How the environmental benefits of efficient lighting can assist in poverty alleviation in South Africa

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ABSTRACT

Global temperatures could rise by several degrees this century because of the build-up of carbon dioxide and other gases in the upper atmosphere. These gases act as a greenhouse, trapping heat that would otherwise be radiated away from the earth. Over time this will cause the earth's temperature to rise. The exact effects of this global warming are hard to predict, but there is widespread agreement that they could be severe.

Coal-fired power stations are one of the main sources of greenhouse gases, and 90% of South Africa's electricity is produced from coal. A coal-fired power station burns some 50 kg of coal to power a typical 100 watt incandescent lamp over its rated 1000 hour life, (about a year of normal usage). That means another 100 kg of CO2 in the atmosphere. A Compact Fluorescent Lamp (CFL) with the same light output, would require just 10 kg of coal.

A related problem, but a serious one in South Africa in particular, is the use of scarce inland water for cooling purposes at coal-fired power stations. On average, each kilowatt-hour that is generated requires 2 litres of cooling water. Replacing 50 million incandescent light bulbs with CFLs would save of the order of 5 million cubic metres of water a year. South Africa's greenhouse gas emissions are small compared to those of the major industrialised countries, but we do account for over half of the African total. Perhaps we have a responsibility to lead by example in encouraging clean environmental practices on our continent. However, on the other hand, and something which is more tangible to comprehend, is the issue of identifying means to alleviate poverty and create jobs on the sub-continent.

South Africa will furthermore be under the spotlight in August 2002, when Johannesburg hosts the World Summit on Sustainable Development, at which world leaders will review progress on the Rio and Kyoto agreements. As host nation at the Summit, it is particularly appropriate that South Africa is part of the international Efficient Lighting Initiative, and is seen to be pro-active in finding solutions to balance the equation and justify the investment in environmental issues, that have a direct impact on poverty alleviation in the country. This is directly in line with the South African government's policy of "Universal Access to Electricity", as well as the objectives laid down by the Efficient Lighting Initiative (ELI-program) in South Africa:

- To lower household energy costs, thereby making more disposable income available, particularly to South Africa's previously disadvantaged population;
- To create employment and economic benefits arising from a robust, energy efficient lighting market; and
- To improve indoor air quality, health, safety and quality of life for South Africa's most needy citizens.

The Bonesa team[1] has identified that lighting makes up 80% of the demand in newly electrified homes and as many as 1000 homes are being electrified each day. It makes sound financial sense to promote energy efficient

lighting from day 1, as this makes a substantial impact on electricity demand peaks, reduces pollution and increases economic activity.

INTRODUCTION

In the run-up to the 2000 local government elections in South Africa, President Thabo Mbeki announced that all residential consumers would be entitled to 50kWh of electricity and 6000 kilolitres of water "free of charge" on a monthly basis. The aim of this rebate was to assist in poverty relief, through the provision of free basic services.

However, there has been a lot of media coverage relating to the implementation of these concessions, both negative and positive. The main problem and delay in implementing this initiative is the difficulty and costs relating to the systems required to be developed, in order to implement the EBSST[2] (commonly referred to as the "poverty tariff"), on a national scale. It was therefore decided to commission a number of pilot programs in different parts of the country, to determine an optimum solution for implementing the EBSST in South Africa. Two of these sites, Zwelitsha and Dengwane in the Eastern Cape, were allocated to ELI, to determine the feasibility of opting for an efficient lighting - based solution to the problem.

However it is generally accepted that, to really alleviate poverty, South Africa needs to stimulate economic growth. Foreign investment in South Africa would be a boon to economic growth and social development. Greater transfer of international funds would bring the country closer to the global economy and we are of the opinion that all of this can be achieved through this proposed efficient lighting solution to the problem. The two pilot sites are still in progress and will hopefully illustrate how these objectives can be met.

Objectives

- Check lines of communication, including physical, geographical aspects, road conditions, postal service, train service, frequent transporters to the area, telephone access, computer e-mail facilities, cellphone availability and signal strengths, service providers in the area;
- Obtain feedback from residents as to whether or not the provision of energy-saving Compact Fluorescent Lamps (CFLs) could serve as a suitable alternative (or partial implementation strategy), for "free electricity";
- Measure sustainability i.e. willingness of community to participate, local pride in success, understanding of technology, long-term sustainability of technology including general maintenance, repair/replacement and manufacture of new products (luminaires), as a possible small business;
- If positive, test the acceptance of various additional efficient technologies to support a program of this nature e.g. low-cost refrigerators;
- Bonesa would need to test different solutions in at least two (2) of the nodal areas i.e. integral vs. modular CFL – options;
- Check on existing lighting technologies (and numbers) used i.e. potential for additional retrofit opportunities through Small, Medium and Micro Enterprises (SMME's);
- Identify, develop and train existing capacity within the villages for possible luminaire assembly, marketing and communications skills, and product distribution;
- Measure the impact of reduced demand on existing "overloaded" networks;
- Test the technical, economical and financial feasibility of "local assembly" of luminaires, by receiving the components in a kit form;
- Test the implementation of existing delivery mechanisms for this option, as well as the development of suitable control procedures required to maintain the system;
- Establish a protocol to offset the CO2 savings as part of a "Carbon Trading Mechanism", with the appropriate stakeholders.

Measurements

- Measure load profiles with the present situation, including the peak coincidence factors of lighting on the overall load;
- Determine the demographics of the affected areas and develop algorithms to predict the load in similar areas;
- Both the above factors are to be tested before and after implementation;
- There is also a definite need to have customer behaviour, as well as social and demographic influences monitored.

Funding requirements

Funding of these two pilot sites in the identified nodal areas, is provided by Bonesa, through the ELI. The cost includes the development of the pilot program, the resources required to run the pilots, as well as implementing the evaluation component of the pilot programs.

In the case of the efficient lighting option, Bonesa/ELI was able to fund the pilot program/development work, within its existing activities, i.e. as part of the "Low-Cost Housing" component of the ELI Program.

1. Bonesa is the local implementing agency tasked with implementing the South African component of the GEF and Eskom funded ELI-program.

2. EBSST refers to the Electricity Basic Support Services Tariff.

BONESA AND THE EFFICIENT LIGHTING INITIATIVE (ELI)

The Efficient Lighting Initiative (ELI) is a three year program supported by the International Finance Corporation (IFC) and funded by Eskom and the Global Environment Facility (GEF), to accelerate the penetration of energy-efficient lighting technologies into emerging markets in developing countries. South Africa is one of seven[3] developing countries taking part in the Efficient Lighting Initiative (ELI). The aim of the ELI is to increase awareness of the problem of global warming and to help reduce greenhouse gas emissions, through the reduction in energy consumption and demand originating from predominately coal-fired generating capacity in the country. The main thrust of the ELI is to promote modern and quality efficient lighting technologies such as the compact fluorescent lamp (CFL).

GEF was formed in 1991 to address four critical threats to the global environment: biodiversity loss, climate change, degradation of international waters, and ozone depletion. GEF receives its funding from its 166 member countries. GEF's sponsorship of the international ELI program is US$15 million, of which South Africa's share is US$2.5 million. Eskom is in addition contributing EURO 4,88 million to the South African component of ELI.

Bonesa Electricity (Pty) Ltd trading as Bonesa is a joint venture company, which was primarily formed to establish and implement the Efficient Lighting Program in South Africa. As mentioned previously, the venture is jointly funded by Eskom (regulated business) and the Global Environment Facility (GEF), through the International Finance Corporation (IFC), who is the private sector lending arm of the World Bank. The partners in Bonesa are made up of Eskom Enterprises (through TSI[4]), Africon Engineering and Umongi-Karebo, with TSI taking up a 45% shareholding in the company and the remaining two partners taking up 26% and 29% respectively. Bonesa's primary objective over a three-year period is to transform the market so that the CFL becomes the lighting device of choice throughout all of South Africa's communities.

The potential exists in South Africa to replace some 31,5 million old-fashioned incandescent light bulbs with CFLs. This would cut the peak load on the national grid by 820 megawatts, which is almost equivalent to the peak load of a city the size of Cape Town. The ELI will thus not only reduce greenhouse gas emissions, but could also save[5] the country approximately EURO 100 billion in new generating plant. In essence, the ELI program is an electricity efficiency initiative, which is providing the economic thrust, drive and foresight to find solutions to link household energy initiatives with other development objectives. Bonesa, as local implementing agency in South Africa, is positioned to support the international vision through implementing local educational, marketing and awareness programs.

The key objectives of the ELI project are as follows:

- The lowering of household energy costs, thereby making more disposable income available, particularly to South Africa's previously disadvantaged population;
- The creation of employment and economic benefits arising from a robust, energy efficient lighting market; and
- The conservation and preservation of the environment, through the reduced demand for electricity during the peak consumption period, i.e. between 18:00 and 22:00.

The overall South African efficient lighting program could save the environment:

CO2 emissions – 3.6 Mt/in the first ten years
Sox emissions – 29.4 kt/year
Nox emissions – 14.65 kt/year
Water use – 4.8 Gl/year
Coal use – 1.92 Mt/year
Ash produced – 505 kt/year

TECHNOLOGY ISSUES

The incandescent light bulb, is a remarkable device that has served us well for over 100 years. But it has three drawbacks; it is inefficient, it doesn't last very long, and it is environmentally unfriendly! Almost all the electricity an incandescent light bulb uses is converted into heat rather than light, but a compact fluorescent lamp (CFL) gives out the same amount of light, using only 20% as much electricity, so that you can replace a 100 watt incandescent lamp with a 20 watt CFL. The filament in an incandescent lamp melts and evaporates as it burns, and a lamp burning three hours a night normally lasts about a year, whereas most CFLs are designed to last between six and fifteen thousand hours.

As its name implies, a CFL is a compact form of the common fluorescent tube. But it uses a sophisticated control circuit to give it the advantages of the fluorescent tube (efficiency and long life), without the conventional tube's two major drawbacks - the CFL does not flicker, and it produces an attractively coloured light, either cool white or a warm yellowish colour similar to a normal incandescent lamp.

A CFL initially costs more than an incandescent lamp, but increasing demand for CFLs is bringing the price down rapidly. A 100 watt incandescent lamp generally costs about EURO 0,3, and over its one-year life (burning three hours a night), it uses in the region of EURO 3 worth of electricity. An equivalent 20 watt CFL would retail at about EURO 3, but while burning three hours a night, it uses only about EURO 0,6 worth of electricity a year. The CFL thus generally pays for itself in just over a year. And over the next five or more years of its life, it saves hundreds of

3. The other participating contries are Argentina, Peru, the Czech Republic, Latvia, Hungary and the Phillipines.
4. TSI refers to Technology Services International, itself a wholly-owned subsidiary of Eskom Enterprises, (the non-regulated arm of the national electricity untility in South Africa)
5. This figure was calculated as part of Eskom's overall Integrated Strategic Electricity Plan, (ISEP).

EURO in lamp replacement and electricity costs, not to mention the costs to the environment.

A middle-to-high income suburban household in South Africa typically has twenty to thirty light fittings or plug-in lamps, and the savings from changing over to CFLs could be EURO 5 to EURO 10 a month. A smaller household might have only five lights, but if this is the main electrical appliance used in the home, then the possible savings could mean a lot more in relative energy consumption terms, and hence the significance for contributing to the EBSST in a sustainable manner, i.e. the lighting load in a newly electrified household could probably constitute up to 80% of the overall electricity bill for that customer. For this to happen, the implementation of energy saving lamps for this program would require the development and implementation of a sustainable technology, linked to a thorough public education drive and a robust (reliable), distribution mechanism.

Even though Compact Fluorescent Lamps (CFLs) are widely recognized as the major solution for reducing energy consumption for domestic lighting, most programs focus on easy to replace screw-based CFLs. Pin-based CFLs however, have the potential to offer a more sustainable solution – with less electronic waste, lower costs, and no risk of being replaced by incandescent lamps after lamp failure. Perhaps the most important advantage lies in the luminaire design – the typical characteristics of pin-based CFLs – form and light distribution – offer new possibilities in this respect.

However, it is also important to differentiate between the controlling mechanisms of these two lamps, (control gear or ballast). By definition, a ballast is the device needed to limit the current through any discharge lamp, connected in series with the lamp. The ballast may having a lagging power factor and may be electronically or electro-magnetically operated. There are pros and cons associated with both of these options and the EBSST pilot program will ultimately determine which is the preferred option for local operating conditions in South Africa.

Why pin-based?

Most widely available CFLs are either screw-based (ES) or bayonet-based, (BC). Pin-based CFLs perform like the others in terms of energy saving, but have a separate ballast (the electronic part needed to produce light); this is no longer part of the light bulb, but incorporated into the fixture. This reduces the price of the lamp when the bulb must be discarded and replaced, since the ballast (which generally lasts three times as long), can be retained. In addition, pin-based fixtures will help to make the switch to fluorescent lamps irreversible.

Why are similar lighting initiatives worldwide and Eskom directly involved in fostering this new product? The explanation is quite simple; the Integrated Strategic Electricity Plan (ISEP)-process wants to set off a revolution that would lead to dramatically reduced residential electricity consumption in South Africa, over a 20-year planning horizon. Lighting uses a large amount of electricity in low-income homes, and CFLs can reduce this by a factor of four. According to the European Commission's Delight report "the switch from incandescent lights to CFLs is as revolutionary as was the switch from gas to electricity in domestic lighting 70 years ago. The role of suitable fixtures is of similar importance".

A new South African standard?

The creation of an innovative new product for this program could become a South African (or even international), standard. This is a big challenge that needs a joint commitment by manufacturers of luminaires and lamp components, designers, retailers and community members alike. Only a common effort by every participant in the process can yield solutions that guarantee the success of this proposal.

As we were introducing technology, which might be relatively unknown to newly electrified consumers, various issues needed to be addressed before actual implementation, ie. a comprehensive awareness and training campaign amongst the community-identified assemblers of the appropriate technologies needed to be launched, pre-program research was conducted, and appropriate monitoring and verification mechanisms were put in place.

It was therefore important that Bonesa, Eskom and the South African government held hands with the community during the pre-implementation stage, to give energy saving concepts additional credibility. Free handouts of CFLs and/or fixtures also scored political points, from a poverty alleviation perspective. It was also stressed that CFLs are not an "inferior" light source but in fact, in many residential and commercial areas, they are regarded as being far superior to conventionally known and commonly used products i.e. lamps and luminaires. CFLs are presently amongst the most advanced technologies available for domestic lighting worldwide, and the amount of light output emitted from an 11 Watt PL-lamp is equal to a 60W incandescent lamp.

It was also important for a program of this nature, that the complete luminaire be sourced locally and assembled at a community level. Such a local supplier had the necessary documented credibility, (from both a company and product point of view), to be able to provide the necessary "skills transfer" that is required for capacity building in the area.

Company credibility

For the reasons stated above, we needed to identify potential luminaire manufacturers and marketing/communications companies that met the following criteria:

- Must have been in possession of a Tax Clearance, for component imports i.e. ballasts that are not available locally;
- Must have had experience in community, Small, Medium and Micro-enterprise (SMME) and product development in this specific market, i.e. this was essential for assistance in job creation activities (product assembly), etc.;

- Participants must have been willing to work with rural communities, ie. they must have had previous experience in development work within rural areas;
- Additional recognitions were an advantage e.g. ISO-accreditation, Recognition Awards, etc.;
- Past experience in this field was essential for community "comfort"/peace of mind and general credibility and trust.

Product credibility, quality criteria and minimum technical specifications

It was important that all products considered for this program, met the following:

- Individual components used, had to be of the highest quality and meet all the ELI specifications;
- South African Bureau of Standards (SABS), test results of complete or similar fittings, which is essential from a community safety point of view, had to be produced and adhered to;
- All components had to be suitably packaged and supplied in "kit form" to site;
- On-site training in assembling and distributing light fittings by the supplier was part of the "package"; i.e. assembly of the luminaires was completed on site by unemployed local labour;
- Product assembly had to take place with the use of basic tools, e.g. pliers, screw driver, etc;
- Product distribution and installation had to be possible with the minimum amount of basic tools, (one tool max);
- Components for repair or maintenance had to be accessible and available from suppliers throughout the country e.g. lamps, ballasts, plug tops, etc.

BASIC ASSUMPTIONS AND INTERNATIONAL EXPERIENCES

After the commitments of the 1997 Kyoto climate change convention for the reduction of CO2 emissions, the European Union estimated that in many countries a significant result could be obtained just by reducing the peak electricity demand caused by domestic lighting.

According to the EU Delight report (1998) on efficient domestic lighting in European countries, the total domestic lighting consumption currently accounts for 17% of all residential electricity use, and is expected to increase by the year 2020. However, several studies sponsored by the European Commission have shown that 43% of Europe's electricity consumption for residential lighting can be saved by the year 2020, simply by promoting technologies already on the market, such as CFLs. The average number of light bulbs is 24 per household across the EU. Around 70% of these are incandescent, with the remaining 30% being fluorescent or halogen bulbs. Only 30% of European households currently have at least one CFL, (the overall average is 0.9 per household). By successfully implementing this proposal, South Africa could become the trend-setter in the use of this economical and efficient technology.

CFLs use 75-80% less electricity than incandescent lamps and last between 6 and 15 times longer. However, their successful market penetration still faces barriers such as the high initial price and the consumers' lack of confidence in the long-term availability of this technology. In South Africa, the fluctuating exchange rate is also a problem, since all the lamps are presently imported into the country. According to the Delight research, only the promotion of well-designed fixtures that meet public tastes and overcome behavioural barriers can change the lighting market, favouring the introduction into the residential sector of pin-based CFLs, already largely used in the commercial market.

Furthermore, from an international program review, it is evident that there definitely exist some efficient lighting program techniques, that show great promise for serving the poorest energy consumers across cultural and geographic boundaries. These techniques were put to the test under South African conditions, through the ELI-EBSST pilot programs.

POTENTIAL SAVINGS/CALCULATIONS

Environmental Impacts

Global temperatures could rise by several degrees this century, because of the build-up of carbon dioxide and other gasses in the upper atmosphere. These gasses act as a greenhouse, trapping heat that would otherwise be radiated away from the earth. Over time, this will cause the earth's temperature to rise. The exact effects of this global warming are hard to predict, but there is wide agreement that they could be severe.

Coal-fired power stations are one of the main sources of greenhouse gasses, and a large portion of South Africa's electricity is produced from coal. A coal-fired power station burns some 50 kg of coal to power a typical 100 watt incandescent globe over its rated 1000 hour life, (about a year of normal usage). That means another 100kg of CO2 in the atmosphere. A CFL with the same light output, would require just 10 kg of coal, to generate the quantity of electricity needed to illuminate the lamp and provide a quality light source, over its much longer rated lifespan!

A related problem, but a serious one in South Africa in particular, is the use of scarce inland water for hydro and cooling purposes at coal-fired power stations. On average, each kilowatt-hour that is generated requires 2 litres of cooling water. Replacing 31,5 million incandescent light bulbs with CFLs, would save in the order of 5 million cubic metres of water a year.

Although South Africa's greenhouse gas emissions are small compared to those of the major industrialised countries it was agreed that, perhaps we do also have a responsibility to lead by example in encouraging clean environmental practices on our continent, as this would not only cut greenhouse gas emissions, but would also save

the country billions of rands[6] in new generating plant. It would also send out a clear message to encourage foreign assistance in NEPAD[7] and showcase a commitment for the World Summit on Sustainable Development (WSSD), to be held in South Africa in 2002.

ISSUES/RISKS ADDRESSED AND (CONTINGENCY)/EXIT STRATEGY

Recent media reports in South Africa have begun to speculate on the potential medium-to-long term affects of rising energy prices on the lowest income groups in society, as a result of the implementation of EBSST on a national scale, together with the government's privatisation initiatives in the electricity industry.

For this reason and irrespective of which solution is ultimately considered for full-scale implementation, it remains imperative that low-income customers are:

- Being educated about energy choices;
- Counselled on household budget problems and solutions;
- Provided with access to energy efficient technologies and techniques;
- Empowered to participate in whatever solution is proposed;
- Informed of safety issues pertaining to the wise and efficient use of electricity.

Should the efficient lighting-based solution prove ultimately not to be the most feasible option, the further "roll-out" of a national proposal could be stopped at any time, ie. an exit strategy would be easy to implement and to justify. However, in the Eastern Cape, where economic recovery has proved elusive, this particular pilot program, together with the implementation of the points mentioned above, will leave the community with some form of limited relief. After all, the poverty situation in the area has a direct impact on the problems relating to low-income consumers' inability to pay their electricity bills. Even if we were required to abandon this particular solution to the EBSST at any time, the consumers will be left with their efficient lighting installation, which would inevitably reduce their future electricity bills.

PILOT SITE IMPLEMENTATION STRATEGY

Background information

The two villages Dengwane and Zwelitsha were electrified in 1997, as part of the *Khoapa* electrification project ie. they were not electrified under their respective names. In total, it is anticipated that the Khoapa electrification project consists of 1220 20 Amp connections. According to the Eskom staff responsible for customer service in this area, it is possible that a small percentage of customers may have upgraded 60Amp supplies. There is also a small percentage of conventionally metered customers, as well as an area in the southern section of Khoapa that is not electrified at all. It was also decided that, in order to avoid upsetting customers in the areas that may not reside specifically within Dengwane and Zwelitsha, that we implement the pilot program in the total Khoapa electrification project, which is primarily constituted by these two villages, and which are supplied with electricity from the same network. Dengwane and Zwelitsha are situated in the Magadla Tribal Authority in the Eastern Cape. They form part of the Umzimvubu Municipality, in the Alfred Nzo District Municipality, whose offices are both situated in Mt Ayliff, which is approximately 30km from Kokstad. Dengwane and Zwelitsha are located approximately 8km from Matatiele on the main road, to Mt. Fletcher in the Eastern Cape. The affected villages that also form part of the Khoapa electrification program, are Khoapa (itself a village), and Hlomendini.

The communities of these villages are largely farmers, who apply a combination of traditional and commercial methods of farming. Land is often tilled year after year, with no period of rest allowed in between. Residents in these villages engaged in primitive production activities of vegetable, poultry and pig production.

Through the environmental upgrading of schools by Sustainable Energy, Environment and Development (SEED) representatives, the youth in the area have already been brought on board regarding the importance of issues such as resource use and environmental concerns. This will further be expanded by implementing the Bonesa/ELI Schools Curriculum at the schools in the area – there are a number of primary and secondary schools active in the area.

In the Maluti district, and with the facilitation of the local Environmental Development Agency (EDA), in conjunction with other key development roleplayers in the area, SEED recently undertook a participatory process with people on the ground, to try and bridge the gap between the development planners and the community. This resulted in the formation of the Maluti Development Planning Committee (MDPC), comprising of 12 members, with 5 members making up the core task team. The DPC is constituted by representatives from the TRC, LDF's, ANC, SANCO, the local business community and various government departments. This structure facilitates and co-ordinates development initiatives in the Maluti district and works towards building the capacity of the Transitional Regional Council (TRC), so that they could implement the Land Development Objectives and Integrated Development Plan effectively.

This is a totally rural area, which has one "major" town in Matatiele. The people in this area are traditionally dependent on migratory labour i.e. the men worked on the mines around Johannesburg, to send home money for their families. Some of the women also went to larger cities like Durban and Pietermaritzburg, in order to earn funds for the family. Now that the mines have begun to retrench

6. The rand (R) is the South African currency and EURO 1 = R10-00.
7. NEPAD is the New Partnership for Africa's Development, which is being spearheaded by South African President Thabo Mbeki.

their workers, we found that up to 65% of the population were unemployed. This is one of the main contributing factors towards the poverty situation in this area.

Existing Infrastructure

The villages are situated about 9km from the nearest two vending stations, for purchasing prepayment electricity coupons. Residents have to use taxis and pay EURO 0,70 to get to their vendor, ie. return trip. A dirt road of about 7km connects the villages with each other and running water (using a prepayment system), telephones, electricity and other services are generally available in the area.

Firewood is very scarce and residents need to travel long distances, if they want to purchase this fuel source. Therefore, most households supplement grid electricity with paraffin and gas, for cooking and heating purposes. Ecotourism is regarded as an area that could explicitly be developed in the area to facilitate job creation. The natural surroundings in the area offer a panaromic view of the Maluti and Drakensberg mountain ranges and the high density snow experienced in the winters, often attracts local and foreign tourists to the area.

Job creation opportunities

In an area with limited avenues for self-empowerment, the implementation of an efficient lighting-based solution to the EBSST, combined with the development of a marketing/communications, assembly and distribution infrastructure within the communities concerned, will contribute to a substantial and sustainable improvement in the existing economic activity in the area. With time, this could even be extended to provide an even more comprehensive lighting/maintenance business, through the provision of a broader range of locally designed and produced luminaires that are representative of the culture of that particular community. These could then be sold to local hardware stores, guesthouses and tourists, to generate additional revenues. Households with more than two light points will also be able to purchase additional luminaires and lamps from these same community-based installers of the efficient lighting products in future.

Training

Firstly, it was important that the community leaders in the respective villages, identify potential unemployed candidates that could be trained to assemble, distribute and supervise the activities within those communities. However, the number of identified candidates to attend the training, was extended beyond these officially identified individuals that were nominated by the communities, to fulfil the specific tasks associated with this pilot program. However, they would not be able to be "paid" by Bonesa to assemble fixtures earmarked for the pilot programs, but could start their own little independent business in this regard.

Furthermore it was requested that, the successful supplier of the components of the light fittings must, as part of his product offering, facilitate the training and monitoring of the quality of the finished products, before distribution within the identified communities. This was followed by an on-going process of quality control and refresher training, on a regular basis.

Lastly, it was estimated that an initial quota of 6 people per village would be required to attend the official training for this purpose, i.e. 1 x Supervisor, 3 assemblers and two distributors. We also needed one individual with some basic computer and communication skills, to facilitate the development of the PE-activities in the area, as part of the Potlako[8] franchise pilot study. An overall local project coordinator was also required to facilitate the project interaction between Bonesa and the community.

Research requirements

Lighting, primarily with incandescent bulbs and candles, are the major end users of energy in the poverty stricken rural areas of South Africa. The introduction of Compact Fluorescent Lamps (CFLs) as a possible alternative to providing free basic electricity (50kWh per month), could significantly reduce electricity consumption in these households and contribute to the objective of poverty alleviation.

Likewise, South Africa is facing increasing residential electricity demand, due to the intensive electrification drive over the last decade. In this market, lighting is considered to be the largest end-use of residential electricity, and this demand for electricity is virtually 100% co-incident with South Africa's peak demand i.e. between 18:00 and 20:00. Residential electricity consumption contributes significantly to the current demand patterns in South Africa and its share is increasing with the continuing electrification program in South Africa. Future growth in residential electricity consumption will be due to the continued electrification program, construction of new low-income homes, and increased ownership of electrical appliances, such as televisions, kettles, irons, etc. At this stage (2001), about 60% of the South African population have been electrified, but that still leaves approximately 2 million homes and 100 million people without access to grid and off-grid electricity. Since most of these connections are presently using standard inefficient incandescent (GLS) globes, this presents a unique opportunity for conversion to more efficient CFLs, which only use approximately 20% of the electricity needed to provide the same *amount* and increased *quality* of light. Estimates of the savings possible from the current Efficient Lighting Initiative (ELI) are 820 MW of peak demand reduction, by the year 2019. This would involve the introduction of approximately 31,5 million CFLs into the South African *residential* market within the planning period.

Similar programs have been successfully implemented throughout the world, in both developing and developed

8. "Potlako" is a word meaning "to move fast" and is a pilot project facilitated by one of the major advertising companies in South Africa, to franchise and empower local communities to develop community-based public education campaigns in their areas.

countries eg. Brazil, Mexico, Poland, Taunton (USA) and the European Union, (Sweden, Germany and the UK).

However, in order to determine whether or not this will be an acceptable option to consumers, government and other stakeholders, we firstly needed to gain some insight into the demographics, cultural indifferences and levels of poverty in the two areas targeted for piloting this option i.e. Dengwane and Zwelitsha in the Eastern Cape. This required the services of a reputable and knowledgeable Metering and Marketing Intelligence Agency, i.e. to implement a "pre-and-post" survey of the areas affected by the pilot programs.

The objective of the survey was to verify the above assumptions and to estimate the electricity savings potential for both the consumer and the local authority/distributor/Eskom, in relation to the free 50kWh promised by government, to all residential users of electricity. It was therefore imperative that the research contractor/s were successful in:

- Determining the consumption and demand savings for all parties;
- Wattage preferences for lighting and lighting fixtures (shades) used;
- Colour preferences for lighting, (cool or warm white);
- Type and hours of use of existing light sources (candles, paraffin, electricity), etc;
- Determine the existing number of light points per household and the potential lamps that possibly could be replaced with CFLs i.e. to determine the quantities of product that would need to be procured, to implement this pilot program;
- Current electricity tariffs, metering (prepayment and conventional), and non payment/illegal connections in the area;
- Appropriate methods of media/product information dissemination in the area, eg. local radio, etc.

Using students for this exercise assisted in reducing the costs and at the same time, provided them with much needed practical experience i.e. capacity building.

The research methodology decided upon, provided results that covered the following six critical areas:

- General customer information i.e. income, unemployment levels, average age and total population in the affected areas, etc;
- A table showing current lighting equipment and usage patterns;
- A section on customer knowledge, attitudes (and understanding), of the Electricity Basic Support Services (EBBST), i.e. free basic services, as well as their knowledge and attitudes towards CFLs in general, as a possible alternative to EBSST;
- A table that covers other appliances that are used in the houses and their usage patterns, including other areas where disposable income is used, e.g. Lotto tickets, cellphone cards, etc;
- Use of dry-cell batteries for radio usage and the associated monthly costs;
- Present consumption levels and frequency, value and venue for purchasing prepayment electricity coupons/vouchers.

Bonesa used briefcases (toolkits) that were available, encompassing an electricity meter, inefficient GLS lamp and efficient (quality) CFL that could be used by the surveyors to demonstrate the light output, energy savings, etc. to the customers during the survey. Bonesa and the successful luminaire service provider, also provided a one-day basic training course, to familiarise the students with CFLs, basic technical questions (so they could answer any questions that may be raised by customers), and on the use of the "toolkits".

Furthermore, due to the poverty and associated high illiteracy levels in these rural communities, the research methodology decided upon, was clear and easy to participate in. The use of graphics is always beneficial, to provide residents with a proper understanding of the objectives of the pilot projects. Questionnaires also catered for data for multi-function rooms.

Once again, the training of researchers was important. They clearly needed to understand the importance of their work and how crucial it was for them to be honest about their own evaluations of the surveys they made. They had to have a basic understanding of the luminaires and lighting technologies (GLS vs. CFL), and some idea of what to expect in the answers. In this fashion, a surveyor could answer basic questions the customer might have on the technology (or provide a contact person and telephone number to refer the customer to), and was able to query the customer, if answers were way beyond the norm. A good use of the local indigenous language (Xhosa) was also a pre-requisite for this exercise.

Additional critical information that was required, included the following:

- Number of electrified customers vs. total population;
- Language preference, (verbal and written communication);
- Number of Photo voltaic (PV) installations in the area;
- Average number of people per household;
- Average income per household;
- Average amount of disposable income spent on:
- Energy (total), and broken down into PM 9 dry cell batteries, gas, wood, etc;
- Electricity.
- Levels of unemployment;

- Main type of economic activity in the area, eg. mining, agriculture, etc.;
- Average monthly kWh consumption per household;
- Number of active primary schools in the area;
- Number of active high schools in the area;
- Number and religious alignment of churches and community halls in the area.

Barriers/Hurdles to implementation

The critical areas of the ELI-proposal that could possibly pose a potential threat to the full-scale successful implementation of the pilot programs are as follows:

- Limited timing required to fast-track the entire program i.e. "rushing" the implementation of the pilot programs, resulting in insufficient timing necessary for detailed planning, stakeholder involvement, monitoring and verification activities;
- The timing for implementation of the program in these particular two areas, commenced immediately prior to the festive season holidays, which traditionally, is not a good time to introduce new technologies, etc.
- Community resistance, due to the limited number of people that can be accommodated in the "job-creation" component of the pilot program, whereas the unemployment levels are estimated to be far higher than the number of people that can be accommodated i.e. not *all* of the needy will be able to benefit from this particular job-creation activity. The local councillors agreed to address this issue with the communities involved.

CONCLUSIONS/RECOMMENDATIONS

The plight of low-income households around the world displays some similar characteristics that transcend culture and geography. Among them are:

1. a struggle to make hard choices between basic needs for services such as healthcare and food;
2. decisions of which bills to pay when scarce unpredictable income materializes;
3. a desperate need for someone to recognize that all of the individual problems of such households can often prove overwhelming, when experienced as a whole.

Most importantly, however, families in poverty share a common desire for self-sufficiency and empowerment, as full participants in the marketplace of choices. Although we often presume to provide solutions to such problems, it does suggest that there is no single source of knowledge that exists regarding successful efforts to address low-income energy problems. Developing countries have a chance to avoid serious mistakes that have been made in addressing such issues in the West, and they have the added opportunity to employ advanced technologies toward the seeking of solutions. Simultaneously, the wealth of experience and lessons learned from countries with longer histories of attempts at addressing low-income energy issues might reveal some ideas that can be equally valuable to emerging issues in developing nations. Above all, the interchange of ideas must continue and expand.

Finally, there will always be a need for a safety net, as it is impossible to imagine a community where everyone has been permanently lifted into economic self-sufficiency. Thus it is important for those involved in programs that aim to reduce dependency on subsidies, to beware of the double-edged sword of success, and ensure that an accurate picture of the families/individuals that remain in need is not lost in the "good news". Based on the information provided in this document, and given the timeous resolution of these issues, Bonesa has strongly recommended the urgent support and approval of the recommended plans, as set out in the broader strategy of implementing EBSST in South Africa.

The relative risk profile of implementing such an initiative is also limited and the benefits are potentially very large, i.e. socio-economic, environmental investment, political, etc. Should this pilot program be successful and receive favourable approval, Bonesa would be able to facilitate the implementation of the ELI-component of the EBSST, on a national scale i.e. as an agent for the South African government.

So, whilst the ELI will mean savings for individual consumers, it will also assist in boosting the South African economy, by providing savings for the country as a whole. By using electricity more efficiently, energy will be freed up for growing demand elsewhere. Results in Mexico have also shown an improvement in the quality of supply, as a result of the widespread implementation of CFLs in rural communities. The net effect of all these components of the program will result in the realization of a huge positive social and environmental impact for the country.

We are therefore confident that the message of "energy efficiency" will be an exciting one, in these market segments where services such as hot water and refrigeration are considered as luxuries.

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