CONSUMER PERCEPTIONS OF A RURAL ELECTRIFICATION ORGANISATION AND CONCOMITANT ECONOMIC DEVELOPMENT.

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ABSTRACT

Rural households have few choices when it comes to energy provision. It is either use the traditional sources, which are becoming scarcer due to increasing demands on resources; expensive in terms of outlay; often dangerous with polluting results; or the alternative of whatever the government has provided. In KwaZulu-Natal, there is limited rural electrification provision: due to the hilly terrain and the low population density, it seems too expensive for the government to provide grid electricity, especially when the affordability levels of consumption are too low to support the maintenance of the grid. As a result of government policy initiatives, extensive PV schemes are being installed in partnership with private companies.

This study investigated one scheme which had 5000 homes electrified with the aim of extending the scheme to 50 000 dwellings. A survey was conducted with 500 customers in order to provide feedback about their perceptions of the functioning of the whole scheme.

Findings indicated that the weak point was consumer education, as many malfunctions were the result of overloading, misuse or ignorance. During installation, when most instruction was offered, only the very old or very young were present.

Support from the energy shops scored highly, functioning well. Repairs took up to a week after reporting to complete, an acceptable delay according to the consumers.

Few business opportunities resulted with only 5% providing information about non-agricultural earnings. The greater availability of light was seen as mostly supporting media usage and light provision (in line with the marketing strategy). The main constraints to income generation were reported as lack of ready markets for products produced (even with the greater availability of light).

1. INTRODUCTION

Rural electrification is especially difficult due to logistical problems and the inability of the rural poor to access financing mechanisms. In rural areas such as the study area, the cost per grid connection is estimated to be more than R9 000 (as much as R20 000 in some cases) compared to approximately R3 000 in urban areas (1). Other advantages of photovoltaic systems include: no fuel requirements, modular components which can provide small amounts of energy at the point of demand, no harmful pollution at the place of use, relatively simple operation and maintenance, long life with little degradation in performance (providing local maintenance is available), economic viability and national economic benefits such as reduced use of coal and oil (2). For these reasons, photovoltaics have been identified as a suitable alternative energy source for sunny areas and the introduction of solar energy to rural areas should have a significant role to play in the quest for rural electrification if appropriately planned and implemented.

When addressing the issue of electrification or rural electrification, stakeholders must be aware of underlying issues. Firstly, the choice of technology should be based on consumer needs, economic viability, technical and institutional capabilities and consumer‘s willingness and ability to pay for the service (3). Secondly, the approach chosen should allow for energy service delivery through a range of public and private sector institutions, as well as local co-operatives and NGO‘s. In addition, social aspects must be incorporated into the implementation phase (4).

There has been a recent awareness of the value of including social issues with the installation and delivery process in order to ensure an effective program for supplying energy to rural populations (3,4). It is hoped that the documentation of one rural energisation process will be useful for others working in similar fields, as well as encourage the publishing and continued sharing of the valuable experiences that have been gained by those working in the field of alternative energy provision.

One of the major threads in current thinking about rural development is that decentralized planning and processes result in better-informed decisions. Rural electrification is no exception. Holland et al (5) argued that decentralized planning and indeed community participation in planning for electrification is likely to lead to more successful and sustainable schemes. No longer do cumbersome cash-strapped utilities have the monopoly on electrical supplies. Solar photovoltaic systems provide the social benefits of improved lighting and communication via radio and TV. Many

new models are being tested, and for practical reasons decentralized solutions are often the most cost-effective (5) because decentralized solutions do not need enormous capital costs.

An integrated rural energy-planning model (IREP) could be seen as a multimodal approach to rural electrification, which considers PV systems along with other options to complement grid extension (3). Loon (6) views the integrated approach as a planning process for rural areas. In this case it means the integration of different technologies in rural electrification, for example the integration of off-grid electricity with LP gas to provide thermal energy. Gandar (7) supported this approach and argued that a diverse energy resource base should be cultivated.

In this study, to assess how sustainable the selected energisation program was, a survey of the management, installers and technicians and customers was conducted. The criteria against which the program was assessed were those suggested by the World Bank; namely —overcome cost barriers, establish responsive and sustainable infrastructure to deliver PV services and provide quality products and services (3)". To this were added careful administrative procedures to limit fraud and corruption, and the social aspects that need to accompany the execution of installation and maintenance (4).

2. RENEWABLE ENERGY ELECTRIFICATION PROJECTS IN KWAZULU-NATAL

These off-grid renewable energy programs are all fee-for-service systems, where a fixed sum per month is paid for the service and maintenance. The Non-Grid Rural Energy Program that the National Department of Minerals and Energy (DME) started is expected to extend the number of Solar Home System (SMS) installations with another 350,000 within the next 5 years. This was assigned to 7 concessionaires each responsible for 50,000 households each (9). Three examples from KwaZulu-Natal will be mentioned here.

There are three KwaZulu-Natal projects approved by the DME concession procedures for electrifying rural areas in South Africa (10). These have been instituted in the northern areas around Mkhuze (bordering Swaziland and Mozambique) for an anticipated 50 000 Solar Home Systems (5500 installed at the time of the study). After this study was completed, delivery slowed because of changes in government contractual agreements.
Another concession in the southern areas of KZN was taken by a joint agreement between Eskom, the national power supplier of South Africa, and Shell International Renewables (12). This concessionaire has subsequently scaled down their operation and was threatening to disband due to government contractual changes.

The third concessionaire operating in KwaZulu-Natal is KwaZulu Energy Services, which consists of Electricité de France (EDF) partnered with Tenesa, a South African module manufacturer owned by Total Energie. This has started slowly with a major problem being the lack of knowledge of where the grid is to be extended. This makes the rural households less interested in installing SHSs (13).

The research reported here concentrated on NuRa as it seemed to offer the greatest scope for success by following the integrated approach as recommended in the IREP model (3).

3. THE ENERGISATION PROGRAM

Firstly delivery operations at NuRa will be described through the eyes of both management and employees at the time of the study. To this end, questionnaires and interviews were undertaken of all available staff. The head office in the town of Mkhuze, had a general manager, a project manager, 10 sub-contractors based throughout the area, who carried out the installations and 6 technicians who responded to maintenance demands. In addition there were 5 energy stores with a staff complement of two to three people each. At the main office where the major repairs were undertaken there were also additional office staff members controlling stocks and records.

The project was initiated in the area with general village meetings arranged through the local chiefs to explain what was to happen. This met with some opposition because people felt that SHSs would prevent them from accessing the national grid and they needed convincing. Interested households paid a R100 connection fee to the nearest energy store and a computerized form was completed. The monthly fee-for-service amount was R58 for the smallest of 10 options. Arrears were not tolerated and any unpaid months had to be paid up before the SHS would function again.

Teams of sub-contractors would collect job cards, load trucks with the listed equipment from the central stores in Mkhuze and then go to the places that had no addresses but in the same general direction. The sub-contractors were local people who had been unemployed and only 2 had had some practical experience before being trained for this SHS installation work.

Technicians conducted post installation check-ups that also ensured that the reported work had been completed and that the equipment was functioning correctly (and provided some consumer education if anyone was home). Customers had to use public transport to go to the energy stores when the LED communication system on the battery boxes showed a limited number of day's power still available (See fig 1). There they purchased a token for another month's use of the equipment (a magnetic smart disc). The purchase was automatically recorded and they also reported any problems.

Figure 1: The battery and control box showing LEDs

Approximately 10 malfunctions per day were reported, mostly minor faults, which could be fixed on the spot such as changing light bulbs, plugs and meter boards. Major faults were usually the result of panels being struck by lightening, in which case these would be taken to the repair shop at Mkhuze, overloading and tampering (to add inverters). All the technicians agreed that the SHSs were durable and trouble free - except for the LEDs that were the most common part to malfunction.

The battery box, meter board and PV panel were initially installed on an outside pole so that technicians could access them easily. Should the box be tampered with (or opened) an alarm siren would go off and the technology would stop functioning. Later adaptations were to put the meter box inside the house (still with its tamperproof alarm) and the panel was placed on the roof, both for greater security. Only the technicians could deactivate the alarm when they came to service the equipment.

Both contractors and technicians raised another important issue, that of non-technical problems that they often experienced during installation and maintenance routines. The main problems cited were the lack of access roads (45%), unavailability of household members in households (33%) and poor directions to find the places (10%).

Security was a big issue and many system parts had been stolen, particularly when first starting up. The most desirable part was the panel. In order to get a replacement, the householder would report the theft, get a case number and if after 2 months it is not recovered, then a sub-contractor would come and reinstall. There was also a reward system for recovered parts.

Consumer education was felt to be a weakness. Aged adult women were the ones most often educated in the households during installation and maintenance visits regarding the usage and proper handling of systems. The instructions were seldom properly understood. In terms of understanding the system, younger adult women were the preferred recipients because they were —"very good". Regarding the information that was most important for good functioning of the entire system, it was suggested that not tampering with meter boxes (to add more appliances) was crucial followed by the correct reading of the LEDs. Subsequent education regarding changing light bulbs and energy efficiency was also felt to be important. Both management and employees felt that the infrastructure was responsive, sensitive to consumers needs and sustainable over time.

4. CONSUMER PERCEPTIONS

The survey was initially aimed at 500 households. One hundred participants were interviewed at each of the five energy stores. This provided a useable sample of 488. It seems that the SHS households were older, not at the child bearing family stage. It was also noted that 72 (14.8%) of households were female headed.

4.1 Household finances

Household finances were investigated from four perspectives. Firstly the source of income or grants into households; secondly the actual regular monthly income per household; thirdly who had the main control over spending and lastly who arranged the R100.00 connection fee? It was also reported that most households found their connection fee from their own savings. There were no known applicants who used credit, loans or stokvels (informal credit union) to finance their connection fees.

Thirty (6.1%) households had no regular income. Adult men were responsible for bringing income into 52.3 per cent of all households, while 31.4 per cent of households had adult females who looked after the family financially. In 8 percent of households this was a shared responsibility.

As can be expected from rural communities or households, the per capita income was not very high. The average monthly household income was R750. The lowest monthly income reported was R110, while the highest was reported to be R8000 but there were 6 percent who declared no income (but never-the-less managed the monthly SHS payment of R58.00). There was a wide variation in incomes. Men paid the deposit in 51% of households.

4.2 Control over household finances

As can be expected from rural African families, 57.2 percent of all households had a father as the sole controller of finances. Mothers were in control over spending in 41.0 percent of households. Whereas in the female-headed households, female control of finances was to be expected, there were an additional 28 percent of male-headed households where females controlled the finances. This is in agreement with the 26 percent of women non-heads of household who made the decision to obtain a SHS. Women were also the most likely to be involved with very small business initiatives.

4.3 Other sources of energy

All participants confirmed the usage of one or more sources of energy other than the SHS. Only 30 per cent of households used paraffin. Liquid petroleum gas (LPG) was reported to be the most widely used source of energy by 343 (70.3%) households. The reason for such popularity was probably the provision by the Energy stores of this type of energy and equipment for cooking. Refrigeration could also have contributed to its popularity. Most households (61.5%) still used candles. This is a large proportion of households bearing in mind that all SHSs are capable of producing light.

The average monthly amount of money spent on other sources of energy by households was R81.37 with a very wide variation in amounts. Households were also asked to report on how convenient it was for them to access such energy sources. Households did not only buy such energy resources at NURA energy shops, but they also made use of local spaza or tuck shops. The only energy sources other than PV solar systems that were available at NURA energy shops were LPG and paraffin. The majority of households (66.0%) reported that it was convenient for them to access any energy sources in terms of distance.

4.4 Business development information

One of the objectives of conducting the household survey was to find out what income generating activities resulted or benefitted from SHS installations. Such activities could be home or community based and should be encouraged as part of an integrated project along the lines of Davis et al (8). It was very disappointing to note that so few people had taken advantage of the new technology to create small businesses, only 25 (5.1%) of households had income generating activities. The big question is why? A number of participants cited low system capacity in terms of power. They argued that the system‘s power was too weak to allow them to create businesses.

Table 1: Income-generating activities in the community

TYPE OF BUSINESS	Frequency*	Percent
None	367	75.2
Cell phone charging	54	8.0
Barber shops	27	2.9
Welding business	21	2.3
Radio and TV. Repairing	19	2.3
Poultry breeding	17	1.6
Basket weaving	16	1.6
Sewing	15	1.6
Water pumping	4	.6
Carpentry	4	.4
Beadwork	2	.2
Total	488	100.0

• Includes multiple responses

Few business opportunities resulted with the main constraints reported as lack of ready markets for products produced with the greater availability of light. The major new businesses were cell-phone charging (8%) and haircutting (3%), cash registers in trading stores, and repairing radio and TV equipment (both 2.3%). The major benefit was reported as lighting, followed by the enjoyment from greater media availability (Up from 55% (14) to 58% on 2004) and feeling more part of society.

For community based income generating activities, it was established that charging cell phones using the systems was the most popular with 8.0 per cent of participants confirming the existence of many such businesses in the community. Contrary to the disappointing results, 48.8 percent of participants thought that enough was being done to promote small businesses in the community

4.5 Satisfaction with system usage

Evaluation is important for any project. Looking at satisfaction from the user‘s point of view would give an indication of what needed to be changed in terms of service or the actual product.

Table 2: Consumer satisfaction with SHSs

SATISFACTION	Frequency	Percent
Very satisfied	55	11.3
It has changed my life for better	221	45.3
I am indifferent	186	38.1
It is worthless, I prefer my old methods	24	4.9
I do not want it anymore	2	.4
Total	488	100.0

The limited lighting led to the overloading because customers connected more lights than was recommended for their systems. This was confirmed in the few houses visited, in that many lights, large music systems, and colour TVs were connected to small SHSs.

Three hundred and fifty one participants (71.9%) said their systems functioned properly at all times. Customers said that problems were fixed within a week of reporting and that was most acceptable. In terms of expectations, 67.0 percent of respondents agreed that before-installation and after-installation expectations were the same. Again the majority of households (76.8%) thought the distance for buying system tokens was convenient compared to 18.9 percent who thought otherwise. Asked whether they were satisfied with the entire system, the majority (56.6%) agreed that solar home systems have changed their lives, but wished it offered more services like ironing, refrigeration and cooking.

5. CONCLUSIONS

During the survey, the government dragged its heels over renewing the contract with the concessionaires. As a

result, workload for the sub-contractors decreased with resultant dissatisfaction at the reduced installation rates; and the local government subsidy of R40 per month was withdrawn. Many households requested downgrading to smaller systems at lower monthly fees.

Never the less, it seems that the IREP model was working very well, albeit subsequently downgraded in size. Overcoming the first cost barrier was avoided through the fee-for-service model and government capital subsidy for the company. Deposit amount at 7.5% of regular monthly income was pitched at an affordable level so that loan arrangements were unnecessary. The Energy shops offered fuels at reduced rates which encouraged their use and subsequent profitability. Competing shops that sold fuel still managed because of their greater convenience (closer to home) even if more expensive.

However, the inflexibility of the monthly fee was a problem. The consumers expected to be able to skip paying if they did not use the electricity (a weakness in the education offered in that it had to be explained repeatedly that the fee was for the rental of technology). Householders suggested that they be able to purchase the amount of energy that they could afford because of family crises. Then they could revert to free fuel wood and candles with early bedtimes. Once the subsidy was removed, there were many complaints about the fee increase from R18 to R58 monthly. This reinforced the World Bank report (3) that operating subsidies undermine the long-term sustainability of a PV electrification program. NuRA established a responsive and sustainable infrastructure and followed stages as suggested by SOPRARE (4) in that the citizens' awareness campaign was generally successful with a constant stream of new customers and high levels of satisfaction from the users.

The training for both technicians and sub-contractors contained little guidance on how to educate the users. There was also no formal individual or group training offered to customers, just informal explanations at installation and servicing, with brochures available at the energy shops. Answers to questions were also provided at the shops. Both children and teenagers were generally omitted from any consumer education. They could also often explain things to the parents Findings indicated that the weak point was consumer education, as many malfunctions were the result of overloading, misuse (abuse) or ignorance.

The local government institutions were involved with the program in that the users' subsidy came through their coffers. However, they were not involved in the day-to-day management, establishing internal use rules, or reinforcing local responsibility as recommended by the World Bank report (3).

The five energy shops were planned to operate at a profit and as freestanding businesses that were self-sustaining. Administrative procedures were all computerized and downloaded to a central computer, ensuring effective fee collection methods and shutting off service for non-payment. The accent was on well-functioning technology. The final World Bank recommendation was to provide quality products and services. This NuRA did in that many of the component parts were specifically designed and made for their use. The repair reports showed that most call-outs were because of user ignorance rather than poor technical quality. However, the oldest systems had only been in use for 2 years and therefore technology fatigue had not set in. Consumer awareness of maintenance and safe operating procedures was however poor. Dissatisfaction resulted more from poor understanding of the system. Better consumer education opportunities would have limited the few unrealistic expectations that were evident.

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