

# The South African Efficient Lighting Initiative: Evaluation of the Hartbeespoort Field Study

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## ABSTRACT

The South African Efficient Lighting Initiative (ELI) is a 3-year, US\$10 million dollar effort jointly funded by the International Finance Corporation (IFC)—via a grant from the Global Environment Facility (GEF)—and Eskom (South Africa's parastatal electric utility). The ELI is a demand-side management (DSM) activity that seeks to transform South Africa's lighting market through the promotion of efficient lamps and luminaires. The initiative is set to commence in July 2000.

This paper describes the objectives and evaluation of a the Hartbeespoort field study that Eskom conducted (along with four other field studies) in 1999 to inform the design and implementation of the full-scale ELI (Eskom 2000a). In Hartbeespoort, Eskom sought to determine whether (1) efficient lighting can provide distributed utility benefits; offsetting lost energy sales with reduced peak demand charges and (2) financing for efficient lamps and distribution through utility depots was an effective means of selling the technology into the market.

The evaluation of the field study showed that the ELI would have a negative impact on South African distribution utilities bottom lines, but that the avoided costs of peak demand could offset most of the revenue lost by reduced kWh sales. As for financing programs, few residents of Hartbeespoort availed themselves of the lease option, preferring to buy the lamps with cash. Finally, with respect to sales through utility depots, the office hours and location of the municipal offices limited accessibility and the municipal staff voiced objection to the additional workload.

## Introduction

The South Africa lighting market is dominated by inefficient incandescent lamps with very low penetration of efficient lighting products (Eskom 1998, 2000a). To begin to remedy this situation, in May 1998, Eskom—South Africa's parastatal electric utility—signed a contract with the International Finance Corporation (IFC) to develop a business plan for a South African Efficient Lighting Initiative (ELI). The objective of the 3-year, \$US10 million (R63 million)<sup>1</sup> ELI is to promote the penetration of efficient lamps and luminaires into the South African market, which consists of three broad segments:

- low income and previously-disadvantaged communities that are currently being electrified at a rate of over 200,000 homes per year;
- "normal" existing and new household markets with multiple light points per dwelling; and
- commercial and institutional building markets and industrial plants.

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<sup>1</sup> The exchange rate in March 2000 was 1 US dollar = 6.30 South African rand. For the remainder of the paper, all prices are quoted in rand.

Through the ELI, the IFC, the Global Environment Facility (GEF) and Eskom jointly propose to address technical, marketing and institutional barriers that have to be overcome to create a cost-effective, robust market for energy efficient lighting. The IFC/GEF contribution to the ELI is \$2.5 million (R16 million) over two years.<sup>2</sup> Eskom's contribution is R48 million (\$7.5 million) over three years. The IFC and GEF's interest in the ELI is to reduce greenhouse gas emissions from South Africa's power plants most of which are coal-fired. Eskom's interest is to reduce its evening peak demand which is highly coincident with household lighting use.

As a first step of the ELI, in December 1998, Eskom initiated four "phase 1" field studies—Soweto, Kutlwano, Albertinia/Heidelberg and Hartbeespoort—to test methods for improving the awareness, accessibility and affordability of CFLs for both low- and mid-to-high income households. These field studies ran for various durations throughout 1999, but activity on all four field studies came to a close by December 1999. This report presents the findings from one of the four field studies—Hartbeespoort—and outlines the recommendations to Eskom and the IFC for full-scale ELI program implementation that came out of Hartbeespoort. Similar, though less detailed reports, have been developed for the other field studies (IIEC 2000).

The first section provides an overview of the objectives of the Hartbeespoort field study. The second section presents the evaluation plan and criteria/matrix devised by IIEC. The third section contains the process and impact evaluations for the field study. The fourth section presents lessons learned from the field study that can be applied to full-scale ELI program implementation.

## Field Study Objectives

Hartbeespoort is a small town west of Pretoria with approximately 3,000 middle- and high-income customers. The field study was part of the town's larger program to promote the wise use of energy and the conservation of natural resources. Faculty from the Department of Architecture at the University of Pretoria designed this larger program. The University also played a large role in designing and implementing the field study (Holm 1998).

As is typical in South Africa, the Hartbeespoort municipality (or "munic") serves as the local electricity distributor, buying electricity in bulk from Eskom and selling it on to its residents. For Hartbeespoort and many other munics, electricity sales are an important source of revenue. Few munics understand that DSM programs can shave their peak load and thus reduce the peak demand charge they pay to Eskom. Rather, they are concerned with lost energy sales from the proliferation of efficient technologies (Eskom 2000a). This field study was designed to show how efficient lighting can provide distributed utility benefits; offsetting lost energy sales with reduced peak demand charges. In addition, the field study sought to determine whether CFL financing (with loan repayment through customers' monthly electricity bills) and CFL sales at utility depots and pay points were effective means of selling the technology into the market.

After conducting a focus group to provide a baseline against which to gauge changing consumer perception, the Eskom implementation plan consisted of entering into a contract with General Electric (GE) Lighting and Osram whereby these CFL manufacturers would

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<sup>2</sup> South Africa is one of seven countries participating in the IFC and GEF funded ELI (IFC 1999). The other countries are Argentina, the Czech Republic, Hungary, Latvia, Peru, and the Philippines.

sell lamps to Eskom for R29. Eskom, in turn, would provide the CFLs to the municipality at the subsidized price of R25 per lamp as well as provide the municipality a R5 commission for every two lamps sold.

Customers whose accounts were paid in full would be able to buy lamps from the municipality at the price of two for R50 and would have the option of paying for the lamps through a line item on their monthly bill. The municipality would encourage customers to use the CFLs in luminaires operating at peak times, 6:00-8:00pm, and in luminaires operating for more than three hours per day. The town's load profile was to be monitored during and after implementation, which (similar to the Albertinia/Heidelberg field study<sup>3</sup>) would provide insights into the distributed utility benefits of residential DSM.

## **Evaluation Criteria/Plan**

The International Institute for Energy Conservation (IIEC) conducted a process evaluation to assess the effectiveness of the planning and implementation of the field study. IIEC also conducted an impact evaluation of the Hartbeespoort field study to quantify the demand and energy savings from the field study.

IIEC carried out the process evaluation principally by interviewing individuals involved in planning and implementing the field study. The process evaluation investigated whether the field study:

- was implemented as planned;
- effected customer attitudes to CFLs; and
- provided adequate data.

IIEC's impact evaluation relied on reports provided by the Eskom staff and consultants who ran the field studies. The outputs of the impact evaluation included the:

- number of CFLs sold;
- impact of CFLs on energy sales and thus on customer savings and municipal revenue; and
- impact of the CFLs on the municipality's maximum demand and hence on the maximum demand charges the municipality pays to Eskom.

## **Evaluation Findings**

In terms of units sold and relative smoothness of implementation, Hartbeespoort was the "model" field study. Hartbeespoort provided insights to both consumer interest in leasing CFLs and data on the municipality's distributed utility costs and benefits.

## **Field Study Implementation**

The mayor of Hartbeespoort municipality formally launched the field study on 14 December 1998. Prior to that date, Eskom provided assistance to the municipality by (1) obtaining bids from major lighting manufacturers to supply CFLs, (2) evaluating those bids

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<sup>3</sup> Albertinia and Heidelberg are small communities in the Western Cape with little industry and relatively high electricity tariffs. As with Hartbeespoort, the Albertinia and Heidelberg field study tested how efficient lighting can provide distributed utility benefits, offsetting lost energy sales with reduced peak demand charges.

and (3) entering into contracts with two suppliers to buy lamps. Osram and GE Lighting were selected as suppliers and contracts were signed in November 1998.

Just prior to the launch, the field study coordinators conducted focus groups to gauge consumer awareness of the CFLs prior to the program launch. The focus groups showed that there was no unaided awareness of the lamps at that time, either among end-users or among the municipal staff. The consumer reaction was overwhelmingly positive to the technology and to the proposed program. Participants viewed CFLs as attractive, high-technology products and liked the fact that the program would make the CFLs available to them at below-market prices.

The CFLs were sold through the Rates and Taxes counter at the municipal offices. Prior to the initiation of the field study, the team coordinating the field study redesigned the Rates and Taxes hall to serve as an "Energy and Water Efficiency Information Center". The center helped to create public awareness at a very appropriate moment—when customers pay their electric and water account. A special exhibit demonstrated the consumption of CFLs compared with incandescent lights.

In addition to the fixed display, during the first three months of the program, the municipality sent electricity bill inserts with information about the CFLs to all customers. Additional publicity included articles in the local newspaper, and public relations campaigns developed by the two manufacturers. Eskom also developed a public relations campaign, which municipal staff in Hartbeespoort thought was much less relevant and successful than those sponsored by the manufacturers.

The municipal staff handling the municipal accounts also handled the CFL transactions and educated potential customers on the benefits of CFLs. Municipal workers received training about two months into the field study. The delay in providing training was attributed to the Christmas holidays. The training appeared to be useful because since February, sales from the municipality's offices increased, and municipal staff resistance to the pilot program (previously perceived as additional unnecessary work) decreased.

In Hartbeespoort customers had two different options for paying for their CFLs:

1. buy one CFL for R50 cash and get one free, with a maximum total of six; or
2. buy up to six CFLs on credit, repaying this loan (plus a small handling fee) through a line item on their monthly electricity bills over a maximum of ten months.

Regardless of the payment method chosen, residents had to fill in a form that requested a minimum amount of information. The municipality offered five different integral CFLs ranging from a 13-watt GE to a 21-watt Osram (either in Edison screw or bayonet type), all at the R25 per lamp price. In addition, a 20-watt high power factor CFL was available at a price of R60. Typically, CFLs sell for R40-60 (and sometimes as high as R80) in South Africa.

A further condition, aimed at improving payments by *masakhane* (low-income) households, was that buyers must have their electricity account fully paid up, which was checked by the municipal clerk. However, in spite of the strained economy, Hartbeespoort residents do pay their municipal accounts, rendering the above incentive to pay one's electric account in full somewhat unnecessary. In other areas of the country, non-payment rates can be as high as 10-15 percent.

An important component of the program was Eskom's guarantee of the CFLs. By agreeing to replace any failed lamps within the period of one year, Eskom's gesture raised

customers' confidence in the technology and allowed the municipality to participate with less hesitation.

### **Process Evaluation—Implementation**

The field study's launch in December posed some challenges. Few Eskom staff were available to provide assistance, and the municipal staff were not pleased with the idea of extra work. Time constraints on the part of Eskom staff made co-ordination among all the parties more difficult. While the CFLs were available for purchase just before Christmas, the program did not really get started until mid-January, the middle of the South African summer.<sup>4</sup>

Moreover, the detailed monthly reports that the University requested of the municipality proved to be difficult to procure. Municipal officials stated that they were overworked and the sale of lamps constituted an additional temporary workload that might not reflect on their performance assessment. As a result, it took several months before the municipality could provide the University with data on lamp sales, returns, broken lamps, etc. The problem was compounded by the fact that the municipality only kept paper records, and did not have the capability to record the information electronically.

Nevertheless, the municipality seems to be enthusiastic about the program. The University makes a monthly report to the municipal board about the lighting and other DSM programs, and board members have used their support of the lighting field study for positive public relations.

Ultimately, Hartbeespoort asked Eskom if it was possible to extend the field study for several months beyond its initial April end date. The University and municipality wanted to use the additional time to gauge whether consumers' interest in the lamps would continue to increase as the public education sunk in. Eskom agreed to a two-month extension.

Based on the success of the second promotional campaign, the University's research team proposed another promotional drive between the local media and the CFL firms. Although this additional activity never took place, the field study nevertheless remained active until October 1999.

The information drive had impacts beyond Hartbeespoort. Requests for information from the research team were received from as far afield as the towns of Knysna and Port Elizabeth both of which lie on South Africa's southern coast some 1,000 kilometers from Hartbeespoort.

### **Process Evaluation—Customer Attitudes**

Most of Hartbeespoort's residents opted to purchase the CFLs outright, rather than lease them through the municipality. The most popular lamps are the integral 20-watt models from GE Lighting and Osram. Since power quality is not of direct interest to residential customers (they do not pay power quality fees), the higher priced, high-power factor models were of little interest to customers.

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<sup>4</sup> CFL programs are usually run during winter months when lighting needs are the greatest. Eskom, however, deemed its need to start collecting data on potential ELI activities as more important than perfect timing.

Overall customer awareness about CFLs has increased. In addition, some customers have expressed interest in purchasing more than the six lamps allowed under the program at this time. The staff interviewed believes that customers are willing to pay more for the CFLs than they currently were charged during the field study. That said, customers did have a number of concerns regarding the new technology:

1. Exterior bulkhead lights cannot be fitted with integral CFLs issued because the CFLs are too long.
2. Some residents wish to use dimmers on CFLs, which is technically not possible with the lamps sold through the program.<sup>5</sup>
3. Although favorably impressed with the reduced energy-related environmental impacts of CFLs (over its lifetime, a CFL in South Africa will reduce power plant water consumption by ~10,000 liters and power plant carbon dioxide emission by almost four tons), some residents questioned the environmental impact of dumping or recycling CFLs due to their mercury content.
4. The fact that few CFLs are manufactured in South Africa concerned residents worried about local job losses if locally manufactured incandescents were replaced on a massive scale by imported CFLs.

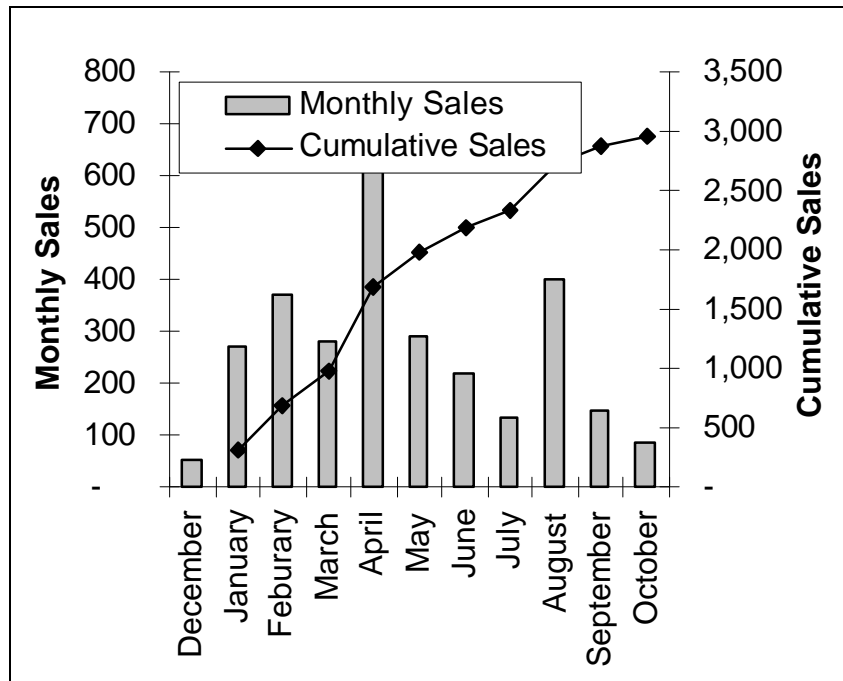
Finally, with respect to the option to lease CFLs, very few Hartbeespoort residents availed themselves of this opportunity. The program did not capture residents rationale for preferring cash payments over leasing, but program staff hypothesize that Hartbeespoort's residents (who are relatively high-income) were not interested in engaging in a lease for such a small sum of money. Staff further hypothesize that the popularity of CFL leasing mechanisms could be much higher in low-income communities.

### **Impact Evaluation—Sales**

Figure 1 depicts the steady rise in sales that followed the launch of the field in December 1999. From April (when the field study was initially envisioned to end) until July, sales fell as no new coupons were sent out and active promotion of the field study was interrupted. In August, when the program was re-launched and advertised, sales jumped before falling again as the field study came to a close.

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<sup>5</sup> Dimmable CFLs are available, but they are much more expensive than standard CFLs.



**Figure 1. Monthly and Cumulative CFL Sales (Holm 2000)**

Monthly sales by product type are shown in Table 1. The GE 15-watt High Power factor CFL costing R60 each must be regarded as a special case. It cost more than double of the other lamps and buyers did not understand the benefit of a high power factor. As seen in the table, about one fifth of all sales were 13-watt CFLs, one quarter of 15-watt and 16-watt lamps with the balance (54 %) taken up by 20-watt and 21-watt CFLs.

**Table 1. Monthly Sales by Model (Holm 2000)**

	GE 13W	GE 15W	GE 20W	GE 15W HPF	Osram 16W	Osram 21W
December	2	14	36			
January	74	30	80		17	69
February	109	35	67		45	114
March	50	31	67		63	70
April	131	81	236	10	106	151
May	90	65	91	6	14	24
June	36	27	60		1	94
July	12	20	6		27	67
August	81	2	118		41	156
September	16	27	45		45	13
October	10	4	20	5	42	5
<b>Total</b>	<b>611</b>	<b>336</b>	<b>826</b>	<b>21</b>	<b>401</b>	<b>763</b>
Mkt. Share	21%	11%	28%	1%	14%	26%

All CFLs that were returned by residents for whatever reasons were accepted without question and replaced with others of the residents' choice. The GE 15-watt had the highest return rate while the Osram 16-watt had the lowest. Overall, monthly CFLs return rates varied from a high of 3% in March 1999 to a low of 2% in May 1999.

### **Impact Evaluation—Distributed Utility Benefit**

As a part of the field study, the University of Pretoria assisted the municipality in measuring the impact from the lighting program and other DSM programs on overall load reduction. Over a period of eight months, the 2,054 households in Hartbeespoort bought and installed 3,000 CFLs. Using the same average monthly savings per lamp (7.2 kWh) and tariffs (R0.33/kWh) as derived in the Albertinia and Heidelberg field study, the total monthly electricity savings by customers in Hartbeespoort comes to 21,600 kWh, netting customers (and costing the utility in lost revenue) R7,100 per month (Eskom 2000b). On an annual basis this comes to R85,200, or R28.40 per lamp.

Since the town's pre-program load profile was known Eskom could predict that the winter peak demand reduction for 3,000 CFLs would amount to 112 kW with a summer peak reduction of 61kW. Since municipality pays a demand charge to Eskom of R40.2255/kVA, the annual demand saving total R35,500  $[(9 \times 61) + (3 \times 112)] \times 40.2255$ . The saving by the municipality on its energy charges from Eskom comes to R19,200 per year. Together, this amounts to a saving of nearly R18.20 per lamp per year. The net effect on the field study on the municipality is thus a loss of roughly R10.20 per unit per year.

### **Lessons Learned**

In Hartbeespoort, Eskom examined a number of options designed to remove the awareness, accessibility and affordability barriers to higher levels of CFL penetration in the South African economy. (Prior to the field studies, Eskom already had found that CFLs largely were acceptable to South African consumers.) The following sections describe how the results of the field study will impact the ELI's planned activities in a variety of different program areas. Findings from several of the other field studies conducted by Eskom are referenced in this section.

### **Distribution Utility Activities**

The Hartbeespoort field studies showed that targeted DSM would have benefits as well as costs for distribution utilities (in this case the munics). The Hartbeespoort numbers are not convincing from a purely profitability perspective (as compared to the Albertinia/Heidelberg numbers that showed that the financial benefits of reduced peak demand slightly out-weighed the financial costs of lost energy sales) but still show that the avoided costs of peak demand can partially make up for revenue lost by reduced kWh sales.

### **Sales through Utility Pay Points**

To build customer interest in CFLs within a targeted area, the ELI could sell CFLs and CFL-dedicated fixtures from Eskom or munic pay points. Eskom tested this option in Soweto (via Eskom) and Hartbeespoort (via the municipal utility). Difficulties in obtaining



approval from Eskom management in Soweto resulted in that field study never getting started. In Hartbeespoort, sales through the local council were relatively brisk, but the office hours and location of the municipal offices limited accessibility and the municipal staff voiced objection to the additional workload. Despite the brisk sales at Hartbeespoort, problems in Soweto and staff complaints in Hartbeespoort suggest that the ELI pursue other potential distribution channels in the future.

### **Transaction Support and Financing**

When buying lamps, most South African consumers make their purchasing decision based on the first costs rather than life-cycle costs. As a result, a relatively expensive CFL is much less attractive than its standard incandescent counterpart. To encourage consumers to make their purchasing decision on life-cycle costs, Eskom wanted to test customer acceptance of a CFL leasing program that would remove the first-cost barrier. Establishing a leasing program required the ELI to devise innovative methods to both extend credit and collect payment.

While Eskom planned several field studies to examine both of these aspects, only one of the planned field studies was carried out and its results were inconclusive (as described above few customers availed themselves of the lease option provided in the Hartbeespoort field study). As a result, the ELI will need to conduct its own research and analysis before making final decisions on which options to implement.

### **Eskom Involvement**

The field studies, including Hartbeespoort, show that ELI should avoid relying on Eskom as the primary implementor. The field studies that progressed most smoothly were those that required the least direct support from Eskom staff (e.g., Hartbeespoort and Kutlwanong). The administrative issues that stopped implementation in Soweto and slowed it in Albertinia/Heidelberg suggest that when Eskom staff involvement is required in the ELI, the involvement should be formalized. This could best be accomplished by working with Eskom to revise its Key Performance Indicators.

### **Conclusion**

Eskom implemented the Hartbeespoort field study to provide data that would assist the development of a comprehensive business plan to transform the South African lighting market. In Hartbeespoort, Eskom sought to determine whether (1) efficient lighting can provide distributed utility benefits; offsetting lost energy sales with reduced peak demand charges and (2) financing for efficient lamps and distribution through utility depots was an effective means of selling the technology into the market.

Eskom and its partners carried out the Hartbeespoort field study over a period of 10 months in 1999. To entice customers to purchase the high-efficiency lighting product, Eskom engaged in a bulk procurement with lighting manufacturers and also provided a subsidy to customers to further bring the retail price down. Eskom also provided a small (R5) handling fee to the municipality which sold the lamps were sold through its Rates and Taxes counter at the municipal offices.

The implementation of the field study occurred without any major difficulties, although municipal staff did express irritation with the additional workload of selling and stocking the CFLs. Ultimately, Hartbeespoort residents bought nearly 3,000 CFLs through the field study. Customers tended to prefer the higher-wattage, higher-lumen models. CFL return rates averaged roughly 2%.

The impact evaluation of the field study showed that the initiative had a negative impact on the Hartbeespoort municipality's bottom lines, but that the avoided costs of peak demand could offset much of the revenue lost by reduced kWh sales. Eskom will apply this lesson to the full-scale implementation of the Efficient Lighting Initiative. The full-scale ELI will not rely on distributed utility benefits to sell the initiative to distribution utilities, but will point out that reduced demand charges from the proliferation of efficient lighting technologies can substantially offset lost electricity sales.

As for financing programs, although few residents of Hartbeespoort availed themselves of the lease option, the ELI is leaving open the possibility of exploring this option further. Finally, with respect to sales through utility depots, the office hours and location of the municipal offices limited accessibility and the municipal staff voiced objection to the additional workload. As a result, Eskom will look to use traditional retail channels to sell/distribute CFLs rather than, or in addition to, relying on utility pay points.

## References

- Eskom. 1998. *Efficient Lighting Initiative Research Project, July 1998, Summary Report*. Johannesburg, South Africa: Eskom.
- . 2000a. *South African Efficient Lighting Initiative Business Plan*. Johannesburg, South Africa: Eskom.
- . 2000b. *CFL Field Study in Heidelberg and Albertinia*. Johannesburg, South Africa: Eskom.
- Holm, Dieter. 1998. *Hartbeespoort Field Study Implementation Plan*. Pretoria, South Africa: Eskom.
- . *Energy Efficient Lighting Initiative Sub Program*. Pretoria, South Africa: Eskom.
- [IFC] International Finance Corporation. 1999. *IFC/GEF Efficient Lighting Initiative: Trance 1 (Argentina, Peru and South Africa) Project Document*. Washington, DC: IFC.
- [IIEC] International Institute for Energy Conservation. 2000. *The Efficient Lighting Initiative: Field Study Evaluation*. Johannesburg, South Africa: IIEC.
- [KCIHT] Kutlwanong Integrated housing Trust. 2000. *Kutlwanong Field Residential Study Report [sic.]*. Kimberley, South Africa: KCIHT.