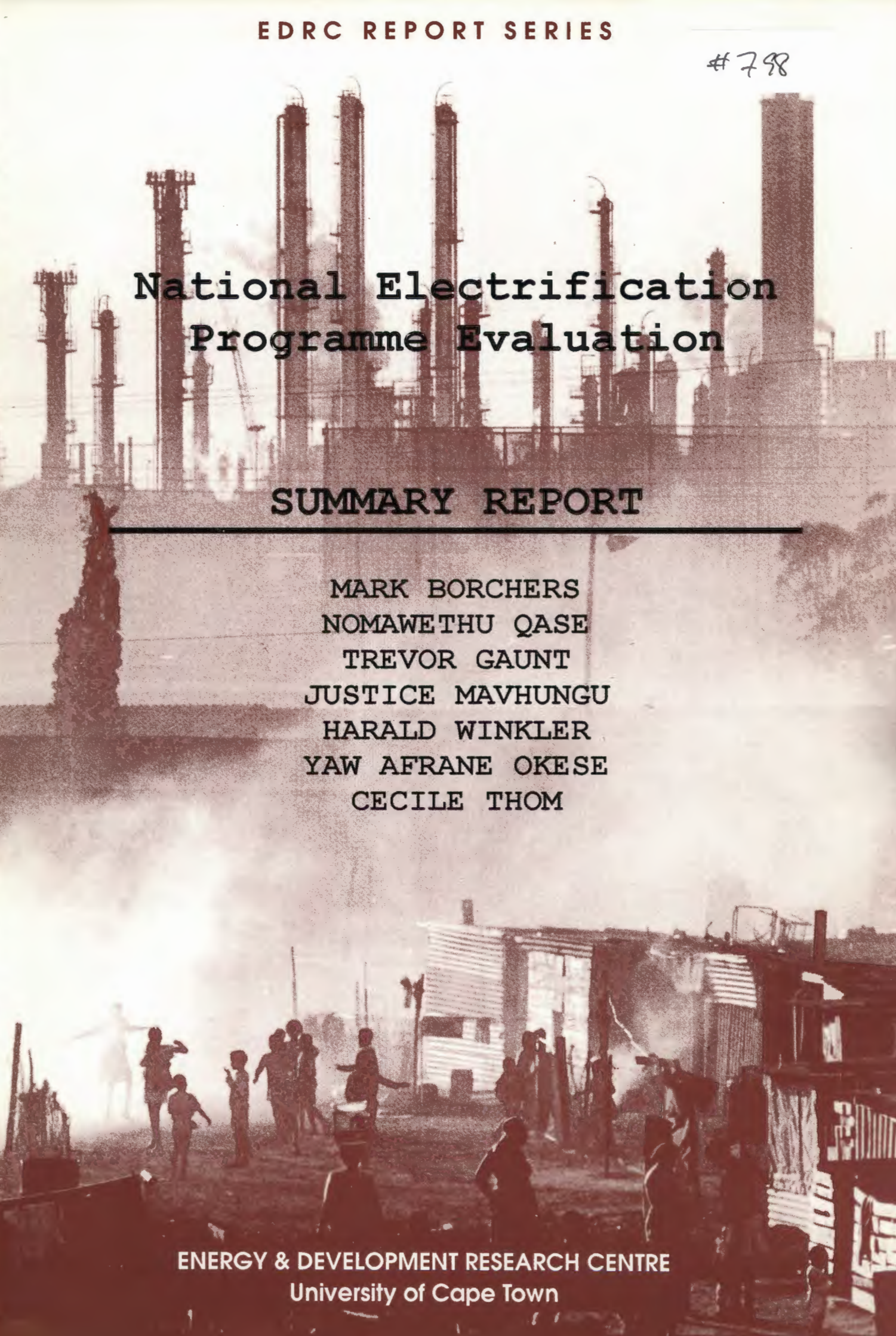

National Electrification Programme Evaluation

SUMMARY REPORT

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