

# **Electricity Distribution Industry Restructuring, Electrification, and Competition in South Africa**

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## Preface

This report represents work done while I was a visiting researcher at the Minerals and Energy Policy Centre in Johannesburg, Republic of South Africa, and the Energy and Development Research Centre/University of Cape Town, Cape Town, Republic of South Africa. This research was sponsored by the U.S. Department of Energy/Office of Utility Technologies, NREL/Center for Energy Analysis and Applications, Eskom (Republic of South Africa's national utility), and the Development Bank of Southern Africa. The views expressed in this report are entirely those of the author. They do not necessarily reflect the views of the U.S. Department of Energy, its National Renewable Energy Laboratory, the Minerals and Energy Policy Centre, the Energy and Development Research Centre, Eskom, or the Development Bank of Southern Africa.

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## **Glossary of Terms**

<b>AMEU:</b>	<b>Association of Municipal Electricity Undertakings</b>
<b>EDI:</b>	<b>Electricity Distribution Industry. The retail sector of the ESI. Electricity Supply Industry</b>
<b>Eskom:</b>	<b>The South African National Electric Utility</b>
<b>Genco:</b>	<b>Electric Generation Company</b>
<b>Lineco</b>	<b>Electric Distribution Company</b>
<b>Munics:</b>	<b>South African term for municipality</b>
<b>NELF:</b>	<b>National Electricity Forum</b>
<b>NER:</b>	<b>National Electricity Regulator of South Africa</b>
<b>Rand:</b>	<b>The South African currency. 5 Rand = \$1.00</b>
<b>RDP</b>	<b>The South African Government's Reconstruction and Development Programme</b>

## **Executive Summary**

A variety of proposals for restructuring the South African electricity supply industry (ESI) have been examined since 1992. The most specific and important involve electricity distribution. The one that has emerged calls for consolidating Eskom's distribution component with the nearly 400 municipal electricity distributors into 5 to 17 regional electricity distributors (REDs). The number and configuration of these REDs will be primarily determined by the financial viability of the RED once it is formed, and thus its ability to provide a reliable, reasonably priced service and undertake needed electrification efforts. Since electrification has not been, and is not expected to be, self-sustaining and self-financing, an infusion of monies raised from a tax of some type will be provided.

The main reason for the proposed consolidation, however, is not to support electrification. The primary motivation for change within the electricity distribution industry (EDI) is the need to ensure that roughly one third of the municipalities that act as electricity distributors can provide adequate, reliable, and acceptable quality service. Currently, they are not able to do so consistently. Further, their situation is only likely to worsen in the absence of actions to improve their technical capability and strengthen them financially. Given the nature of their customer base, local economy, and the demands for extending service to more citizens through electrification, these municipal distributors are unlikely to achieve sustained financial viability on their own. Since the service they provide is essential for meeting basic human needs, as well as to support and stimulate the local economy, external funds will be needed. Absorbing these municipal electricity operations in a RED is proposed as a means of subsidizing their operations, and providing the needed technical and management expertise. Not all municipalities suffering financial problems, however, have nonviable electricity operations. They are diverting revenues needed to pay for electricity to other municipal services. The EDI consolidation proposal does not directly address this matter.

There are subsidiary reasons for the proposal. It is anticipated that consolidation, and a simultaneous move to cost-based pricing, will bring about economic efficiency gains of scale and scope to make the EDI as a whole less costly and more efficient. It is hoped that this will permit REDs containing previously financially nonviable municipalities to be viable as a whole, and that electrification can be implemented on schedule and evenly across the country. A related reason is to make tariff reform and adoption of cost-based pricing more manageable, the idea being that formulating and administering tariffs for 5 to 17 REDs is much more feasible than for 400 separate entities.

Overlaying this proposed restructuring of the EDI is the concept of allowing competition into the ESI; initially in wholesale supply and eventually at the retail level. In anticipation of this, recommendations to unbundle Eskom's generation, transmission, and distribution functions have been made. In fact, at the National Electricity Regulator's (NER) instructions, Eskom has already begun to "ring fence" these three operations. It has also created a power pool within its own system, and separate plants now compete to be dispatched.

### **Observations and Recommendations**

Change in the ESI is happening within the context of a broader national development agenda that encompasses health, education, sanitation, water, transport, other energy sectors, housing, and telecommunications. In addition to these infrastructure development areas, new forms of governance are being implemented, from a new constitution to the reformulation of provincial and municipal authorities.

Many of the ESI's problems derive from this situation. *In a sense, everything is happening at once, but everything cannot be done at once.* Priorities must be set. Issues within the ESI are not considered by those outside the industry to be as pressing as problems and opportunities in other areas. In terms of the costs involved with development, the ESI represents relatively minor costs when compared to health or education.<sup>1</sup> Further, development costs can be internally financed by the ESI and do not require direct funding from the fiscus (the national treasury). Consequently, the government has been slow to act on the various recommendations for change of the ESI.

A variety of issues confront the industry at present. Three, however, appear to be most significant:

- The method of EDI consolidation
- Containing electrification costs
- Coordinating electrification with other infrastructure development activities

### ***Top-Down versus Bottom-Up***

The problems besetting the EDI are more related to national, provincial, and local governance issues, and macroeconomic factors, than to the EDI's structure or internal functioning. Unfortunately, there is little the EDI, or the entire ESI for that matter, can do to confront and solve these larger problems directly. The ESI certainly must act to address the problems it experiences as a result. The question is, Which actions are most suitable and within the industry's power to implement? While it may be the best approach for the long term, in the near term the proposed consolidation of the EDI may exacerbate problems being experienced by the municipalities it is intended to "rescue." Further, the transaction costs of merging 400 disparate entities have not been estimated, nor have the benefits of the consolidation been rigorously derived. Consequently, the net economic benefits are unknown. Also, no plan or schedule for implementing the consolidation has been developed. While detailed planning is not feasible or necessary at this stage, strategic planning should be done in order to identify priorities, issues requiring special attention, and the types of service dislocations possible during implementation. Finally, although the government has adopted the recommendation as its initial position in future discussions with stakeholders, it appears final action will not be taken for several months. Further, given the complexity and importance of the issues involved, discussions with stakeholders may fail to achieve a clear consensus on the recommended approach.

Thus, an alternative to address immediate problems is needed. That alternative may be emerging from the bottom up, as opposed to the top down. A variety of municipalities have shown an interest in voluntarily merging. Admittedly, there are similar problems with the bottom-up approach as with the proposed top-down mega-merger. Additionally, not all local authorities will wish to merge because doing so will not address the problems they are facing now; nor should some of them merge unless with partners who are financially and technically strong. The interest of strong municipalities in voluntarily merging with weak ones is probably quite small. Consequently, the bottom-up approach is unlikely to provide "wall-to-wall" coverage across the country. Yet, a bottom-up approach offers real benefits; the major ones being that EDI rationalization can begin, and local authorities with an incentive to merge are likely to be better motivated and able to solve some of the difficult problems any merger faces. Thus, the benefits of facilitating an evolutionary approach to consolidation should be seriously examined. Moreover, methods other than top-down consolidation should be investigated to provide needed technical and financial support to municipalities experiencing service delivery problems. The circuit rider approach employed by small U.S.

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<sup>1</sup> The cumulative recurrent costs for education and health combined over the next 5 years are estimated to be more than 260 billion rand (~\$52 billion), compared to less than 2 billion rand (~\$4 billion) for electrification undertaken by the ESI.

municipal utilities and rural electric cooperatives is a promising candidate for providing technical and administrative assistance to those municipalities needing it.

### ***Containing Electrification Costs / Integration of Grid and Off-Grid Technologies***

Given the operating losses Eskom experiences from rural household electrification, it should incorporate renewable off-grid technologies into household electrification program planning and delivery. The capital cost of photovoltaic (PV) systems is often lower than that of a grid connection and will reduce with economies available with increased manufacture. Operating costs for PV may be significantly lower than for grid connections and can in all likelihood be recovered from revenue collected from newly electrified customers. Admittedly, PV is a low-power application. Eskom, however, is already providing 8-amp service in an effort to reduce operating losses and plans to offer 2.5-amp service in the near future. PV provides this level of service. Therefore, beyond its environmental, modularity, and resource diversity benefits, PV could be an effective cost-containment strategy to reduce operating losses (and thus the current electrification cross-subsidy) or to free up monies for additional new connections. Whether PV or other off-grid technologies actually offer significant cost savings, however, critically depends on the marginal cost for grid electrification. This is the potentially avoidable cost. A rough calculation of the costs avoidable through use of 20-W PV systems in rural areas was done as part of this study. It estimated that more than R300 million (1995 rands, or \$60 million) could be saved between now and the year 2000 if PV were used in lieu of grid connections.

It is important to note that comparison is against Eskom's average cost/connection, not that of a rural grid connection. Rural grid connections are twice as costly now and will become more so as areas further away and less densely populated are grid connected. Consequently, more 20-W PV systems and/or larger 50-W systems could produce the same or larger cost savings. Given the impressive size of these savings, a rigorous examination of PV benefits should be done and off-grid technologies integrated into the analysis, planning, and implementation (where cost-effective) of the household electrification program.

Providing low-power service, however, raises the issue of what the goal of electrification is: to provide basic service or to support economic development. There is no clear statement by the government on which of the two is the goal of electrification. In the current context of fiscal constraints, the two goals cannot be achieved simultaneously. It appears that by default the goal, at least for Eskom's efforts, is to provide basic service. A clear goal statement from the government is needed.

### ***Coordinating Electrification with Other Infrastructure Development Activities***

Electrification has been pursued independently of other infrastructure development activities until now. This lack of coordination has been suboptimal in terms of economic development. Electricity is a necessary, but not sufficient, condition for economic development. This suggests that it should be done only in tandem with other infrastructure development. If the government's goal for electrification is primarily to support economic development, then ideally integrated development is critical to successfully achieving it. Other infrastructure delivery sectors, however (except water), are apparently experiencing serious problems in meeting their schedules and targets. The reasons for this are unclear, but probably involve the nature of the services themselves and/or the available funds and technical expertise to deliver them. Thus, the question arises whether attempting to integrate electrification with other infrastructure development is feasible or would serve to drastically slow the pace with which electrification is now being accomplished. It may be more realistic to accept the fact that other sectors cannot keep pace with the ESI at this time and go ahead with electrification. This requires acceptance that the gains of integrated development must be foregone in

favor of putting one of the critical components for development in place now. It would be advisable, however, to establish several pilot integrated development projects to find out in a hands-on fashion what the obstacles to integrated development are and the means and cost of overcoming them. Perhaps the current special development initiatives (SDIs) that target development corridors can be used for this purpose.

# Introduction

This paper reviews the status of the South African electricity supply industry (ESI) and proposals for reorienting and restructuring it. South Africa has been intensely examining its ESI for more than 4 years in an effort to determine whether and how it should be restructured to best support the country's new economic development and social upliftment goals. The debate has been spirited and inclusive of most ESI stakeholders. The demands on and expectations for the ESI are many and varied. The debate has reflected this diversity of interests and views. In essence, however, there is a consensus on what is expected of the industry, namely, to extend provision of adequate, reliable, and affordable electricity service to all citizens and segments of the economy. This means a large-scale electrification program to reach as many of the nearly 50% of households currently without electricity service as soon as possible, tariff reform to promote equity and efficiency, and the upgrading of service quality now being provided by some of the newly consolidated municipal authorities.<sup>2</sup> The issues involved are how best to achieve these results within the context of the national Reconstruction and Development Program, while accounting for time and resource constraints and balancing the interests of the various parties. This has been a complex and demanding task. While many issues have been defined and specified, there is no universal agreement on how to proceed. There appears, however, to be consensus on several things.

1. <sup>TM</sup> The electricity distribution industry (EDI) is fragmented and inefficient. It must be rationalized in some way to ensure sustained financial viability and to meet its responsibilities.
2. <sup>TM</sup> Electrification is a critical infrastructure development activity that needs to be implemented.
3. <sup>Ü</sup> Electrification currently depends on cross subsidies and will continue to do so for some time. The recurring cost of serving newly connected, low-usage customers is the most critical financial burden. It is estimated to be nearly R1.2 billion (1995 terms, ~\$240 million) over the next 4 years.<sup>3</sup>
4. <sup>Ü</sup> Hidden cross subsidies should be eliminated or drastically reduced and tariffs should be cost-based.<sup>4</sup> Electrification should be supported through a transparent tax on suppliers or levy on sales.
5. <sup>TM</sup> The present approach of setting numerical targets only for electrification is wasteful, inefficient, and does not promote economic development effectively or equitable provision of basic service.
6. <sup>Ó</sup> Separating the three components of the industry, generation, transmission, and distribution, first, and then introducing competition in supply at the wholesale level within the next few years is desirable for gaining cost savings and economic efficiencies.

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<sup>2</sup> In 1996 more than 1200 local authorities, mostly a creation of the old government, were consolidated into 760 by combining formerly white and black municipalities/townships. In South Africa currently, local municipal authorities have the right/responsibility to provide electric service within their boundaries. Where they exist in rural areas local authorities also have these supply rights. In rural areas outside of municipal boundaries, Eskom (the national electric utility) has the right/responsibility for electric supply. Of the new local municipal authorities, only about half (394) actually supply electricity within their boundaries. The remainder are supplied either by other municipalities or Eskom. In addition, Eskom provides service directly, usually at high voltage, to 3 large customers and to 140 large customers through its distribution division. About 80 large customers are supplied by the municipalities.

<sup>3</sup> Electrification subsidy estimates vary from 1.3 to 1.7 billion rand/year (\$260 to \$340 million) in capital cost and just below 300 to 350 million rand/year (\$60 to \$70 million) in operating (recurring) costs. The figures used in this report of 1.3 billion rand/year (\$260 million) in capital and 295 million rand/year (\$59 million) in operating (recurring) losses are taken from the Reconstruction and Development Programme (RDP) document cited later.

<sup>4</sup> There is a recognition that subsidies exist beyond those to support electrification. Some form of subsidized "lifeline" service will have to be maintained. The manner in which these subsidies are collected and distributed, however, should be as transparent as possible.

Given the subsidies needed to accomplish electrification and the severe service provision and financial problems with many municipal electricity distributors, a model that will produce cost reductions to offset subsidies and improve the financial health and performance of the EDI has been sought.

## Background

Intensive, focused examination of issues in the ESI began in late 1990 when the South African Energy Policy and Training Project was initiated. It identified and specified many of the issues that were the subject of later efforts to understand the needs and future role of the ESI. Building on this work, four focused efforts to examine the ESI have been undertaken since 1992, three of them in sequence: the National Electricity Forum (NELF), which resulted in the creation of a National Electricity Regulator (NER) in 1995; the Electricity Working Group (EWG), which produced a report and recommendations in mid-1996; and the Electricity Restructuring Interdepartmental Committee (ERIC), which presented its draft report and recommendations at the end of August 1996. In parallel with the EWG and ERIC, the government, through the Department of Minerals and Energy (DME), has been developing a comprehensive energy policy white paper recommending strategy and policy for all energy sectors, including the ESI. The EWG, ERIC, and the draft white paper all make similar recommendations,<sup>5</sup> although the initial draft EWG report recommended a single national electricity distributor (NED), but after broader stakeholder input was received it modified that to a regional electricity distributor (RED) model. The draft white paper and ERIC report recommend the RED model. In addition to all of this, draft legislation aimed at restructuring the ESI and redefining the role and authority of the National Electricity Regulator (NER) was developed by the DME and the NER, but has not yet been formally submitted to the cabinet for consideration, pending action on the policy recommendations coming out of the EWG, ERIC, and the white paper process.

NELF was initiated in anticipation of the transition in government and the needs that would be placed on the ESI of what became the new government's Reconstruction and Development Programme (RDP). The EWG was an outgrowth of the new NER's first attempts at overseeing and licensing electricity distribution authorities. NER's examination of the license applications submitted by many of the new municipal authorities suggested that there were serious problems in the electricity distribution sector that could not be effectively addressed solely through regulation. This, along with a growing belief that the feasibility and potential benefits of some level of competition in the ESI should be re-examined, led to the NER asking that the DME form the EWG. The EWG's initial recommendation that the fragmentation, inefficiencies, and financial problems in the EDI be addressed through creation of a single NED and its subsequent modification of that to a RED model reflected some of the turmoil underlying the debate on industry restructuring. Labor apparently strongly supported the NED, but the local authorities were just as strongly opposed to it, favoring the RED model.

It is not entirely clear, at least to this reviewer, why the EWG changed its initial recommendation. Analysis of the two models, however, apparently suggested that the RED model was more likely to yield cost savings through economic efficiency gains than the NED. Further, the RED model was generally viewed as a model more responsive to local concerns and interests. In the new South Africa, getting individuals and their communities directly involved with policies and services affecting them is highly prized. These two points may explain the shift in the EWG's recommendation.

ERIC was apparently initiated to formally bring into the debate the government departments most directly affected by recommendations in the EWG report and in the DME draft energy policy white paper so that a coordinated recommendation could be made to the cabinet. ERIC delivered its draft report to the Inter-Ministerial Coordinating Committee on Restructuring in October 1996. Questions were posed back to ERIC on that draft. These were subsequently responded to, and the revised draft report and draft cabinet memo were given to the Minister of Minerals and Energy in November 1996. In February 1997 the ERIC report was presented to the cabinet with the recommendation that it be adopted as the government's initial

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<sup>5</sup> The three reports do not all address the same areas.

position in discussions with stakeholders to finalize a policy generally acceptable to all involved. The cabinet apparently accepted this recommendation.

A variety of proposals for restructuring the South African ESI have been examined since 1992. The most specific and important involve electricity distribution in the ESI. The one that has emerged calls for consolidating Eskom's distribution component with the nearly 400 municipal electricity distributors into 5 to 17 REDs. The number and configuration of these REDs will be primarily determined by the financial viability of the RED once it is formed and thus its ability to provide reliable, reasonably priced service and undertake needed electrification efforts. Since electrification has not been, and is not expected to be, self-sustaining and financing, an infusion of monies raised from a tax of some type will be provided. The main reason for the proposed consolidation, however, is not to support electrification.

At present, roughly one third of the municipalities that act as electricity distributors cannot consistently provide adequate, reliable, and acceptable quality service. One reason for this is the consolidation last year of formerly white and black municipalities as part of the democratization process in the new South Africa. Compared to the white municipalities, the black municipalities had larger populations (generally poor), were understaffed, underfunded, and had an inferior, deteriorating electric infrastructure. Further exacerbating the situation, a culture of nonpayment arose in black areas to protest against the former government's social policies. Prior to the consolidation in 1996, the black townships received an operating subsidy directly from the national government. This subsidy has since been withdrawn. Thus, when consolidated, many of the newly integrated municipalities could not cope financially or technically. Their revenue base is inadequate, the practice of nonpayment continues, and their reticulation (distribution) systems badly need upgrading, which they cannot afford. An important element in all of this is the fact that municipalities in South Africa have traditionally depended on revenue from electricity sales to fund other municipal services. Thus, they price electricity to their citizens and businesses above cost. The "problem municipalities" do this too.

The black municipal authorities had built up a large debt with Eskom prior to the consolidation of municipalities, nearly R1.7 billion in total (~\$340 million). With little realistic chance of recovering this amount from these municipalities, Eskom developed a "debt forgiveness" plan that went into effect in June of 1995. In brief, the plan "forgave" backlogs up to June 1995 if the municipalities kept up to date in the future in paying their bulk account to Eskom. Eskom was not agreeing to write off these debts, but rather to "write them forward." This meant that Eskom would recoup the balance owed through its bulk rates to these municipalities as well as other customers. Other customers therefore subsidize these municipalities through the higher tariffs Eskom must charge to recoup the loss. The plan appears to be working, with only five municipalities not staying current in their accounts to Eskom.<sup>6</sup> Eskom has threatened to stop supplying these municipalities. The problem is that this would unfairly penalize the customers who are paying their electric bill to the municipality. Industrial customers in particular are very upset and are considering shifting operations to other locations or receiving direct service from Eskom's distribution division. The irony is that a municipality's tax and job base critically depends on retaining and expanding industrial and commercial activity. Further, they depend on revenues from electricity sales to support other municipal services. If they drive paying customers "out of town," or onto Eskom, they lose these funds. This situation, combined with the problems in service delivery, has prompted the move to rationalize the EDI.

Given the nature of their customer base, local economy, and the demands for extending service to more citizens through electrification, these "problem" municipal distributors are unlikely to achieve sustained financial viability on their own. Since the service they provide is essential for meeting basic human needs, as well as to support and stimulate the local economy, external funds will be needed. The proposal to

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<sup>6</sup> Personal communication with John Bradbury, consultant to municipal authorities.

absorb these municipal electricity operations in a RED is a means of subsidizing their operations, and providing the needed technical and management expertise. Integral to the proposal to establish REDs is one to allow municipalities to replace the revenue they lose if they can no longer use electricity revenues to subsidize other municipal services with a direct tax.

Overlaying this proposed transition in the EDI is the notion that competition in some form is desirable. Two forms of competition are most widely discussed. The first is wholesale competition where multiple generators compete to sell electricity to the REDs for resale to retail customers. These generators could be Eskom's generation component (or individual power stations within it), current municipal generators, independent power producers (IPPs), and utilities or IPPs in neighboring countries having their power wheeled through the SAPP (Southern African Power Pool). Prices for wholesale electricity would not be regulated. The market would set the price. Transmission, its price, its terms, and conditions of service would, however, be regulated as a monopoly by the NER. Tariffs for distribution would also be regulated by the NER on a cost-of-service basis. Retail competition is also being considered, but not as seriously or concretely as wholesale competition. The form retail competition might take is not yet clearly defined. Presumably all customers would eventually have free choice of suppliers, with REDs acting as aggregators of load for smaller customers and providing "wires" services at regulated tariffs. It is unclear if REDs would also own generation. Further, the type of control and dispatch for the system has not been spelled out. Regional pools, or possibly the SAPP itself, could do this job. Finally, one specific recommendation contained in the EWG and ERIC reports as well as the draft white paper is that large customers have a choice of supplier. In the context of the current situation and recommendations, this means being able to take service directly from Eskom's distribution division and bypassing the municipal authorities or the REDs if they are created. This recommendation does not represent a move to retail competition. Rather, it acknowledges that large customers should not have to continue to pay the above-cost tariffs presently charged by municipalities and should have access to adequate and reliable supply. The principle of customer choice, however, embodied in the recommendation is an important one necessary to support retail competition in the future.

## Electricity Issues in the Context of National Development

It must be remembered that changes in the ESI are occurring within the context of a much larger national development agenda. The major components of the proposed transition -- restructuring of the EDI through consolidation into REDs, functionally unbundling Eskom, moving to cost-based pricing to remove internal cross-subsidies and replacing them with a more transparent levy to fund electrification, preparing for wholesale competition in supply, and allowing municipalities to tax electricity service to replace surpluses lost -- are all substantial changes. Yet, they are not first-order considerations for the government from the vantage point of crafting policies and criteria for an integrated national development program. In fact, according to an RDP office document used as a discussion piece at a March 1996 Infrastructure Investment Conference in Cape Town,<sup>7</sup> it is assumed that most development financing in electricity will be done internally within the industry without significant allocation of government budget funds. The sense of the RDP document is that the government assumes the industry can sort out how it will meet overall national goals and targets for development once they are established, without involving Government in any major changes to the industry. The document acknowledges that work on EDI restructuring has been intense and ongoing, yet one does not get the sense from the document that the scope and nature of the changes being proposed have either been focused upon or fully appreciated. Perhaps this is because the resources needed for development in the electricity sector are small by comparison. Electricity sector expenditure as a percentage of total monies needed for development is indeed small under either of the two scenarios presented in the RDP report. This is especially true if one only looks at electrification costs as a percentage of the total (see Table 1).

Each scenario in the RDP document is a combination of individual sector projections for delivering infrastructure development. The sectors included are: energy, water, transport, communications, housing, health, education, and security. Both scenarios use the same demographic assumptions (see Table 2). Their economic growth assumptions, however, differ. Scenario 1 assumes an annual growth in gross domestic product (GDP) of 7%, whereas scenario 2 assumes a 3.1% GDP growth rate.

**Table 1: Relative Size of Energy Infrastructure Investments (1996 - 2001)**

Development Item	Scenario 1		Scenario 2	
	Cost in 1995 Rand (millions)	% of Total (All Devel.)	Cost in 1995 Rand (millions)	% of Total (All Devel.)
Urban Electrification	6 493	2.80	3 500	2.05
Rural Electrification	4 500	1.94	2 400	1.41
Schools & Clinics	704	0.30	352	0.21
Subtotal	11 697	5.04	6252	3.67
Rural PV	250	0.10	135	0.08
Rural Biomass	200	0.09	200	0.12
Generation & Transmission	20 000	8.62	20 000	11.73
Nuclear	301	0.13	301	0.18
Total Energy	32 448	13.98	26888	15.76
Total All Development	232 139	100	170 693	100

Source: *Towards A National Infrastructure Investment Framework*, 25 March 1996, Ministry in the Office of the President; p.6-28

<sup>7</sup> *Towards a National Infrastructure Investment Framework*, Confidential Second Draft, 25 March 1996, Ministry in the Office of the President.

**Table 2: Demographic Assumptions in RDP Scenarios (x 1000)**

	1995	2000	Annual Growth Rate
Urban population	23 200	27 400	3.3%
Rural population	18 000	18 000	0.0%
<b>Total population</b>	<b>41 200</b>	<b>45 400</b>	<b>1.9%</b>
Urban households (n=4)	5 800	6 800	3.3%
Rural households (n=5)	3 600	3 600	0.0%
<b>Total households</b>	<b>9 400</b>	<b>10 400</b>	<b>2.1%</b>

Both scenarios are 5-year investment strategies. Scenario 1 reflects the preferred expenditure plan of the relevant Government departments or parastatals. It represents a high scenario where backlogs are fully recovered within the 5 years in most sectors. The RDP office concluded, however, that in the aggregate these sectoral plans are neither sustainable at the local level, nor affordable by the national government. Thus, scenario 2 was designed to allow targets that could be accommodated by implementing agencies such as local authorities and parastatals and within the economic and financial resources available to the national government. The primary way this was achieved in scenario 2 was to extend the delivery period from that of scenario 1, not reduce the ultimate targets.

The energy sector consisted of household energy, electricity generation, transmission and distribution, a rural biomass program, a low-smoke fuels effort, and the nuclear industry. The scenarios excluded energy infrastructure within the private sector, such as petroleum and the synthetic fuels industry. Scenario 1 is consistent with the targets contained in the RDP, which call for 2.9 million new household connections (1.125 million rural, 1.775 million urban) and 9000 connections to schools and clinics by 2001. Scenario 2 cuts the number of new household connections by about half to a total of 1.35 million (600,000 rural, 750,000 urban). In both scenarios the following assumptions were applied: (1) capital expenditures on transmission and distribution constant at R4 billion/yr (~\$800 million);<sup>8</sup> (2) capital costs for new household grid connections of R3000 and R4000 (\$600 and \$800) for urban and rural connections, respectively; (3) higher connection fees for high-income households; (4) a 25:75 split between Eskom and local authorities for urban connections; (5) on-budget financing of off-grid energy of R200 million (\$40 million) over 5 years; (6) a 15%/yr increase in consumption by newly connected households from 60 kWh to 150 kWh for rural and 80 kWh to 350 kWh for urban.

As is seen by reviewing Table 1, the capital expenditures on the energy sector (primarily electricity) are relatively modest under either scenario, albeit higher as a percentage in scenario 2. Scenario 2's assumed 3.1% annual growth in GDP was judged by the RDP Office, as well as by a panel of private-sector stakeholders, to be realistic and thus able to support the level of effort contemplated by the scenario, whereas the 7% annual growth in GDP assumed by scenario 1 was viewed as unachievable. Electrification, including schools and clinics, represents less than 4% of total infrastructure capital expenditures under the more realistic scenario 2 and only 23.3% of all energy sector investments. Further, scenario 2 contemplates delivery of basic as opposed to full services and stretching out delivery from 5 years to 8 years. The latter point is important for two reasons. First, it allows the capital investment to be extended over a longer period, thus making it even more manageable. Second, the recurring losses resulting from electrification due to newly connected customers' low usage are reduced in scenario 2 since less costly 20-amp or 2.5-amp

<sup>8</sup> All money values are in constant 1995 rands.

service is provided as opposed to 60-amp full service. The RDP office study projects a cumulative deficit from new connections under scenario 2 to be *R1.77 billion* (\$354 million) over the 6-year period 1996-2001. This may be understated as it is based on the assumption that a proportion of newly connected urban customers will consume 350 kWh/month after 5 years, and experience to date tends not to support this assumption. However, even increasing the deficit to *R2 billion* (\$400 million) to account for this does not impose a significantly higher percentage burden.

The RDP study estimates that a 16.5% increase in high-income household tariffs, spread over 5 years, is required to sustain the cross-subsidy needed to support the operating deficit. Since the study claims to be working in inflation-adjusted terms and uses 1995 rands, I assume that the 16.5% is in real terms and would be higher in nominal rands. In real terms this becomes an average annual increase of 3.3%. Eskom has already committed itself to a further 7.3% price reduction in real terms by 2000.<sup>9</sup> Thus, even without economic efficiency gains from EDI consolidation and wholesale supply competition, the effective tariff increase would be 9.2% (16.5 less 7.3), or 2.3%/year.

While not insignificant, this increase is not large, especially given the relatively low base to which it would be applied. The government, however, apparently favors a situation where the real price of electricity will not increase over the next 5 or so years. Therefore, means to offset the 2.3%/year real increase must be sought. EDI consolidation, cost-based pricing, and/or competition in wholesale supply (if introduced in the next year or so) are the candidate means to produce the needed offsetting cost savings after these further real price reductions by Eskom. *If there is not a substantial basis for believing that these changes, separately or in combination, can produce these modest savings needed to prevent any increases in the real price of delivered electricity, then such changes should be seriously reconsidered.*

The McKinsey Study carried out for the ERIC, however, strongly suggests (at least to this reader) that substantial efficiencies are possible with EDI consolidation and a simultaneous move to cost-based tariffs. In fact, the implication in the study is that both an electrification levy and a municipal service tax to replace lost revenues could be absorbed and offset by economic efficiency gains. This does not include potential gains from wholesale competition. This means that EDI restructuring and cost-based tariff design alone can absorb electrification costs, both capital and recurrent. If so, a tariff increase to recover these costs is either not needed or would be minimal.

The conclusion from all this seems to be that the government is correct in assuming the electricity sector can self-finance its contribution to overall development. Yet, the policy and legislative changes needed to implement EDI consolidation and ESI restructuring and allow the industry to address serious distribution issues, while maintaining self financing, have not been acted on by the government. Why? Perhaps it is just that the government is as yet unaware that a means to finance electrification and address service and financial problems has been found, one that does not require help from the fiscus or the need to raise prices. Possibly it is aware, but is as yet unconvinced or has not been able to focus needed attention on the issues. It bears repeating, however, that from the government's perspective the costs involved are minor. This is particularly true of the operating deficit from electrification when compared to other sectors like health and education where the RDP office estimates recurring costs of *R83.4 billion* (\$16.7 billion) and *R176.8 billion* (\$35.4 billion), respectively, for scenario 2. Electricity sector numbers are simply not in the same league and therefore do not compel the same level of attention from an already overburdened government.

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<sup>9</sup> The source for this is the Eskom 1995 Annual Report, which states on p.6 in the Overview by the Chairman section, "*The price increase for 1995 was 4% against an inflation rate of 8.7%, a real reduction of 4.7 percentage points. The increase for 1996 is again 4%, an anticipated real price reduction of a further 4%....An undertaking was given in 1994 to reduce the real price of electricity by 15% by the year 2000 and this is expected to be achieved.*" Thus, if 15% real reduction is the goal in the 6 years between 1994 and 2000, and 8.7% has already been achieved (4.7% in 1995 and 4% in 1996), then 7.3% real remains.

This is especially true if the government believes that most of the efforts in the sector can be self-financed. This may explain why the government was slow to act on the ERIC recommendation. Even then did not adopt it as final policy. Instead, it adopted it as its initial position for additional discussions with stakeholders.

## Hard Questions about EDI Consolidation

What is the goal of consolidating the EDI? There appear to be three, but their relative priorities are not entirely clear:

- Acquire economic efficiency gains of scale and scope
- “Rescue” from collapse about one third of the municipal authorities (“problem municipalities”) now experiencing severe financial and/or technical problems
- Position the ESI for market competition in the future.

### Net Economic Benefits of EDI Consolidation

Very little work has been done on how and over what time period the EDI consolidation will be accomplished, and no estimates of the transaction costs have been made. Similarly, the benefits of consolidation have been stated in aggregate terms, and it is not clear what portion derives from the consolidation itself and how much from cost-based pricing.<sup>10</sup> (Cost-based pricing can be accomplished without consolidating the EDI and not involve the associated complexity and potential dislocations.) Therefore the net economic benefits of the proposed EDI consolidation cannot be estimated. Clearly, some actions are needed to handle the problems facing about one third of the municipal distributors, both in terms of electrification and with regard to their overall financial viability and ability to provide an adequate, reliable, and sustainable service (see below). Yet, is a “mega-consolidation” from the top down to 5, 9, or 17 REDs the answer? Over the long haul the answer is probably “yes.” The economies of scale and scope potentially available are worth acquiring, and it would also provide needed stability and continuity to the industry. This alone helps minimize costs by controlling uncertainty. In the near term, however, the answer is not as clear.

The issues surrounding such a consolidation are formidable. If viewed as a merger, the complexity is daunting. Merging 400 separate entities and Eskom’s distribution division, entities that are so disparate in size, ownership specifics, financial condition, outlook, and type and skill of personnel, is a challenge of the first order. There are numerous difficult tasks to be undertaken. Assets must be valued, a common accounting system must be devised and applied, pay scales must be harmonized, different organizational cultures must be melded, new management and control procedures developed and applied, etc. It could easily take 3 to 4 years to accomplish, with a variety of unexpected “bumps” sure to be experienced along the way. What happens during the transition phase? Where does accountability and responsibility lie for operations and electrification? If the benefits of consolidation become accessible only after the EDI has been substantially restructured, and it takes 3 to 4 years to do that with the top-down approach, it will be the year 2000 before benefits begin to offset transition/transaction costs. What will be the effect of this on operating performance and electrification in the next 4 years? These questions do not appear to have been systematically examined.

### “Rescue” of Ailing Municipal Authorities

The roughly 120 or so “problem municipalities” do not all suffer from the same thing. This complicates the analysis. Apparently in many the electricity distribution departments are actually functioning well.<sup>11</sup> The

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<sup>10</sup> I have received inconsistent information on this point, and it is one that needs to be clarified. Some stakeholders have claimed that benefits in the range of 15% can be achieved solely through consolidation. McKinsey, however, states that their estimates and recommendations were based solely on moving to cost reflective tariff.

<sup>11</sup> Personal communication with Jan Malan (Association of Municipal Utility Undertakings/AMEU), Kevin Morgan (NER), Ray Dabengwa (Eskom).

municipality as a whole, however, is experiencing serious financial problems and using electricity revenues to address them. Electricity service delivery is not the problem here. Therefore, EDI consolidation per se does not address the issue for this subset of “problem municipalities.” Another group of “problem municipalities” is experiencing serious difficulty in providing adequate, reliable service on a consistent basis. These municipalities apparently have financial problems too. The proposed consolidation would be able to address these technical delivery problems through the seconding and/or transferring of qualified personnel within the newly created RED. The financial problems, however, remain unaddressed directly.

Ironically, the municipalities that have serious delivery and operating problems for electricity service, and are the ostensible reason for change in the eyes of some stakeholders (NER), would probably be the least able to function effectively through the stress and uncertainty inherent in a “mega-merger.” Their performance may deteriorate further as a result, at least in the initial stages of consolidation.

## **Conclusion**

The benefits claimed for EDI restructuring have been roughly quantified. The costs of restructuring, however, and the real-world requirements and impacts on the industry have not been clearly defined or quantified. While detailed planning is not feasible or necessary before the policy decision is made, it seems prudent that strategic planning should be done in order to identify priorities, issues requiring special attention, and the types of service dislocations possible during implementation and to bracket the costs involved. Until this has been done, and the government can fully consider the entire range of ramifications of the policies proposed to it, it seems unlikely that the government will act to implement a top-down EDI restructuring.

## An Alternative Approach

The debate and examination of the ESI during the past 5 years have clearly been beneficial. They have caused stakeholders to scrutinize the industry, and their interests in it, and how the ESI can contribute to the country's Reconstruction and Development Programme. While no absolute agreement has been reached on all aspects of repositioning the ESI to meet the challenges facing it, there does appear to be consensus on two things. First, that the EDI is inefficient and not fully effective or functional in its current form. Second, that electrification is not being delivered as cost-effectively as it could be due primarily to lack of strategic direction. The recommendations coming out of the white paper process, the EWG, and ERIC represent the opinion of the majority of key industry stakeholders<sup>12</sup> on how to address these two issues. As previously discussed, however, the government has been unwilling to act to adopt and implement them. Perhaps the top-down approach to EDI consolidation is not feasible at this time.

Apparently, a variety of municipalities have approached the DME and the NER inquiring about merging into "mini-REDs." The number who have done so to date, how many others are considering it or could be encouraged to, and what "customer coverage" would result if such mini-REDs were formed is unclear. Yet, there may be an important opportunity available here to cultivate a naturally occurring, bottom-up approach to EDI consolidation, one that may be more feasible, less costly, and less disruptive. It may also be more acceptable to the government than the top-down approach because it is evolutionary and driven by the local authorities in response to their understanding of the issues and responsibilities they face. In this regard the industry debate during the past 5 years has been valuable in calling attention to problems and approaches for dealing with them.

At this juncture, it is worth considering what can be done to facilitate and encourage a bottom-up approach to EDI restructuring and, through analysis, match the benefits and costs of doing so against the top-down approach. To some extent the regulator is exploring this option, but involving the rest of the stakeholder community more formally in it, as was done on ESI issues with the NELF or the EWG, could be beneficial.

There are several tiers of merger candidates: those who have already decided a merger is advantageous; those who would if the benefits were made known to them; those who acknowledge the long-term benefits, but wish to avoid certain frontloaded costs of merging; and those who simply wish to retain sole ownership and control of electric service. Presently, the number of municipalities within each tier is unknown, except of course for those who have already come forward. It would be advisable, however, to try to determine the number of municipalities falling into each category and what customer coverage they represent, along with the potential for and feasibility of encouraging more municipalities to consider merging on their own to satisfy their particular interests.

Clearly, for the municipalities now experiencing such severe problems, merging with other like municipalities is not a solution for them, their customers, the ESI, or the country. If their problems are not effectively addressed, then this or any alternative approach is unacceptable. There may, however, be a way to meet their needs while also permitting/facilitating the bottom-up evolutionary approach to EDI consolidation. It involves borrowing the "circuit rider" concept, which has been successfully employed in the United States by small rural electric cooperatives and municipal electric utilities. Under the circuit rider

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<sup>12</sup> While these are a majority of key electric industry stakeholders, they are not all of them, nor representative of all other groups directly affected by the industry and its operations, structure, and governance.

approach groups of utilities with similar problems share a number of technical and administrative personnel to allow them to meet technical and operational needs, assess their ongoing personnel requirements, and train staff to address these matters on a continuing basis. The talent pool to provide circuit riders appears to exist in South Africa, and the monies needed to support it are likely to be small compared to the costs of a top-down consolidation and/or allowing service to deteriorate further in the problem municipalities.

## Other Key Issues

### Integration of Grid and Off-Grid Technologies for Electrification

One of the problems with the current electrification program is that it is driven by aggregate numerical targets for new connections per year. Eskom has an annual target of 300,000 new connections, and the municipal authorities' combined target is 150,000 per year. No other criteria are used. Since Eskom does not have supply rights in many of the urban areas, the bulk of South Africa's electrification program has been rural electrification. The cost of grid connected electrification in rural areas ranges between R4,000 (\$800) and R6,000 (\$1,200) per connection.<sup>13</sup> In addition, the actual costs of supplying electricity are not being recovered because usage by newly connected customers is very low, especially in rural areas. According to preliminary information from Eskom, the total cost incurred in 1996 from all the electrification it did was R1.093 billion (\$218.6 million).<sup>14</sup> Eskom collected R56 million (\$11.2 million) from newly connected domestic customers. Therefore, the loss from all household electrification in 1996 was R1.037 billion (\$207.4 million), to be recovered as a subsidy from other customers. This is a substantial amount, and ways to reduce it are needed. One thing to be determined in order to find ways to minimize this deficit is how much of the net loss is avoidable without simply ceasing to electrify new households. The answer lies in establishing the marginal cost to serve a newly connected customer and what components make it up. Clearly, given Eskom's surplus generating capacity situation, the capital investment in generating plant (including debt service) is not avoidable. These are sunk costs, and thus not part of the marginal cost to supply new customers. In the same vein, the load on Eskom's transmission system from newly electrified domestic customers is small and does not require system upgrade. Therefore, the capital cost and debt service of the transmission system are not components of the marginal cost. That leaves the capital cost directly associated with connecting new customers (including financing), the cost of supplied energy (fuel, operation and maintenance, and technical and nontechnical losses), and operation and maintenance directly associated with electrification investment. The operation and maintenance costs on supply (generation, transmission, and distribution) directly associated with electrification are an extremely small fraction of the total. This is true of technical (line) losses as well. Further, due to Eskom's take-or-pay coal contracts, most of the fuel cost cannot be avoided.

A rough calculation was performed to estimate the costs avoidable by substituting 100,000 20-W PV systems for grid connections in low-density rural areas. The results are presented in Table 3. Substituting this proportion of PV systems seems reasonable since a large portion of the easier and less costly urban and periurban connections have already been made, and their number will diminish during the 4-year period examined. Further, although PV is a low-power application it is roughly equivalent to the 2.5-amp service Eskom is currently piloting. Given that usage in similar areas already electrified is very low, between 30 kWh and 50 kWh per customer per month, the PV system should be adequate to meet this demand.

It appears from this admittedly crude analysis that the use of PV could reduce recurring electrification costs by more than *R300 million* (\$60 million) over the next 4 years.<sup>15</sup> This is not an insignificant amount.

<sup>13</sup> There is not a clear definition of what constitutes rural and periurban areas; hence the wide range of this estimate.

<sup>14</sup> All Eskom figures on actual electrification costs obtained from a confidential Eskom draft study.

<sup>15</sup> It is acknowledged that this analysis focuses on the early years and is not a proper full net present value comparison, which would capture estimated benefits of grid connections in the future near the end of the planning period. With so many uncertainties facing the ESI, however, it was believed that capturing these "end-effect" benefits 10 and 15 years hence was not the most reliable indicator upon which to base current decisions. Thus, the "cashflow" approach was taken to determine the approximate size of near-term benefits that might be realized, to determine whether a more rigorous analysis of this option would be warranted.

Although there are other important factors to consider before making a decision to substitute PV for a portion of grid connections, the rough estimate done here strongly suggests that this option deserves rigorous evaluation. Thus, besides its environmental, modularity, and resource diversity benefits, use of PV may be a cost-control strategy that can free up funds to make additional connections and/or reduce the level of cross-subsidy needed to support electrification.

**Table 3 Electrification Cost Comparison of Grid Connection Versus PV Systems (thousands of 1995 \$)**

Year	Grid Cost	PV Cost	Savings From Use of PV
1997	41,500	31,800	9,700
1998	55,500	36,740	18,760
1999	69,680	44,860	24,820
2000	83,320	73,400	9,920
<b>Total</b>	<b>250,000</b>	<b>186,800</b>	<b>63,200</b>

**Note:** 100,000 20-W PV systems in lieu of grid connections. 20-year life assumed for PV with a 3-year life for batteries. Thus, six battery replacements are included. For ease of calculation the cost of all battery replacements is accounted for in the year 2000. PV costs are assumed to decrease in real terms by 2.5%/yr. To be conservative all battery replacement costs were assumed at the real cost in the year 2000. The battery is assumed to represent 25% of the PV system capital cost. A 20% annual financing rate was assumed for the PV systems. Installation, maintenance, administration, and dealer's margin costs were assumed to remain constant at \$240 per installation in all years. This too is done to be conservative. Total PV unit costs in 1997 were assumed at \$480 (\$240 capital and \$240 other). Rand values were converted to \$ at 5 rand/\$. Grid costs were taken directly from a confidential Eskom study. They represent the *average cost* per connection and thus are somewhat lower than the costs for rural grid connections. This also was done to be conservative. A 16% annual financing rate, plus a 4% internal return was used. Costs included only the capital cost estimated for grid connections amortized over 25 years, the associated financing costs, and the operations and maintenance costs directly related to electrification. All PV costs taken from a recent EDRC study; *Scheme for Large-Scale Implementation of Solar Home Systems in South Africa*, Final Report, Volume I, Part B; EDRC, August 1996.

Given the potential for significant cost savings, full integration of off-grid options like PV should be adopted as a component of electrification planning at the national, provincial, and local levels so that the "on the ground" economic analysis of the type outlined above is done in determining the most cost-effective approach to extending electric service in rural areas. It will also have application in urban settings, although grid connection costs are much smaller there and customer usage is higher.

### **Integrating Electrification with Other Infrastructure Development**

At present, there is little if any coordination of electrification with other infrastructure development efforts, such as roads, water, sanitation, and housing. This lack of coordination is potentially very wasteful of precious and scarce resources, both monetary and human. "Potentially" because no effort has been made to assess systematically the level of inefficiency. Yet, the anecdotal evidence of this is abundant. Discussions with Eskom's electrification planning manager (Thula Bopela), for instance, suggest that many of the rural areas electrified have not had other infrastructure services provided. Thus, while electricity is a necessary condition for economic development and growth, by itself it does not create it in the absence of other physical infrastructure components like roads, water supply, sanitation, housing, and telecommunications. Developing local economies is essential to improve the quality of life by providing economic opportunity and to eventually permit infrastructure services like electricity to operate without subsidies. Continuing to implement electrification independently of delivery of other needed infrastructure development does not

seem to be the best way to deploy the scarce resources available to meet economic growth and social upliftment goals.

Yet, there is another dimension to the situation to be considered; the relative capability of the various sectors to deliver infrastructure expansion. Consider, electricity is a necessary (although not sufficient) condition for economic development. The ESI appears roughly capable of meeting its numeric electrification targets, while other sectors are not meeting their targets and schedules. Should electrification be delayed by trying to integrate it with other infrastructure development? Perhaps not. This view assumes, based on performance to date, that the organizations responsible for delivery of other infrastructure components cannot do so as rapidly, efficiently, or on the same scale as the ESI. The reasons for this may involve the different scale and scope of the services to be provided and/or the lack of capital, expertise, and mechanisms to deliver them. Further, there is an implication in this viewpoint that reducing the pace and scope of electrification efforts to match those of other infrastructure development will raise equity or fairness issues to be avoided when those areas slated for electrification now do not receive it until some later date and complain they are being discriminated against. Of course, the current practice of electrification raises equity issues also. Eskom is the most able to deliver electrification, but for reasons already mentioned, is doing so mainly in rural areas. The larger municipal authorities are meeting their targets, but many others apparently are not. Thus, the situation arises in which people living in areas already possessing some or all of the other infrastructure needed for economic development, but served by municipalities with limited ability to meet their electrification goals, are not electrified, thus having to forgo economic development opportunities. At the same time, however, electrification is being provided to people in areas that cannot use it as effectively for economic development. Might not the people foregoing electrification believe they are being unduly discriminated against? Might not they point out that provision of electricity to them before less developed areas is the sensible way to help the country as a whole improve and expand its economic base?

This scenario raises a fundamental strategic question: What is the goal of electrification? To provide electricity for all<sup>16</sup> or to support economic growth in the near and long terms? The pattern, sequence, and cost of electrification will be substantially different depending on the answer to this question. Currently, the answer in terms of how electrification is being implemented is “electricity for all.” Yet, the strategic vision contained in the RDP suggests that it is also “to support economic growth in the near and long terms.” Given limited resources for development in all sectors, it does not seem feasible to pursue both goals simultaneously. This, however, has become the policy by default and has led to confusion and inefficient delivery of electrification from a strategic perspective. Even if integrating electrification with other development activities is judged theoretically correct, but unfeasible now as a practical matter, policy guidance from the government on electrification priorities is essential. Perhaps this situation can be tolerated in the near term as the government struggles with a plethora of other pressing issues confronting it as it tries to remake the country. *If so, however, it is desirable to acknowledge this and thus provide clear guidance and sanction to those now charged with implementing electrification and other development efforts.*

## **Wires and Trading**

This is a concept to introduce flexibility into the supply and delivery of electricity by unbundling the service of transmitting electricity from its purchase and sale. This approach to overall service provision could be used under any of the models for industry structure proposed so far. It also anticipates the introduction of competition into the industry at both the wholesale and retail levels. Under this approach, municipalities could continue to own the “wires” (distribution) but have it operated by another party in the private or

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<sup>16</sup> There is a secondary, but also important question embedded here too, i.e., what level of electric service should be provided “to all”? What constitutes providing for a basic human need?

public sector through a leasing arrangement. In the context of the present EDI consolidation recommendation to government, the operation of the “wires” would be leased to the REDs. The current electricity department staff of the municipality could also be “leased” to the third party as part of the arrangement. The municipalities would receive a leasing fee from the RED and this would provide a revenue stream. The municipality could also continue to aggregate load for their citizens and broker for supply on the wholesale market, i.e., the “trading” function. There would be a difference in the wholesale tariff the municipality purchased at and the retail tariff the electricity was resold at. This differential would also provide the municipality with a needed revenue stream.

The idea of leasing the “wires” function to another party to operate and receiving a fee for so doing seems to be a reasonable approach both to addressing technical service delivery problems and to replacing the revenues lost in the move to cost-based pricing. The advantages of the “trading” part of the “wires and trading” concept are less certain. The reason is that there is not now a competitive wholesale market to “trade” in, and it is unclear when one will emerge. Consequently, the advantages to the municipality of “trading” will depend on the rate-setting process of the NER. With cost-based tariffs the rationale for having a retail rate above the wholesale rate is mainly in the need to recoup the cost of performing the distribution function. The municipalities will not be performing this function, having “leased” it to the RED. The costs of doing the trading are small by comparison. Thus, on a cost basis one would not expect the retail tariff to be substantially above the wholesale tariff. Therefore, the revenue stream to the municipalities from the wholesale–retail tariff differential would not be significant. This suggests that the NER will have to set a wider differential if the “wires (leasing) and trading (tariff differential)” revenue streams are to be adequate to replace either current revenue or that expected from the proposal that all municipalities tax electricity sales.

This is an intriguing concept that merits further examination as a means to overcome some of the problems in the ESI and gain needed economic efficiencies.

## **Taxonomy of EDI Consolidation and Competition Effects**

Tables 4 and 5 represent an initial attempt to organize for subsequent analysis the possible effects of EDI consolidation and competition on electrification and on customers. The tables contain candidate hypotheses to be tested through analysis. They need to be extended, however, to account for various governance/regulatory models that could overlay different industry structures and levels of competition. This may be the subject of a subsequent research effort.

**Table 4 Possible Effects of Competition on Distributors and Customers**

Customer	Wholesale Competition	Retail Competition
<b>Municipal Distributors</b>	<p>Costs lowered by the level of economic efficiency gains. Thus, tariffs could be reduced by this amount and still keep the subsidy from electricity to other municipal services at the same level. Or, tariffs remain the same and contribution to other services increases by amount of efficiency gain or something in between.</p> <p>Economic efficiency gains may not be as great for small municipal distributors as for large municipal distributors.</p>	<p>Could lose customers, especially large ones seeking tariffs equivalent to those of competing businesses. Ability to price electricity above the market not possible. This means that the ability to price above cost to generate surpluses would probably be lost unless cost was below the market price, in which case above-cost pricing up to the market price would be possible. It seems unlikely, however, that cost would be significantly below market for any sustained period or, if it were, that the differential would be large enough to yield significant surpluses. Surpluses foregone under retail competition could, however, be reclaimed through an above-cost “wires charge” on distribution or via a municipal services tax. This may cause larger, less captive customers to move out of the municipal service territory.</p>
<b>Large Municipal Customers</b>	<p>May see prices reduced by level of the economic efficiency gain. However, Eskom directly connected customers will be able to access a similar, if not larger, efficiency gain. Thus, relatively speaking, large municipal customers could be worse off vis-à-vis Eskom directly connected customers if municipal suppliers continued to price above cost and/or impose a “wires charge” or municipal service tax.</p>	<p>With direct access to alternate suppliers, these customers should see lower prices equal to the economic efficiency gain from moving to retail competition. This could be offset, however, by higher municipal “wires” charges to replace surplus revenue lost to competition. Whether the offset equals the savings through direct access depends on both the level of the economic efficiency gain and the level of any “wires” charges.</p>
<b>Small Municipal Customers</b>	<p>May see tariffs reduced if economic efficiency gains are realized. These gains, however, might be shifted to large customers as the municipality attempts to maintain its revenue surplus and bring large customer tariffs more in line with those paid by large customers directly connected to Eskom.</p>	<p>Same basic situation as described above. However, since smaller customers have correspondingly smaller loads, the transaction costs of accessing alternative suppliers will be a higher percentage of their total bill. Thus, individually they may not realize a significant reduction to net price. This, of course, is dependent on the level of the economic efficiency gain generally from retail competition. If small customers can aggregate their load, however, either by forming cooperatives and/or their own “brokerage” organizations they may be able to realize savings equivalent to large customers.</p>
<b>Eskom Direct Customers</b>	<p>Prices lowered by amount of economic efficiency gain.</p>	<p>Should be the same as large municipal customers, except that they could avoid any municipal “wires” charges or service tax if imposed.</p>
<b>Regional Electricity Distributor</b>	<p>Tariffs lower than under current EDI structure by level of economic efficiency gain and by removal of cross subsidies for other municipal services. This latter, however, likely to be offset by direct municipal taxes or a distribution “wires” charge to replace surpluses lost under restructuring.</p>	<p>Could become “Lincos only” (regional transmission and local distribution companies) under retail competition, owning no generation of their own. If they do own generation, they would have to set tariffs at market price or lose sales on power and energy to competitors. Could also act as aggregators of small customer load.</p>

**Note:** In all cases the current electrification subsidy is assumed to be removed from tariffs, but collected through a national levy on electricity sales applied to transmission so that all suppliers are equally affected. Thus, this component is the same in each case, and thus has been “factored out” and therefore not mentioned in this table.

**Table 5 Potential Effects of EDI Restructuring and Competition on Electrification**

	<b>Electric Distribution Sector Restructuring</b>	<b>Wholesale Competition in Generation</b>
<b>Delivery</b>	Initially, not as good as Eskom’s current standard, but better than many of the municipalities. After the transition is complete should improve to match Eskom’s current standard.	Should have no direct effect on delivery of electrification. It could enhance delivery if economic efficiencies are realized and applied to delivery.
<b>Pace</b>	The pace will probably slow, possibly a lot, during the transition period. Merging so many disparate organizations will inevitably affect the ability to deliver new connections as new management structures, procedures, and personnel are put in place and refined with operating experience.	Initially it could slow the pace at which electrification proceeds as distributors try to understand the new market and focus more of their attention and resources on gaining competitive benefits from alternate suppliers. After the adjustment, however, cost savings gained from competition could be applied to accelerate the pace of new connections.
<b>Cost</b>	Costs will still be primarily a function of where connections are made, i.e., urban, periurban, or rural. Larger organizations, however, may be able to gain some efficiencies of scale and scope that could reduce costs overall from what they are at present.	Competition should have no effect on the cost of electrification, but should reduce overall operating costs. This allows for funds “freed up” to be used for electrification. Whether they are, of course, is a matter for distributors to decide. See above comment.
<b>Location</b>	This refers to where connections are made and in what sequence. Ultimately, this should be guided by explicit government policy that establishes clear criteria. Formation of REDs, however, represents an implicit government policy on allocation of resources to electrification via the number, boundaries, and composition of the REDs created. If the REDs have resources roughly equivalent to the electrification needs in their respective service territories, then there should not be an imbalance in the type and level of electrification accomplished within each RED unless imposed by explicit government policy.	In theory, competition should have no effect on where and in what order new connections are made. In practice, however, the ability of each distributor to successfully adapt to and exploit competition can affect this matter.
<b>Grid/Off-Grid</b>	EDI consolidation should have no direct affect on this matter, as it should be set by policy not EDI structure. The consolidation should, however, make such a policy easier to implement evenly across the country if it is adopted.	Competition is for <i>grid-supplied electricity</i> . Thus, depending on the relative size and sustainability of economic efficiencies gained, off-grid technologies <i>might</i> be disadvantaged from a cost viewpoint by competition. For connections in areas not presently served by the grid, however, off-grid technologies are likely to remain more cost-effective than extending the grid to provide basic service.
<b>Integrated Development</b>	Larger organizational units should be able to coordinate electrification efforts with other infrastructure developments more effectively than the current structure. Whether they do, of course, is also a function of strategic policy set by the government, which provides necessary guidelines and criteria to all development efforts and actors, not just the electric industry.	Competition should not have any direct effect on coordinating electrification with other infrastructure development efforts.

**Note:** The “Delivery” category refers to the quality of project management, e.g. effectiveness and timeliness of delivery.

## Conclusion

This paper reviewed the status of the South African ESI and proposals for reorienting and restructuring it. The ESI's situation must be viewed within the larger context of fundamental change occurring politically, socially, institutionally, and economically within the country. Issues within the ESI are driven by these factors.

The most pressing problems are in the EDI. A significant number of the local municipal authorities currently supplying electricity are not financially viable, and some of these are experiencing serious problems in providing adequate service and meeting electrification targets. In addition, local authorities have traditionally priced electricity above cost to subsidize other municipal services. This pricing distortion is increasingly seen as a barrier to obtaining needed economic efficiency gains in the industry. Further, the idea of permitting competition, first at the wholesale level, but later at retail, is viewed by many stakeholders as necessary for long-term growth and efficiency. Cross subsidies of any kind cannot be easily supported in a competitive environment. This means current subsidies in tariffs for electrification and municipal "shadow taxes" through retail tariffs will have to be eliminated. Revenues generated by both, however, will have to be replaced through a transparent tax mechanism.

The following conclusions have been made.

### ***Exploit the opportunities possible in a bottom-up approach to EDI consolidation to enhance goals sought through a top-down approach***

An alternative to address immediate problems in the EDI is needed if political consensus on the top-down approach cannot be reached. That alternative may be emerging from the bottom up, as opposed to the top down. The benefits of facilitating an evolutionary approach to industry consolidation from the bottom up should be seriously examined.

### ***Clarify the goal of electrification***

The goal of electrification is unclear and the electrification program lacks proper strategic guidance from the government. If economic development is the goal, the government must revise the current numeric criteria to provide useful guidelines to implementors for targeting their efforts. Even if basic service provision is the goal, the government should still give guidelines on the pace and location of new connections to allow for more effective and equitable implementation.

### ***Integrate PV resources into electrification analysis, planning, and implementation***

The capital cost of PV systems is often lower than that of a grid connection and will reduce with economies available with increased manufacture. Operating costs for PV may be significantly lower than for grid connections and can probably be recovered from revenue collected from newly electrified customers. A rough calculation of the costs avoidable through use of 20-W PV systems is estimated at more than R300 million (1995 terms, ~\$60 million). Given the impressive size of these savings, a rigorous examination of PV's benefits should be done, and off-grid technologies integrated into the analysis, planning, and implementation (where cost-effective) of the household electrification program.

### ***Determine the feasibility of integrated development through focused pilot efforts***

Electrification has been pursued independently of other infrastructure development activities until now. Electricity is a necessary but not sufficient condition for economic development. If the government's goal for electrification is primarily to support economic development, then ideally integrated development is

critical to successfully achieving it. Other infrastructure delivery sectors, however (except water), are apparently experiencing serious problems in meeting their schedules and targets. Thus, the question arises of whether attempting to integrate electrification with other infrastructure development is feasible. It may be more realistic to accept the fact that other sectors cannot keep pace with the ESI at this time and go ahead with electrification. This requires acceptance that the gains of integrated development must be foregone in favor of putting one of the critical components for development in place now. If these gains cannot realistically be acquired, however, pushing ahead with electrification independently may be the best course to take. It would be advisable, however, to establish several pilot integrated development projects to find out in a hands-on fashion what the obstacles to integrated development are and the means and cost of overcoming them. Perhaps the current SDIs, which target development corridors, can be used for this purpose.

## Appendix 1 People Interviewed

Name/Title	Organization	# Sessions
Dr. Ian McRae/Chairman	National Electricity Regulator (NER)	3
Kevin Morgan/Staff Director Legal Services	NER	5
Ray Dabengwa/Executive Director - Distribution	Eskom (National Electric Utility)	5
Dr. Izak Kotze/Manager	Renewable Energy for South Africa (REISA)	4
Judy Wade/Principal	McKinsey, Incorporated	2
Dr. Wolsey Barnard/Dep. Director Electricity & Gas	Department of Minerals & Energy (DME)	1
Dr. Deon Stassen/Policy Business Unit	Development Bank of Southern Africa (DBSA)	4
Rodney Buttle/Non-grid Electrification Manager	Eskom	1
Ian Whitlock/Senior General Manager Finance	Eskom	4
Johann Basson/Chief - Energy Directorate	DME	4
Dr. Paul Jourdan/Advisor to the Minister	Department of Trade and Industry	1
Koos Shoeman/Finance Manager - Electrification	Eskom	1
Neila Heydenreich/Environmental Specialist	DBSA	4
Tony Surrige/Director - Electricity, Coal, & Gas	DME	1
Thula Bopela/National Electrification Planning Manager	Eskom	2
John Bradbury/Consultant	Consultant	2
Randolph Forbes/Manager of Tariffs	NER	3
Wendy Poulton/Environmental Research Manager - Operations	Eskom	1
Dr. Stephen Lennon/Research Manager	Eskom	1
Mvuyo Ndziba/Director	Department of Public Enterprises	2
Bill Cowan/Researcher PV	Energy and Development Research Centre	3
Cecile Thom/Researcher	Energy and Development Research Centre	2
Frans Bergh/Rates and Tariffs	Eskom	4
Jan Malan/President	Association of Municipal Electricity Undertakings	1

## References

1. *Tariff Distortions*; Internal Draft Eskom Study; December 1996
2. *ESI Restructuring - Guiding Principles*; National Electricity Regulator; December 1996
3. *Towards A National Infrastructure Investment Framework*, Confidential Second Draft, 25 March 1996, Ministry in the Office of the President
4. *Electricity Working Group - Final Report*, National Electricity Regulator; 1996
5. *Report of the Large Customer Task Team of the National Electricity Regulator*; National Electricity Regulator; October 1996
6. *Working Group for the End-Use of Energy and the Environment*; National Electrification Forum; J.A. Basson; July 1994
7. *The Electricity Act*; Act 41 of 1987; Lex Patria Publishers
8. *Electricity Amendment Act Of 1995*
9. *Electricity Supply Industry Regulation Bill - Draft VI*
10. *Synthesis Report on Cogeneration and Independent Power Production in South Africa*; R.B. Anderson; Department of Minerals and Energy Affairs; 1994
11. *Draft Electricity Sub-section - White Paper on Energy Policy*; November 1996
12. *The Distribution of Power: Recommendations on Electrification Policy*; Mark Davis, Mark Pickering, Grove Steyn; Energy for Development Research Centre and Minerals and Energy Policy Centre; September 1996
13. *Electricity Pricing Policy: Widening Access to Basic Energy Services for the Urban and Rural Poor*; Mark Pickering; South African Energy Policy and Training Project; Energy for Development Research Centre, University of Cape Town; 1994
14. *Institutional Alternatives for Electricity Supply to Serve the People of South Africa*; Private Report to Eskom; David S. Schwartz; July 1990
15. *Eskom Statistical Yearbook- 1995*; Eskom
16. *Eskom Annual Report: Electric Energy Connects Us - 1995*
17. *Meeting South Africa's Electricity Distribution Challenges - Confidential Report*; Electricity Restructuring Inter-departmental Committee; 30 August 1996
18. *Options Available to the South African Electricity Industry for the Introduction of an Electricity Market*; Report to the National Electricity Regulator; Electricity Market Task Team; July 1996
19. *Eskom, its finances and the national electrification program*; Clive van Horen; Energy and Development Research Centre, University of Cape Town; August 1995
20. *Scheme for Large-Scale Implementation of Solar Home Systems in South Africa*, Final Report, Volume I, Part B; EDRC, August 1996

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