VOLUME I

NATIONAL ELECTRIFICATION PROGRAMME (NEP) 1994 - 1999

SUMMARY EVALUATION REPORT

DEPARTMENT: MINERALS AND ENERGY
REPUBLIC OF SOUTH AFRICA

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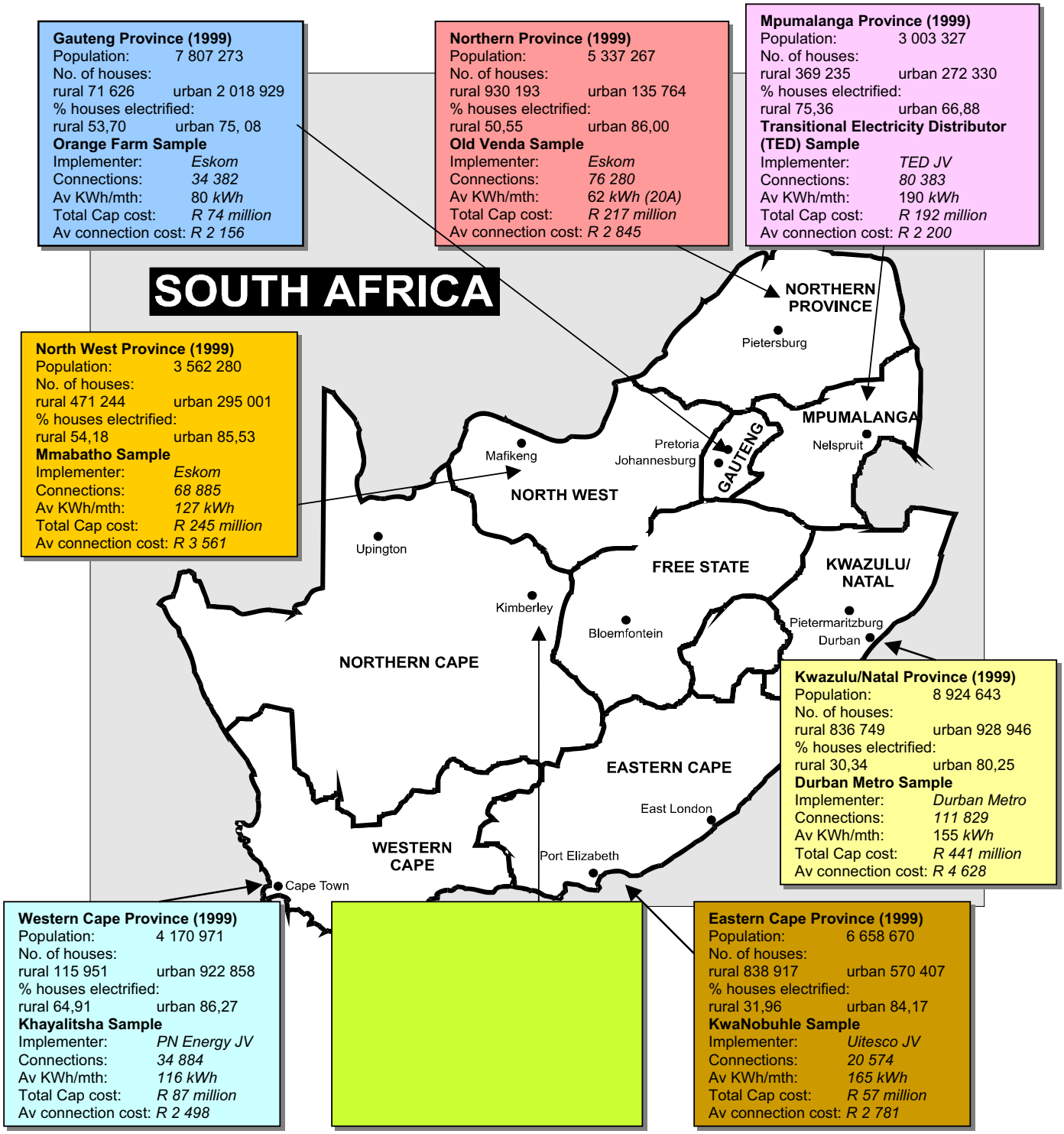
National Electrification Programme Evaluation

Provincial data with sample site location and description



Gauteng Province (1999)
Population: 7 807 273
No. of houses:
rural 71 626 urban 2 018 929
% houses electrified:
rural 53,70 urban 75, 08
Orange Farm Sample
Implementer: *Eskom*
Connections: *34 382*
Av KWh/mth: 80 *kWh*
Total Cap cost: *R 74 million*
Av connection cost: *R 2 156*

Northern Province (1999)
Population: 5 337 267
No. of houses:
rural 930 193 urban 135 764
% houses electrified:
rural 50,55 urban 86,00
Old Venda Sample
Implementer: *Eskom*
Connections: *76 280*
Av KWh/mth: 62 *kWh (20A)*
Total Cap cost: *R 217 million*
Av connection cost: *R 2 845*

Mpumalanga Province (1999)
Population: 3 003 327
No. of houses:
rural 369 235 urban 272 330
% houses electrified:
rural 75,36 urban 66,88
Transitional Electricity Distributor (TED) Sample
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 (1999)
Population: 3 562 280
No. of houses:
rural 471 244 urban 295 001
% houses electrified:
rural 54,18 urban 85,53
Mmabatho Sample
Implementer: *Eskom*
Connections: *68 885*
Av KWh/mth: *127 kWh*
Total Cap cost: *R 245 million*
Av connection cost: *R 3 561*

Kwazulu/Natal Province (1999)
Population: 8 924 643
No. of houses:
rural 836 749 urban 928 946
% houses electrified:
rural 30,34 urban 80,25
Durban Metro Sample
Implementer: *Durban Metro*
Connections: *111 829*
Av KWh/mth: 155 *kWh*
Total Cap cost: *R 441 million*
Av connection cost: *R 4 628*

Western Cape Province (1999)
Population: 4 170 971
No. of houses:
rural 115 951 urban 922 858
% houses electrified:
rural 64,91 urban 86,27
Khayalitsha Sample
Implementer: *PN Energy JV*
Connections: *34 884*
Av KWh/mth: *116 kWh*
Total Cap cost: *R 87 million*
Av connection cost: *R 2 498*

Eastern Cape Province (1999)
Population: 6 658 670
No. of houses:
rural 838 917 urban 570 407
% houses electrified:
rural 31,96 urban 84,17
KwaNobuhle Sample
Implementer: *Uitesco JV*
Connections: *20 574*
Av KWh/mth: *165 kWh*
Total Cap cost: *R 57 million*
Av connection cost: *R 2 781*

Note: Provincial data from NER sources. Refer to Appendix I for further details and update.

TOTAL PROVINCES

Population:		43 054 307
No. of houses:	rural 3 873 988	urban 5 752 528
% houses electrified:	rural 46,29	urban 79,71

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*

SYNOPSIS

Summarised Key Findings of NEP 1

- NEP 1 has met connection targets and has been very successful in that regard but economic developments are lacking
- This has been achieved with a wide diversity of structures. Uniform restructuring may not bring improvements. (Peak volumes were delivered in the so-called fragmented battling industry)
- No projects are viable or sustainable in the long term (with one possible exception, i.e. TED and even TED is currently being run down)
- Subsidies are not transparent and obscure the true financial position
- Basic information (costs of construction, losses, network plans etc) is not available from all distributors (especially Eskom)
- Prepayment meters have not solved the problems of non-payment and are expensive and not totally reliable. Good management and good discipline is still the best revenue management tool despite what type of metering is used
- Communities are not sufficiently involved in the EDI
- Connections from 2.5 A to 60 A have been used. There is no "one size fits all". Low current connections are perceived to be "poor connections for poor people". There is little hope of long-term sustainability if the supply does not allow consumption to increase to 350kWh/month levels.
- Networks are diverse reflecting the nature of the country. There is no need for a uniform standard and a menu of "suite of technologies" should be encouraged.

Key Recommendations for NEP 2

- Encourage "strength through diversity" in: -
    - Structures,
    - Competition
    - Entrepreneurship
    - Black empowerment
    - Revenue collection and metering
    - Network design and construction
    - Technology choices
- So that the best possible solutions emerge for each distributor.
- Promote new targets including viability and long term sustainability (coupled to economic job creation developments)
- Insist on proper records and their public availability (NER can enforce this as a license condition)
- Ensure community involvement through local democratic structures. Discourage paternalistic management. Encourage cooperation with community leaders.
- Clarify and ensure transparency of all subsidies

PREFACE

South Africa's National Electrification Programme (NEP) Phase I: 1994-1999

The Electrification Distribution Industry (EDI) in South Africa has been comprised of a national utility, Eskom, and some 385 licensed municipalities (Local Authorities - LAs), represented by the South African Local Government Association (SALGA). Historically, service provision in SA was limited geographically to established towns and areas of economic activity. By 1993 approximately 3,7 million households had been electrified, 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 25 000 rural schools had no access to electricity.

In 1994 the new democratic Government of South Africa (GoSA) launched the Reconstruction and Development Programme (RDP) that required an accelerated and sustainable National Electrification Programme (NEP). The NEP was selected as an accelerated Presidential Lead Project towards the RDP. Eskom and LA distributors accepted the RDP electrification targets in an unwritten (Social) Compact with Government. The aim of Phase I (1994-1999) was to make 450 000 connections per year (Eskom 300 000 and municipalities 150 000 per year). By the end of 1999 the Compact had met its target by providing access to electricity for an additional 2 500 000 households, with additional connections to rural clinics and schools. Eskom had made 1 750 000 connections, distributed across the whole country, but mainly in rural areas, at a cost of R5 billion plus. LA's had made 750 000 connections, mainly in urban areas, at a total cost of R2 billion plus. The programme was funded by a combination of debt financing and by a mark-up contained as an implicit surcharge in the Eskom tariff. Eskom also agreed to transfer an amount of R300 million per annum (annually adjusted in line with tariff increases) to the National Electricity Regulator (NER) for allocation to the municipalities. The total cost of the NEP Phase I was about R8 billion, making it one of the largest, if not the largest electrification programme in the world at the time.

Ex Post Evaluation of the National Electrification Programme (NEP): 1994-1999

A national evaluation of Phase I was commissioned by the DME prior to planning of the New National Electrification Programme (NEP Phase II). The need for the evaluation was identified by the National Electrification Co-ordination Committee (NECC) and stems from: the achievement of the RDP targets; the release of the Government of South Africa's Energy White Paper in 1998; the decision that government, not ESKOM, will lead the new (Phase II) national electrification initiative in the future; the restructuring of the 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 anticipated necessity for full or partial subsidization by the GoSA (not the EDI) 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 LAs).

The DME entered into a consortium with the Operations Evaluation Unit (OEU) of the Development Bank of Southern Africa (DBSA) to manage the evaluation, under the direction of an Evaluation Steering Committee comprised of the NECC, DME, NER and DBSA. The OEU commissioned the evaluation on behalf of the DME, contracted the evaluation consultants and contributed Technical Assistance of M&E expertise. An evaluation sample of eight Distributors was drawn, one from each Province, except Free State. DBSA conducted evaluations of two projects that had been funded by DBSA: TED in Mpumalanga and Uitesco (Kwanobuhle) in Eastern Cape. The EDRC conducted six evaluations: Western Cape (Khayelitsha), Northern Cape (Kimberley), North West (old BEC), Northern Province (old VEC), Gauteng (Orange Farm), and K-Natal (Durban Metro). The evaluations are consolidated in this Summary Evaluation Report on the NEP.

Dr. I. A. KOTZE,
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Department of Minerals and Energy, Pretoria
November 2001

DR. P. M. MANDELA,
Executive Manager,
Development Bank of Southern Africa, Midrand
November 2001

ACKNOWLEDGEMENTS

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ELECTRICITY DISTRIBUTION INDUSTRY (EDI) AND LA OFFICIALS:

Official	Distributor
I. Sokopo	Eskom Megawatt Park (Head Office), Gauteng
A. Kuhn	Eskom Western Cape Distributor
C. Hazard, C. Lomas, M. Mdingi, B. Gugger, P. Harris	PN Energy Services, Western Cape
B. Finch	Durban Metropolitan Electricity, K-Natal
S. Phipson	Eskom Central Region Distributor, Gauteng
S. Matlawe	Eskom NW Province
N. Nenguda	Eskom Northern Province
G. Ferreira, P. Nielsen	Uitenhage Electricity Supply Company (Uitesco)
D. Wicht, P. Fakude	Transitional Electricity Distributor (TED)
D. Louw	South African Local Government Association (SALGA)

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PHOTOGRAPHS: front cover by NASA/Reuters, in text by Trevor Gaunt, back cover by TED & DBSA

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 R8 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)
Financial IRR (weighted)	7.7 % (ranges from –5.4% to 21%)
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 be 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.

Abbreviations and acronyms used

abc	aerial bundle conductors
ADMD	after diversity maximum demand
BECOR	Bophuthatswana 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 (the transmission voltage range)
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 (220 or 380V)
Metro	metropolitan council
Munic	municipality
MV	medium voltage (11 or 22kV)
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

SOME DEBATE RAISED BY THE EVALUATION

ON THE SUBJECT OF INNOVATION	
Response from Eskom	**Reply by EDRC**
The report, due to its limited sample, contains a few items that are not completely correct. These relate to the innovation and efficiency of the program especially in Eskom. Eskom would like to highlight a few of these points. The report states that limited technical innovation was apparent and on the surface, this may appear to be the case. However, in order to achieve the 300 000 connections per annum, with a variation in capital and connection numbers of well under 1 % for the five years, and simultaneously, drop the real cost of connections by more than 50%, required innovation on a number of fronts. These achievements have been recognised in international productivity awards as well as acclaim from organisations such as the World Bank who has employed Eskom to advise on methods to reduce costs elsewhere. It is due to the innovation and achievement of Eskom Distribution that the costs per connection are now under half that in other parts of the world doing electrification in similar conditions. The grid costs are so low that mini grid systems cannot compete at this stage and are likely to become less competitive as more innovative grid designs are used. Research into more appropriate design parameters, and calculations amounted to around R3m per annum for the five years. As mentioned earlier, the success of the programme could not be achieved on one front alone. Eskom Distribution had to tackle the issue in four major areas, these are technology innovation and standardisation, process development, community involvement and tariff establishment and revenue management. (Eskom provided a paper entitled "Effective Rural Electrification – The Eskom Distribution (South African) Experience" by R. Stephen and I. Sokopo). Based on this paper, Eskom cannot fully agree with the report that innovation was lacking in some way.*	Eskom agrees that "limited technical innovation was apparent" … "on the surface", and that their achievements "required innovation on a number of fronts", as listed opposite. The statements in the Evaluation Report relate specifically to limited technical innovation. Eskom gives no specific information about the technical innovations they introduced and, reviewing the evaluation, EDRC can still find very few. There may be a problem with semantics. There were several technical innovations already made by municipalities before the commencement of the NEP or Eskom's participation in electrification, but not adopted by Eskom at that stage. That Eskom adopted some of these as internally new practices does not make them, in EDRC's opinion, technical innovations in the overall electrification programme. Also, acclaim from the World Bank and international productivity awards do not necessarily imply recognition for technical innovation. Further, it is expected that acceptance of the acclaim by Eskom would include appropriate recognition of the many other participants in the electrification programme for their contributions to the technical and other achievements. There is one key area in which Eskom made technical innovation, and they refer to it as "research into more appropriate design parameters". Actually, load research commenced and was undertaken with the municipalities and without the participation of Eskom initially. Eskom only participated in the load research from 1997/98, and since 1999 has had a similar number of monitoring sites as the municipalities. Based on results from the load research project and early returns of sales from their electrification customers, Eskom adopted, half way through the NEP, an innovatively very low design parameter of ADMD=0.4 kVA for electrification network design. This innovation allowed Eskom to make substantial capital savings in the NEP. However, recent results from the load research project (only being measured as the Evaluation Report was being completed in August) indicate that this design parameter is being exceeded in *most* of the Eskom electrification projects being monitored, well inside the expected design life of the networks. This technical innovation, therefore, risks being an enormous liability for Eskom, as feeder reinforcement will be needed for which the cost has not been taken into account in the financial and economic evaluation. The financial implications may be even more serious than those arising from the problems of the prepayment meters. In the light of EDRC's comments above, the statement that the report "contains a few items that are not completely correct" cannot be factually supported. There is clearly scope for further debate, aimed at improving for future application the understanding of the processes involved and the "more innovative grid designs" now being researched.

* R. Stephen and I. Sokopo are Corporate Consultants in Eskom Distribution
email: stepherg@eskom.co.za

ON THE SUBJECT OF STREET LIGHTING		
Response from Eskom	**Reply by EDRC**	**Response by SALGA representative**
The recommendation of the report to include street lighting is not supported. As mentioned the cost per connection in Durban Metro reached R10 000 in rural areas. This is with the inclusion of street lighting. It must be realised that the remaining households to be electrified are in more rural areas than that close to Durban. To include streetlights in these areas would mean a cost per connection at least similar to that of Durban (i.e. R10 000). This is over three times the connection cost target set in these areas and would mean a severe reduction in connection numbers. It is recommended that the reasons for lighting be explored and the utility benefit be realised in more cost effective ways.	The suggestion that lighting would increase the cost/connection to R10'000 is neither a correct interpretation of the situation nor the recommendations of the report. It would obviously be inappropriate to spend R7000 on lighting and R3000 on the household connection, and the recommendation should be considered in context. However, the communities put a very high value on lighting, and the benefit and contribution of lighting to meeting the purpose of the electrification programme should be considered.	It is difficult to understand the authors' recommendation that 'Streetlighting should be provided as a part of electrification . . . ' (page x) when in their own findings they state that 'Electrification is in most cases not financially viable, and, in fact, revenues in many areas do not cover operating costs (page ix). Communities may well value streetlights but in terms of the doubts regarding the long-term sustainability of electrification projects, who do they think is going to pay for the streetlight service? Municipalities who do provide a streetlight service will tell you that they are expensive to install, operate and maintain. The recommendation would only serve to exacerbate an already unsatisfactory financial situation.

ON THE SUBJECT OF PRE-PAYMENT METERS		
Response from SALGA representative	**Response from Volkswagen SA (on Kwanobuhle report)**	**Comment by DBSA Technical Assistance Team**
It is stated on two occasions (pages viii and ix) that `. . . prepayment metering may not have been as successful at reducing non-technical losses as was once thought. . . '. It must however be stated that prepayment meters were never intended as instruments in the battle against non-technical losses. On the contrary, many of the participants in implementing the NEP were convinced that the installation of these meters within the household would inevitably lead to increased meter tampering. Their introduction was supposedly to reduce meter reading and administrative costs (billing) and probably more importantly, to assist the poor with budgeting for their energy usage.	Whilst the prepayment metering in Kwanobuhle may give a negative EIRR, the negative return should be seen in the context of social spending on an area where low usage and high credit risk would make most similar electrification projects financially unattractive .The prepayment metering is a good budgetary tool which is becoming popular not only in the previously disadvantaged areas. Accordingly, possible ways to enhance the EIRR in the area with the retention of prepayment meters should be looked at before consideration is given to their discontinuance. It is difficult to understand the meaning of `all areas' in the statement (page x) the 'Vending stations need to be accessible in all areas, . . . '. In common with other service providers such as banks (ATMs) and supermarket that evaluate where to locate their outlets, electricity service authorities have to evaluate the location of vending stations. In doing so it is necessary to balance the high capital and operating costs with projected income streams and accessibility needs of customers. Minimum standards are laid down in the national standard NRS047, compliance with which is a condition of the licence issued to distributors by the National Electricity Regulator (NER).	The problem is that Pre-payment metering costs and the losses that they cause are far higher than the savings obtained in meter reading and administration costs. This places a financial burden on the utility that is compounded by the short life and high replacement cost of the meters. Assisting people to budget for electricity is good and the ppm has an advantage here. Regrettably, the ease of by-pass and tampering leads to free electricity and long-term viability problems for the utility. The team found that some utilities are not always complying with NRS047.

ON ECONOMICS, VIABILITY AND RECOMMENDATIONS FOR PHASE II		
Response from Eskom	**Reply by EDRC**	**Response from SALGA representative**
The report mentions that for Phase 2 connection, cost targets, technical and non-technical loss targets, etc need to be included. These, have, however, been included and strictly enforced in the Phase 1 of the programme. Without these targets the cost and connection targets would not have been achieved. The recommendation of the zero connection fee tariff at a lower capacity is strongly supported. Energisation or other methods to stimulate growth with these limited capacity supplies need to be explored. In conclusion the main recommendations of the report should be the focus on the methods to leverage the benefit of electrification to increase growth and prosperity.	The Evaluation Report has already acknowledged the achievements by Eskom (and the municipalities) and the contribution of project management to meeting the connection targets. Eskom expresses support for the Report's recommendations in respect of targets for Phase 2, the consideration of free connections of limited capacity, and the leveraging of electrification projects to achieve the purpose of the programme.	It is not clear what is meant by '. . . economic developments are lacking?' The NEP has never had an objective of achieving `economic development' per se. The main objective was surely to improve the quality of life for households that previously have not had access to a supply of electrical energy. It is also noted in the Executive Summary (page vi) that `Electrification is simply one factor in promoting economic development, and is generally not the most important one". While it is probably true that innovative approaches to electrification have partially been a result of the current industry structure, it is becoming increasingly clear that the objective of `sustainable electrification' is not achievable for many small local authority distributors. Despite the capital subsidy for service connections, operational losses are a severe constraint to many municipalities continuing with electrification. Attempts to reduce the level of non-technical losses will, in many cases, continue to be futile until the industry is placed at `arms length' from political influence. This will only be achieved through the industry restructuring, It is also true to say that Eskom have been extremely successful with its electrification implementation despite having a uniform approach across the country.

TABLE OF CONTENTS

VOLUME I: SUMMARY EVALUATION REPORT

Sample site location and description *i*

Synopsis *ii*

Preface *iii*

Acknowledgements *iv*

Executive summary *v*

Abbreviations and acronyms used *xi*

Responses from stakeholders *xii*

1. Introduction **1**

1.1 Background to the national electrification programme evaluation 1
1.2 Evaluation purpose and objectives 2
1.3 Sampling 2
1.4 Research methodology and its limitations 3

2. Evaluation findings and analysis **5**

2.1 Programme inputs 5
2.1.1 The distributors 5
2.1.2 Technical targets and standards 6
2.1.3 Financial resources and requirements 7
2.1.4 Economic requirements 8
2.1.5 Reaching the community 8
2.1.6 Environmental evaluation 10
2.2 Programme outputs 10
2.2.1 Institutional differences 10
2.2.2 Technical achievements 11
2.2.3 Financial costs 11
2.2.4 Social aspects of project implementation 12
2.2.5 Environmental effects of the projects 13
2.3 Programme outcomes 14
2.3.1 Institutional achievements 14
2.3.2 Technical operation of the networks 15
2.3.3 Financial and economic costs/benefits achieved 17
2.3.4 Social effects of electrification 19
2.3.5 Environmental effects of electrification 22

3. Issues identified in the evaluation 23
3.1 Achievements 23
3.2 Viability and targets 23
3.2.1 Financial and economic viability 23
3.2.2 Effectiveness of connection targets 24
3.2.3 Blanket or selective electrification 24
3.2.4 Non-domestic electrification 25
3.3 Appropriate technologies 25
3.3.1 Innovation 25
3.3.2 Capacity of supply 25
3.3.3 Prepayment metering 26
3.4 Affordability and pricing 26
3.5 Institutional effectiveness 26
3.5.1 Strength in diversity 26
3.5.2 Reporting systems 27
3.5.3 Joint venture companies and agents 27
3.6 Community participation 28
3.6.1 Community liaison 28
3.6.2 Employment 28
3.6.3 Vending stations 28
3.7 Increasing the benefits of electrification 29
3.8 Environmental impact 29

4. Lessons and recommendations from the evaluation 30
4.1 Overall assessment of NEP Phase 1 30
4.1.1 Has the programme contributed to the welfare of communities? 30
4.1.2 Has the programme promoted economic development? 30
4.1.3 Has the delivery of electricity been sustainably undertaken? 30
4.1.4 Has the programme been efficiently undertaken? 31
4.2 Five lessons from the evaluation 31
4.3 Conclusion 36

5. Strategic guidelines for planning and implementing NEP Phase 2 37

References 39

Appendices:

I: Electrification statistics

II: Terms of reference

III: Evaluation Logframe

UNDER SEPARATE COVER

VOLUME II: INTERIM OUTCOMES REPORTS: PROGRAMME EVALUATIONS

Introduction

Programme Evaluations

A.	Durban (KwaZulu Natal)	A1-A30
B.	Khayelitsha (Western Cape)	B1- B36
C.	Kimberley (Northern Cape)	C1-C21
D.	Mmabatho (North West)	D1-D19
E.	Orange Farm (Gauteng)	E1-E32
F.	Thohoyandou (Northern Province)	F1-F22

Appendices

A. Terms of Reference

B. Reconstructed Logframe used as a basis for the evaluation

C. Input sheets for financial and economic cost-benefit analysis

D. Methodology for the cost-benefit analysis modelling

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 R8 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.

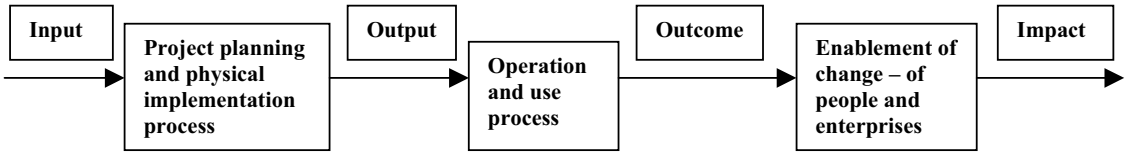

Figure 1: Logical framework of programme activities

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. Kwanolec (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.

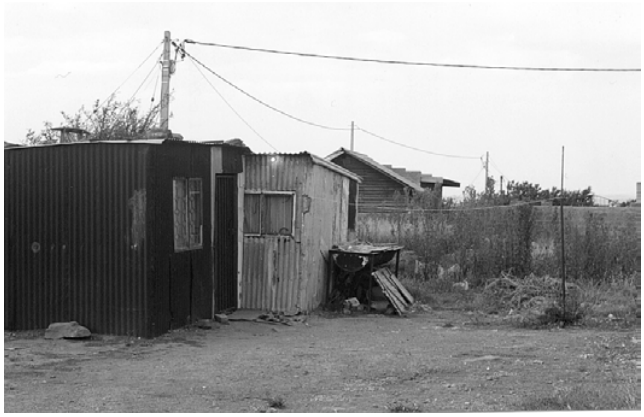

Figure 3: Electrified informal house

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 (1 792 137 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 achieved. Eskom achieved the planned 1 792 137 connections, and with the municipalities, significantly exceeded the target of 2,5 million connections during the period 1994-1999, according to NER figures. (For further detail refer to the NER publication "Lighting up South Africa", April 2000).

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.

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.

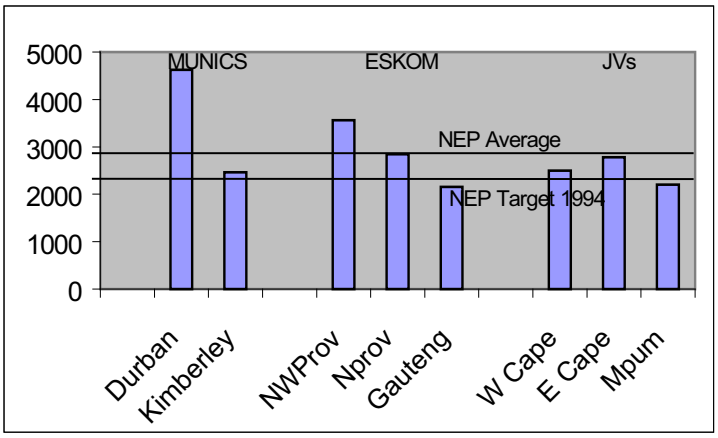

Figure 4: Cost per connection in Rands for evaluated projects[6]

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

[6] 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.

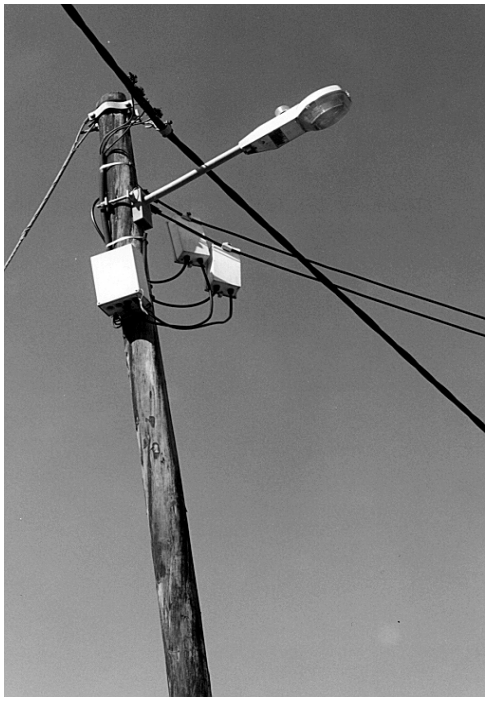

Figure 5: Wood pole with LV abc conductor, pole top distribution box, photo cell switched street light and split meters suspended on the service connection cables

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)
IRR (weighted)	7.7% (range from –5.4% to 21%)
Economic NPV per customer (weighted)*	R 146
Economic benefit: cost ratio (weighted)*	1.0
EIRR (weighted)	8.2%

* 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.[7] 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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[7] 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.

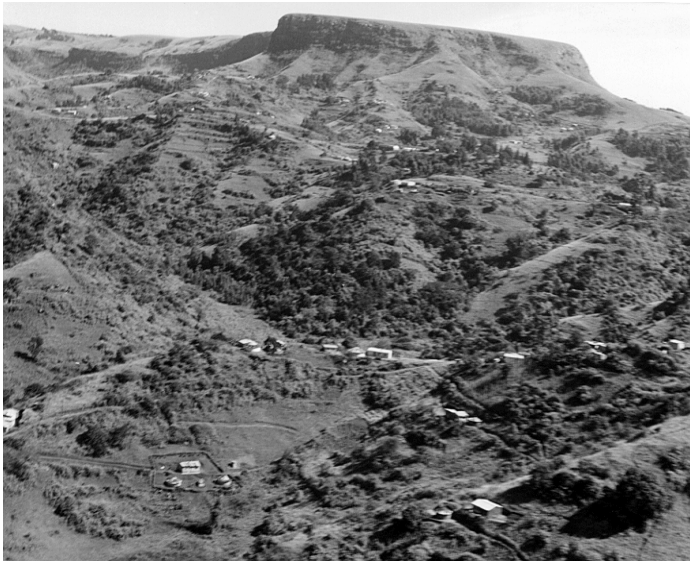

Figure 6: Very low density settlement

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.[8]

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

[8] 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.

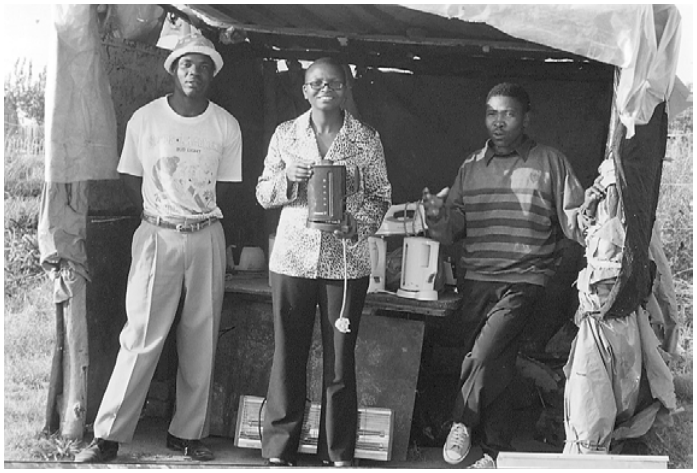

Figure 9: Roadside appliance repair business

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[9] 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.

[9] 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.[10]

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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[10] 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.[11] 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

[11] 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 1 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 Mpumalanga 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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APPENDIX I -A:

ELECTRIFICATION STATISTICS BY PROVINCE AS AT 31 DECEMBER 1999

Province	Type of area	Population*	Houses**	Houses Electrified	Houses Not Electrified	% Electrified	% Not Electrified
EASTERN CAPE	Rural	4 221 597	838 917	268 141	570 776	31.96	68.04
	Urban	2 437 073	570 407	480 112	90 295	84.17	15.83
	Total	6 658 670	1 409 324	748 253	661 071	53.09	46.91
FREE STATE	Rural	852 401	177 949	107 268	70 681	60.28	39.72
	Urban	1 862 253	467 683	386 528	81 155	82.65	17.35
	Total	2 714 654	645 632	493 796	151 836	76.48	23.52
GAUTENG	Rural	234 218	71 626	38 466	33 160	53.70	46.30
	Urban	7 573 055	2 018 929	1 515 726	503 203	75.08	24.92
	Total	7 807 273	2 090 555	1 554 192	536 363	74.34	25.66
KWAZULU-NATAL	Rural	5 078 122	836 749	253 875	582 874	30.34	69.66
	Urban	3 846 521	928 946	745 450	183 496	80.25	19.75
	Total	8 924 643	1 765 695	999 325	766 370	56.60	43.40
MPUMALANGA	Rural	1 829 026	369 235	278 241	90 994	75.36	24.64
	Urban	1 174 301	272 330	182 128	90 202	66.88	33.12
	Total	3 003 327	641 565	460 369	181 196	71.76	28.24
NORTH WEST	Rural	2 319 044	471 244	255 324	215 920	54.18	45.82
	Urban	1 243 236	295 001	252 304	42 697	85.53	14.47
	Total	3 562 280	766 245	507 628	258 617	66.25	33.75
NORTHERN CAPE	Rural	261 691	62 126	46 438	15 688	74.75	25.25
	Urban	613 531	133 262	110 008	23 254	82.55	17.45
	Total	875 222	195 388	156 446	38 942	80.07	19.93
NORTHERN PROVINCE	Rural	4 750 168	930 193	470 178	460 015	50.55	49.45
	Urban	587 099	135 764	116 752	19 012	86.00	14.00
	Total	5 337 267	1 065 957	586 930	479 027	55.06	44.94
WESTERN CAPE	Rural	462 978	115 951	75 262	40 689	64.91	35.09
	Urban	3 707 993	922 858	796 177	126 681	86.27	13.73
	Total	4 170 971	1 038 809	871 439	167 370	83.89	16.11
TOTAL	Rural	20 009 245	3 873 988	1 793 193	2 080 795	46.29	53.71
	Urban	23 045 062	5 752 528	4 585 185	1 167 343	79.71	20.29
	Total	43 054 307	9 626 516	6 378 378	3 248 138	66.26	33.74

Source: *Lighting up South Africa (NER, 2000)*

APPENDIX I – B:

ELECTRIFICATION STATUS PER PROVINCE AS AT THE END OF 2000

Province	Type	Population	Houses	Houses Electrified	Houses Not Electrified	% Electrified	% Not Electrified
EASTERN CAPE	Rural	4 221 597	838 917	301 388	537 529	35.93	64.07
	Urban	2 437 073	570 407	508 080	62 327	89.07	10.93
	Total	6 658 670	1 409 324	809 468	599 856	57.44	42.56
FREE STATE	Rural	852 401	177 949	110 233	67 716	61.95	38.05
	Urban	1 862 253	467 683	406 273	61 410	86.87	13.13
	Total	2 714 654	645 632	516 506	129 126	80.00	20.00
GAUTENG	Rural	234 218	71 626	38 466	33 160	53.70	46.30
	Urban	7 573 055	2 018 929	1 573 021	445 908	77.91	22.09
	Total	7 807 273	2 090 555	1 611 487	479 068	77.08	22.92
KWAZULU/NATAL	Rural	5 078 122	836 749	284 515	552 234	34.00	66.00
	Urban	3 846 521	928 946	766 885	162 061	82.55	17.45
	Total	8 924 643	1 765 695	1 051 400	714 295	59.55	40.45
MPUMALANGA	Rural	1 829 026	369 235	281 517	87 718	76.24	23.76
	Urban	1 174 301	272 330	218 913	53 417	80.39	19.61
	Total	3 003 327	641 565	500 430	141 135	78.00	22.00
NORTH WEST	Rural	2 319 044	471 244	283 582	187 662	60.18	39.82
	Urban	1 243 236	295 001	293 137	1 864	99.37	0.63
	Total	3 562 280	766 245	576 719	189 526	75.27	24.73
NORTHERN CAPE	Rural	261 691	62 126	48 459	13 667	78.00	22.00
	Urban	613 531	133 262	113 579	19 683	85.23	14.77
	Total	875 222	195 388	162 038	33 350	82.93	17.07
NORTHERN PROVINCE	Rural	4 750 168	930 193	522 833	407 360	56.21	43.79
	Urban	587 099	135 764	125 437	10 327	92.39	7.61
	Total	5 337 267	1 065 957	648 270	417 687	60.82	39.18
WESTERN CAPE	Rural	462 978	115 951	79 001	36 950	68.13	31.87
	Urban	3 707 993	922 858	820 078	102 780	88.86	11.14
	Total	4 170 971	1 038 809	899 079	139 730	86.55	13.45
TOTAL	Rural	20 009 245	3 873 990	1 949 994	1 923 996	50.34	49.66
	Urban	23 045 062	5 745 180	4 825 403	919 777	83.99	16.01
	Total	43 054 307	9 619 170	6 775 397	2 843 773	70.44	29.56

Source: *Annual Report, (NER, 2000/2001)*

APPENDIX II:

TERMS OF REFERENCE FOR THE APPOINTMENT OF CONSULTANTS

GOVERNMENT OF SOUTH AFRICA:

DEPARTMENT OF MINERALS AND ENERGY (DME)

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

ASSIGNMENT NO: 99793

JANUARY 2000

Prepared by:
Evaluation Management, Operations Evaluation Unit,
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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).[12] The RDP electrification target was accepted by the EDI members (ESKOM and LA distributors) and undertaken in terms of an unwritten Compact with Government.[13] 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.

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[12] "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

[12] "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 .

- 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 +.

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.

ATTACHMENT: PROPOSED ESTIMATED BUDGET

APPENDIX III:

SUMMARY OF OBJECTIVES, KEY PERFORMANCE INDICATORS AND EVALUATION METHODS (LOGFRAME)

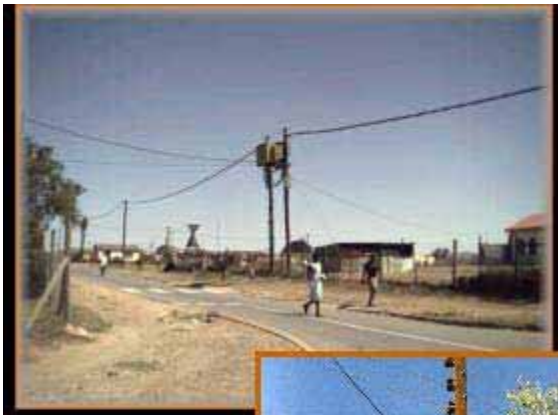
OBJECTIVES	*INPUTS (Resources for programme activities)*	*OUTPUTS (Service delivery by programme)*	*ASSUMPTION/RISK (Result depends on)*	*M&E OF OUTCOMES (Benefits of project activities)*	*EVALUATION METHOD (What, who and how).*
1. Meeting basic energy needs of the disadvantaged To meet basic energy needs of the disadvantaged by: providing expanded access to affordable electrification with a target driven approach and an accelerated electrification plan. 1.1 Increasing electrification of poorer households by: <u>Creating access</u> To address backlogs and to provide electrical infrastructure in economically sustainable areas. To provide economic benefits through improved business, administrative, health and educational opportunities. <u>Ensuring affordability</u> 1.2 Electrification of community services: (schools, clinics, community development projects, security alternatives) To provide economic benefits through improved administrative, health and educational opportunities. Upgrading and modernizing education and training with technology Upgrading and modernizing medical services with technology Improving security with exterior lighting	Preparation, planning, appraisal, financing and implementation of the programme to achieve the goal and objectives by applying: DBSA Appraisal Process and Eskom CIP Process with technical design and installation guidelines that conform with Eskom's national standards for. <u>Installation of</u>: Main bulk electricity supply Electricity distribution lines Appropriate area lighting Internal reticulation networks <u>Consumer service connections for:</u> Households Social services: e.g. Schools and Clinics and Community Development projects Security lighting <u>With financing of:</u> R7 billion	Targets: 1994-1999 <u>Domestic electrification</u>: Additional 2 500 000 households over 5 years at 500 000 per year: ESKOM: 350 000 per year LA's: 150 000 per year <u>Electrification of social services</u> 15 000 existing schools, mainly rural, without electricity? existing clinics, mainly rural, without electricity. plus new schools and clinics Geographical spread of electrification: By ESKOM: 1 750 000 connections in rural areas particularly former "homelands" By LAs: 750 000 connections in existing formerly "black" townships or new high density areas – urbanized and functionally urbanized.	Communities want, use and can afford electricity. <u>DBSA Funded Projects</u> Lessons Learned from Completion Reports Implementation as per Loan Agreement Monitoring during Implementation <u>Memorandum of Agreement with ESKOM</u> Principles and criteria applied. <u>TED's approach:</u> Incremental, consultative strategy for electrification supply and connection to households (and small businesses), in previously disadvantaged areas. Participative identification of concentrations of potential customers who are willing and able to pay, within transformer zones, in contrast to a roll-out or blanket approach. Targeting of households with expressed demand for electricity and ability to pay	Electrification of households <u>Electricity consumption</u> kWh / household R / month Consumption rate: conventional meters? pre-paid meters? <u>Access/affordability of supply</u> Connection costs comprising: Wiring cost: (4 rooms) Real connection cost (fee +Ready Board) What % households cannot afford this? <u>Uses of alternative energy</u> Fuels used and for what? Costs <u>Appliance acquisition/use</u> Appliances acquired Priority order Where purchased <u>Electrification standard/ options</u> 60A and / or 20A- %? pre-paid card system - %? Pre-paid meters / conventional Electrification of social services <u>Schools:</u> No. of schools electrified Extended teaching hours (Adult Education) Vocational training: electrical trade skills Availability of electrical equipment <u>Clinics:</u> No. of clinics electrified Medical uses of electricity Need for standby generator Availability of electrical equipment <u>Security</u> No. of high mast lights and Exterior lighting	Evaluation question 1: Programme planning and imlementation? Evaluation methods: Evaluation question 2: Efficiency of electricity delivery? Evaluation methods: Evaluation question 3: Effectiveness of electrification? Evaluation methods: Evaluation question 4: Sustainability of electrification? Evaluation methods:

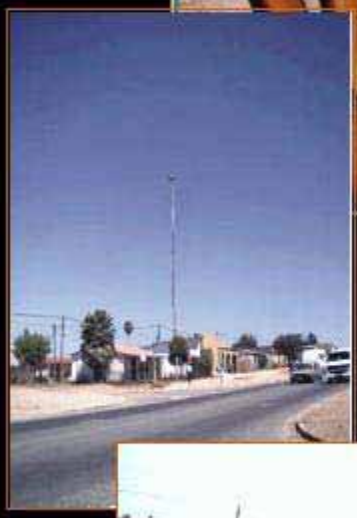
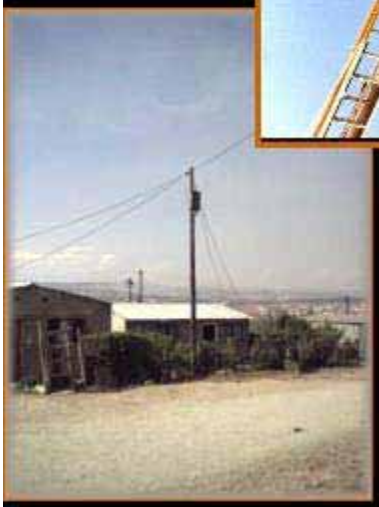
OBJECTIVES	*INPUTS (Resources for programme activities)*	*OUTPUTS (Service delivery by programme)*	*ASSUMPTION/RISK (Result depends on)*	*M&E OF OUTCOMES (Benefits of project activities)*	*EVALUATION METHOD (What, who and how).*
Implicit Goals: 2. Improving energy governance: To maintain and improve good EDI/distributor governance with cost effective extension of the existing grid and financial sustainability. 2.1 Commitment to reform 2.2 Commercialisation and corporatization 2.3 Institutional capacity and transformation 2.4 Technical competence and innovation 2.5 Financial viability 2.6 Sustainability of electrification	Preparation, planning, appraisal, financing and implementation of the programme to achieve the goal and objectives by applying: DBSA Appraisal Process and Eskom CIP Process with institutional design and installation guidelines that conform with Core business focus Business structure Organisation structure Organisation systems Reporting Business capacity: Management capacity Financial plan Marketing plan HR plan Financial performance: actual parameters Growth of sales and future electricity consumption - likely to increase.	Single service delivery - electricity distribution in the region – or multiple service Size and composition of supply area. Ring-fenced business Outlook over 10 year period Distributor ownership: public or private sector (Borrower) Reporting on goals: NER KPIs Acquisition and building of the right capacity to achieve the business objectives Relations with personnel Relations with customers/consumers Relations with community Provision of training, including technical, for own staff members and emerging contractors. Social responsibility iro electrical skills training and artisan training.	The electricity sector responds to need for reform The sector is committed to transparency and accountability. Distributors remain financially viable.	Ownership/Transformation: Shareholding: P/P partnership? Joint venture? Borrower ownership? Community Representation. Employ. Equity Outsourcing: secondments, contracting out Training: of in-house staff & emerging contractors Marketing: Incremental, consultative strategy for electrification supply and connection. Demand-driven or roll out / blanket approach. Prioritizing of households with immediate affordability. Client focused delivery Technical Evaluation Outsourcing of technical services Single phased lines first? Design work contracted out? Contractor purchases supplies? Open tenders for construction? Prioritizing smaller plots? Technical Losses and Quality of supply – service maintenance (power failures, voltage drops) Supporting infrastructure for electricity distribution to the previously unelectrified areas Financial Evaluation Ring fenced business: revenue management (cost & debtor-control systems, control of theft / illegal connections: NTLs) Financial viability and Key Indicators. Capital expenditure and income generation. Sensitivity analysis Service payment level - %? Accountability & transparency Sustainability of electrification Capital cost / connection goal: R 2 800 Av. monthly operating cost / customer, (excluding depreciation and interest): R? Monthly consumption goals: Av sales/pre-payment customer: 350 kWh Av. sales/prepayment customer: r Income / consumer / month goal:?	Evaluation question 1: Programme planning and imlementation? Evaluation methods: Evaluation question 2: Efficiency of electricity delivery? Evaluation methods: Evaluation question 3: Effectiveness of electrification? Evaluation methods: Evaluation question 4: Sustainability of electrification? Evaluation methods:

OBJECTIVES	*INPUTS (Resources for project activities)*	*OUTPUTS (Service delivery by project)*	*ASSUMPTION/RISK (Result depends on)*	*OUTCOMES - NOT IMPACTS (Benefits of project activities)*	*EVALUATION METHOD (What, who and how).*
Implicit Goal 3. Stimulation of economic productive capacity To stimulate economic productive capacity by employment and self-employment creation. 3.1 Economic viability and sustainability 3.2 Electrification as an input to small enterprises 3.3 Employment creation 3.4 Electrical skills training 3.5 Integrated development	Preparation, planning, appraisal, financing and implementation of the programme to achieve the goal and objectives by applying: DBSA Appraisal Process and Eskom CIP Process with technical design and installation guidelines that conform with Eskom's national standards for. Integrated Development Modernisation of Small Business by electrification of: Emerging small farmers Micro and small businesses Employment Creation	Existence of economic activities at the time of electrification. Programmes to develop and support economic activities subsequent to electrification such as training and capacity building. Nos employed by Distributor Contracts awarded to emerging contractors. Support to emerging contractors.	There is Integrated Development Planning and support in addition to electrification development: There are linked development initiatives in supply area e.g. SDIs Support is available for small enterprise development:: Micro loans, advice entrepreneurship training, and marketing Scarcity of emerging electricians is probably due to problems of education and skills development including technology training, Maths and Sciences education, and insufficient apprenticeships to create a workforce of registered electricians Providing support to emerging contractors incurs costs, but is less expensive than using established contractors to do service connections and contributes to effective development of local capacity.	Re-estimation of Rates of Return Key assumptions. Key Economic Indicators: EIRR, NPV, Benefit: Cost Ratio Tourism New developments Existing developments Benefits and problems experienced Income and employment gains Emerging small farmers Uses of electricity Income gains from electrification Benefits/Problems experienced Electricians: locally available skills: emerging contractors, electrical trades, appliance repair services Survivalist, micro-enterprises Enterprises using energy Existing enterprises which have switched to new electricity supply Enterprises which have started up because of electrification. Profitability SMME training, advice/ support CD projects Type of activity/ electricity uses Equipment and products Training and marketing Income and Problems Employment creation: Labour intensive approaches in project design Training: nos trained on/off site Emerging entrepreneurs Use of small contractors for: service connections and infrastructure Electrical Skills Training Availability and suitability of courses. Accreditation and recognition status. Training: nos trained on/off site; for women	Evaluation question 1: Programme planning and imlementation? Evaluation methods: Evaluation question 2: Efficiency of electricity delivery? Evaluation methods: Evaluation question 3: Effectiveness of electrification? Evaluation methods: Evaluation question 4: Sustainability of electrification? Evaluation methods:

OBJECTIVES	*INPUTS (Resources for project activities)*	*OUTPUTS (Service delivery by project)*	*ASSUMPTION/RISK (Result depends on)*	*OUTCOMES - NOT IMPACTS (Benefits of project activities)*	*EVALUATION METHOD (What, who and how)*
Missing Goal (Energy Policy Objectives) 4. Environmental sustainability (Assumption: Environmental sustainability will be improved by electrification.) 4.1 Minimise deterioration of biophysical habitat 4.2 Improve community health 4.3 Achieve legal compliance	Preparation, planning, appraisal, financing and implementation of the programme to achieve the goal and objectives by applying: DBSA Appraisal Process and Eskom CIP Process with technical design and installation guidelines that conform with Eskom's national standards for.		Compliance with regulatory conditions Environmental impacts considered during planning of the route Social impacts assessed Environmental permit required in terms of the environmental legislation Integrated energy planning and use of appropriate technology.	Operation and maintenance plan Scoping report, EIA, EMP Resettlement plan or social impact assessment Number of power failures per month Level of vegetation rehabilitated Percentage visible soil erosion Number of sites of significance avoided Percentage visibility of aesthetic impact River crossings perpendicular Bird flappers in place Power line at least 400m from nearest settlement Percentage fuel wood collected Air pollution levels Environmental permit	Evaluation question 1: Programme planning and imlementation? Evaluation method: Evaluation question 2: Efficiency of electricity delivery? Evaluation methods: Evaluation question 3: Effectiveness of electrification? Evaluation methods: Evaluation question 4: Sustainability of electrification? Evaluation methods:

OBJECTIVES	*INPUTS (Resources for project activities)*	*OUTPUTS (Service delivery by project)*	*ASSUMPTION/RIS (Result depends on)*	*OUTCOMES - NOT IMPACTS (Benefits of project activities)*	*EVALUATION METHOD (What, who and how).*
Missing goal 5. Securing supply through diversity of alternatives: but: in the NEP other alternatives were not considered to: - Grid electrification - ESKOM and LA institutional models (except the TED, Kwanobuhle and Khayaletsha projects)					

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