Integration of biogas into the rural energy supply of solar home system powered households in South Africa: A case study of Tsware, Mailula and Muropo villages in Polokwane

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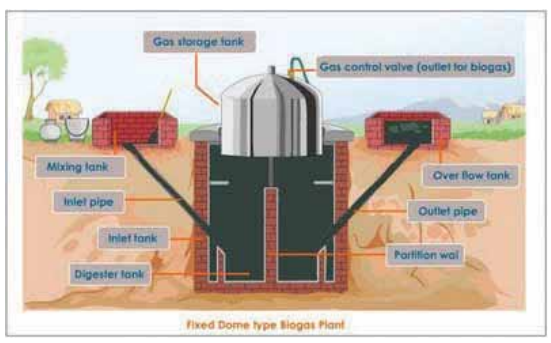
1. INTRODUCTION

To provide electricity to off-grid communities, thousands of solar home systems have been rolled out in South Africa, in government supported initiatives. However the solar home systems of 50wp can only cater for lighting and entertainment, therefore people still use non-renewable fuels within their proximity, especially wood, for their heating and cooking needs. The study explores the use of modern and hybrid energy technology (combined solar and biogas systems) for energy provision in rural areas to ensure poverty reduction and environmental protection.

2. THE TECHNOLOGY

The problems associated with non-renewable fuels, including deforestation, justify the introduction of renewable sources of energy, such as biogas, to cater for rural household thermal requirements. Use of biogas can reduce the labour of gathering and using wood for cooking, indoor air pollution, deforestation, and greenhouse gas emissions. The organic materials needed for the production of biogas are readily available in most rural areas. The sludge from the production process can also be used as fertiliser by farmers. Biogas can be used for electricity production, space heating, water heating and process heating.



Biogas digesters can process different feedstocks, and be implemented in a variety of applications, including:

- Rural households/farms with four or more cows, where the cattle dung can be collected fairly conveniently.
- Rural households/farms with a mixture of livestock and sufficient supply of dung from animals such as pigs, chickens, sheep, horses and goats.
- Institutions such as rural schools where there is inadequate sanitation, but a fairly large number of users.

Integration of biogas in the energy mix has the potential to stimulate productive activities and economic growth in rural area; improve the living standards of the poor, reduce rural urban migration and ensure availability of affordable, reliable and sustainable energy service delivery; the main driving force for policy on energy access.

3. METHODOLOGY

A survey was conducted among solar home system-equipped households in Limpopo, government departments and private companies. The study used both qualitative and quantitative research methods. Data collection from the households was done using semi-structured interviews. A semi-structured interview was used to elicit useful information from the participants on the energy demands and on the feasibility of incorporating biogas into the energy mix. The responses from the household interviews were analysed quantitatively. Interviews were also conducted with key stakeholders from the Limpopo Provincial department of Energy, Solar Vision and Agama. The results from the study together with secondary material based on African and international experiences with biogas programs were used to draw up the findings and recommendations for this study.

4. FINDINGS

- About 10 500 households from Limpopo benefited from the Department of Energy's legacy project on solar home systems; (the vision of the solar home system project is to provide rural poor people with a basic lighting system for audio-visual purposes).
- Current sources of energy are solar PV, kerosene, candles, wood, dried animal dung, car battery and dry battery cell.
- Negative effects of using these energy sources include the detrimental effect of smoke on health, high purchase costs, and deforestation.
- A total of 47 of the 90 households were involved in agricultural activities such as maize production, cattle, goat, pig, sheep and chicken rearing whose waste could be used for biogas.
- Agricultural waste could be combined with the human waste from the pit latrines to produce biogas.
- There is need to have a sample bio-digester within the community, and for communities to be shown how it operates, and its capacity.
- The unit cost of a 6m_ biogas plant is about ZAR 23 575 (US$ 3368). This is comparatively more expensive than solar home systems programs, where one pays R100 for installation and R28/month for maintenance.
- However once the bio-digester has been installed, maintenance is minimal.
- The biogas program needs to get subsidy like other renewable energy sources, such as solar home systems and solar water heating programs.

5. CONCLUSIONS AND WAY FORWARD

The study has indicated that it is technically feasible to combine solar home systems and biogas to meet the community's thermal needs, however more work needs to be done to arrive at the best possible financial implementation model. All participants indicated that if biogas were to be introduced they would use it, even if they have to combine agricultural waste and human waste. The main challenge would be the financing of the bio-digesters as many of the households rely on social grants and pensions, and their total household income is below R3 500. The construction of a bio-digester could be ten times their monthly income. In light of the work done in this study and some of the work done in many other countries the following are some of the recommendations on implementation, and how to ensure the success of biogas. Mapako (2009) suggests some points that may contribute to the successful market development of modern energy service delivery.

- Firstly the demonstration phase should target opinion leaders in communities and should be large enough to have impact, with units that work and produce happy users.
- Training in technical aspects for installers and end users, as well as managerial and financial management skills for the companies involved.
- Enforcement of long-term maintenance-support for clients, and ensuring availability of technicians locally, with refresher courses to keep levels of competence high.
- Availability of suitable finance schemes and favourable repayment terms, giving consideration to those whose earnings are seasonal. A possible and recommended implementation model would be the fee for service scheme. In this model the supplying company owns the system, and provides an energy service to the end-user, who pays a periodic fee (e.g., monthly) to the service provider. The end-user is not responsible for the maintenance of the renewable energy system and never becomes the owner, although the end-user may own for example the battery and lamps/radio or gas stove.

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