26th WEDC Conference Dhaka, Bangladesh, 2000

WATER, SANITATION AND HYGIENE: CHALLENGES OF THE MILLENNIUM

# Solar power for community water supply

*Mark Bannister, South Africa*

It is generally accepted that solar technology (photovoltaics) is by now a well proven and mature technology, however the field of community water supplies can hardly be described as a "controlled environment". The institutional, socio-economic circumstances vary from community to community and raise such detractions as:

- the relative ease with which solar panels can be stolen for use in other energy-driven processes
- high capital costs
- high risk with regards vandalism or damage
- uncertainty as to the sustainability of solar systems

Since 1996 The Mvula Trust have successfully implemented six projects within South Africa where it is still fairly much a novelty. These projects have been treated as a collective programme to evaluate the use of solar pumping as a sustainable alternative form of energy under specific niche conditions.

The results obtained suggest that these issues can be addressed successfully if the recipient community is in full support of a project.

The aim of this paper is to describe the projects undertaken by Mvula Trust and the methodology, research and experiences used, and to address those issues of 'doubt' which are common to many other countries.

## Project details

The following projects have been successfully completed:

| Mudzidzidzi, Northern Province | |
|---|---|
| Location: | Venda (70km North of Thohoyandu). Mudzidzidzi is a community of 453 people occupying 52 stands. Hilly green location. Panels located away from village. |
| Security: | Fencing installed around unit, for security. No security problems |
| Selection: | Deep bore-hole delivering to prefabricated reservoir |
| Project Status: | Project Opened in January 2000. Solar pumping has been successfully operational since July 1999. Flow of water is within designed flow rate. In fact, appears to be approx 30% greater than designed flow. |
| Datalogger: | Data logger was shipped from overseas, and was installed in October 99 |
| Supplier: | Tenessa |
| Backup water supply: | Nearby village has supply, requiring a couple of km walk. |
| Technical: | 19m$^3$/day @ 115m total design head,3.5kw AC motor |
| Cost of system | R186 000 |

| Maupye, Northern Province | |
|---|---|
| Location: | 70km NW of Pietersburg. Maupye is a community of 796 people occupying 171 stands in the Seshego district of the former Lebowa. |
| Security: | Panel situated on private property, within their yard. Siting is near a township, to see whether locating in private yard will reduce risk of theft.<br>Unfortunately, on the 24/3/00 3No panels were stolen - the system is still pumping. Water Committee will now build a security fence and include an alarm system to ensure no further theft. |
| Project Status: | Has been working for 22 months. Flow of water is more than the designed flow rate. Working under maximum power flow. |
| Data-logger: | Installed, but the water meter on the outflow of the pump was incompatible with the data-logger. Meter has been changed over and final connection to the data logger will be completed within a month. |
| Backup Water supply | Diesel pump on separate borehole is available but is not normally required for normal daily use. |

| | |
|---|---|
| Supplier: | Siemens |
| Technical: | 35m$^3$ / day @ 45m total design head ,2.5kW AC motor |
| Cost of system | R170 000 |

| **Tshokotshoko, Northern Province** | |
|---|---|
| Location: | 100km NE of Tohoyandu in Venda. Very dry, barren area. High solar insolation. |
| Security: | Very remote desert-like location. A few baron hills and scrub bush surrounding panels. Security fence included. No problems. |
| Selection: | Very deep borehole, therefore equivalent pumping head as Maupye. The new solar pumping system has been installed on an existing borehole with a good yield. |
| Backup water supply | An existing diesel pump has been relocated onto a new borehole as a back-up supply but has not been utilised on aregular basis. |
| Project Status: | Infrastructure completed. Community receiving plenty of water since completion in December 1999. |
| Project Agent: | Tenessa |
| Technical: | 25m$^3$ / day @ 67m total design head, 1.4kW AC motor |
| Cost of system | R225 000 |

| **Malundjawele, N. Province** | |
|---|---|
| Location: | A community of 250 people, located 100km NE of Thoyandou in Venda in a very remote sandy area. The remotest project we have. Undulating and sparce. |
| Security: | Located well away from village (out of site). Security fencing included. |
| Project Status: | Installation of solar pumping system due within next 2 weeks. Rest of infrastructure will be completed within 6 weeks |
| Backup water supply: | Hand-pump located in centre of village |
| Project Agent: | Devwatt |
| Technical: | 8.7m$^3$/day @ 84m total design head, 1kW DC motor |
| Cost of system | R78000 |

| **Makopung, Mpumalanga** | |
|---|---|
| Location: | A community of 2000 people 100km North West of Nelspruit. Barren and hilly, the panels are sited in site of village but far away. |
| Security | Electrical fence installed powered by additional panel. |
| Project Status | System installed and operational for approx 24 months. |
| Backup water supply | Solar panel designed as second supply to diesel, and so daily manual changeover is completed via a change in pully. |
| Project Agent: | Franklin Electrics |
| Technical: | 30M$^3$/day @100m total design head, 3.7kW DC |
| Cost of system | R250 000 |

| **Kheis, W. Cape** | |
|---|---|
| Location: | A community of about 500 people. Very dry, desert-like, small undulating hills. |
| Project Status: | Panels were installed approx 6 years ago. There have been some difficulties with broken panels which have since been replaced. Security fence included. |
| Backup water supply: | Diesel available on separate borehole, and is designed for normal split use with solar (manual changeover) |
| Project Agent: | Franklin Electrics |
| Technical: | 12m$^3$/day @ 40m total design head, 0.5kW DC |
| Cost of system | R25 000 |

## Cost comparisons:

Let us consider the cost implications of PV systems compared with the typical costs of diesel systems:

| **A simple cost comparison for a 1kW system Development / Capital Costs (Rands)** | | | | | |
|---|---|---|---|---|---|
| **Diesel System** | | **PV System (AC)** | | **PV System (DC)** | |
| Engine | 18 000 | Panels | 66 000 | Panels | 54 000 |
| Pump | 3 300 | Pump | 5 400 | Pump | 27 000 |
| Columns | 3000 | Inverter | 9 000 | Current Booster | 3 000 |
| Pumphead | 2 400 | Pumphead | 1 500 | Baseplate/Cable/Pipe | 5 700 |
| Base | 9 000 | Base | 4 500 | | |
| Frame | 2 400 | Risingmain | 18 000 | | |
| **TOTAL** | **39 600** | | **107 400** | | **101 100** |
| **Recurrent Costs (Rands / year)** | | | | | |
| Fuel | 7 500 | Fuel | 0 | Fuel | 0 |
| Parts | 4 500 | Parts | 900 | Parts | 0 |
| Labour | 28 500 | Labour | 21 000 | Labour | 21 000 |
| Transport | 10 500 | Transport | 3000 | Transport | 3 000 |
| **TOTAL** | **51 000** | | **24 900** | | **24 000** |

The graph and table shown above demonstrates that in just over 2 years the PV system has justified its higher initial capital cost. By calculating capital and recurrent costs and analysing the total expenditure over time, the economics of alternative systems may be easily appreciated.

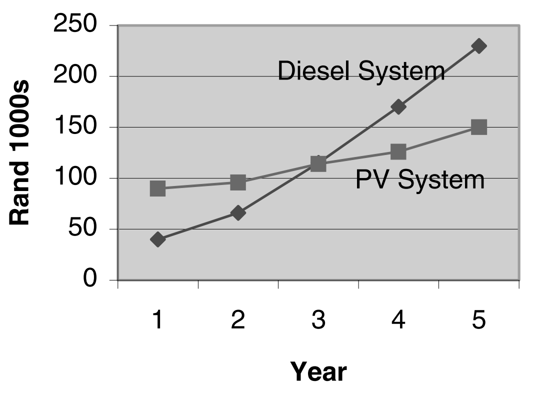

**Fig 1. Diesel System/PV(AC) Capital and Recurrent Costs**

## Conclusion

The project completed by The Mvula Trust has covered a wide spectrum of communities within different geographical locations – from some of the most rural communities in South Africa to peri-urban type settlements. Theft and vandalsim issues have been considered at each project with preventative measures being taken at each, such as:

- Locating panels in a community member's yard

- Electric Fences around the panels
- Alarm system and movement sensitive lights
- Night security
- Latest technology of panels which are more robust and designed to make it difficult to steal

Although there has been one problem at Maupye with a stolen panel, the issue was resolved by the community by installing an alarm – all other projects have performed well and has re-affirmed the potential of PV systems as an alternative source of energy supply for specific community water projects.

It is already a well established fact that economically PV systems are a more viable option provided that the reliability and security against theft and vandalism is maintained. The latter provisos have been addressed to demonstrate that if they are taken into account during the design of PV systems and the positioning of equipment, then the doubts can be greatly reduced. Even though the occasional panel may fail for whatever reason, communities may still be able to obtain water, be it of a smaller quantity, until such a time that the problem is rectified.

The benefits of PV systems for smaller, more specific communities are clear and can outweigh the downfalls if carefully operated and maintained. The Mvula Trust will continue to consider PV as an alternative pumping arrangement within suitable community water supplies.

## References

Water Supply & Wastewater Management Handbook 1994

M. BANNISTER – Regional Engineer, Mvula Trust