

Potential analysis for solar thermal systems in Botswana health sector

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Executive summary

The report analyses the potential for solar thermal systems in health facilities in Botswana. The study identifies 35 hospitals and 660 clinics of varying size in the country. Most health facilities are run by the Ministry of Health and Wellness, which by default is the largest health care provider. The study shows that Botswana has excellent solar resources which are however underutilised. The report identifies the primary heat demand activity in health facilities i.e. hot water production and steam generation. The recommended domestic hot water temperature is 60°C which is best provided by evacuated or flat plate solar collectors. No large scale solar thermal system is installed at any of the facilities although smaller thermosyphon systems are installed at some but these suffer from lack of maintenance.

Total hot water demand in health facilities in Botswana is estimated to be 34.6 GWh. Most hospitals make use of coal fired steam and hot water boilers for their heat demand. Clinics mostly use hot electric hot water geysers. A recurring problem with most of the boilers in hospitals is lack of quality maintenance leading to frequent breakdowns. Although the study shows considerable benefits in terms of solar thermal energy gains, large scale implementation of solar thermal systems in hospitals is not currently financially competitive with cheap coal. The study found out that smaller solar thermal systems for clinics are more attractive and financially feasible. The study has shown that coupled with heat pumps to mitigate electricity usage large scale solar thermal systems can provide up to 35% of thermal energy needs of a hospital at high system efficiency (71%.) Implementation of solar thermal systems in health facilities faces numerous challenges such as lack of data on hot water demand in facilities, cheap fossil fuels, lack of knowledge and awareness about solar technologies among decision makers, conservative thinking that hampers trying new ideas etc.

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1 Introduction

Botswana experiences some of the highest solar irradiation in the world. The average annual global solar irradiation is over 2100 kWh/m² which compares favourably to some higher latitude countries such as those in the EU that have extensively implemented solar applications despite a lower solar resource. Botswana has a very low uptake of solar thermal systems despite its huge potential. The goal of the project is to evaluate the potential for application of solar thermal technologies to meet the heat demand of health facilities across Botswana. The report briefly outlines the solar resource in Botswana and the technologies available to utilize this resource. Botswana energy capacity is also briefly outlined. The heat demand of health facilities is estimated from available literature and data gathered from the field. Financial savings are analyzed as potential impetus to implement solar thermal applications in health facilities.

Auspices

The project was carried out under a bursary fund provided by AEE – Institute for Sustainable Technologies, with funding from the Austrian Development Agency, in collaboration with the SOLTRAIN initiative.

1.1 Objectives

The objectives of the project are:

- To survey hospitals and clinics in the country, including the number of beds and the monthly average number of patients;
- To calculate hot water consumption in hospitals and clinics; and
- To derive potential for thermal solar systems for the health sector.

1.2 Methodology

Data collection

The data were collected within the framework of published literature in the relevant field, be it the web and/or research papers, consultation with experts in the field as well as collection of data during site visits to health facilities. Unavailable data was estimated and checked for plausibility on the basis of various publications. Targeted data were hot water consumption, electricity consumption, thermal generation technologies, and financial data.

Heat demand calculation

Literature reveals a method of determining the thermal energy demand of hospitals based on the number of beds in the frequent case that such data is not available. The thermal energy demand is subject to size of facility which determines the type of technology used for generation.

Simulation

Equivalent solar thermal analogues of current heat generation technologies employed in health facilities were realized using the simulation tool T*SOL™. T*SOL is a simulation program for the design, optimization and calculation of solar thermal systems. The sizing of the solar thermal system were based on hot water demand profile. The tool simulates the complete solar thermal system including solar collector area, storage and associated hydraulics which then allows estimation of annual thermal, electrical and financial savings.