Stakeholder workshop report

Program design and development of an investment model for the uptake of solar thermal technologies in industry and institutions

Jameson Hotel, Harare

11 December, 2012

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Executive Summary

The Scientific and Industrial Research and Development Centre (SIRDC) and SNV-Netherlands Development Organisation have commenced the preparation of a strategy for up-scaling the use of solar thermal technologies in industry. To achieve effective participation in the development of the investment proposal and programme design, a stakeholder workshop was held on the 11th of December 2012, at Jameson hotel, Harare.

Prior to the workshop, the SIRDC team had identified the key stakeholders namely, the various relevant industrial sectors, government ministries and agencies, academic and research institutions, financial sector and solar energy companies and experts. A questionnaire that also sought to solicit views on solar energy usage in industry was drafted and distributed electronically and physically. Previous energy audit results done by the Energy Technology Institute were also used in the study. The major objective of the workshop was to provide extensive and direct consultation with the stakeholders so as to identify options, opportunities and challenges for accelerating solar thermal technology uptake. The cross-sectional representation of all players enabled sharing of ideas and views.

The workshop was attended by 48 participants drawn from all relevant sectors of the economy. Presentations by the Ministry of Energy highlighted the Policy thrust of the Government of Zimbabwe as enunciated in the National Energy Policy of 2012. The SIRDC team presented results of their questionnaire and industrial outreach and a representative from Carbon Africa highlighted opportunities available for industry to access climate change funding. Interactive group discussions revealed challenges faced by the solar industry and recommended action points for Government, industry and the finance sector.

This Report presents the outcomes of the stakeholder workshop in a sequential way and sets out factual information relating to the establishment of the workshop, reflects on achievements and concludes with recommendations and way forward arising from the work of the participants. Workshop deliberations were independently facilitated by Mr Panganayi Sithole of the Zimbabwe Energy Council.

1 Introduction

The Scientific and Industrial Research and Development Centre (SIRDC) and SNV-Netherlands Development Organisation have commenced the development of a solar thermal energy uptake investment proposal and strategy, for facilitating a market for solar thermal products in Zimbabwe's primary, secondary and tertiary industries. To achieve early and effective stakeholder participation in the development of the afore mentioned core Strategy, SIRDC and SNV held a stakeholder workshop to allow discussion of the issues that will need to be addressed and to identify potential options for addressing those issues for the successful implementation of solar thermal energy in industry and institutions.

SNV engaged SIRDC as a Local Capacity Builder to facilitate the stakeholder workshop process. The local capacity builder was tasked to lead several processes that will culminate in an investment proposal and programme design for facilitating market development for solar thermal products.

Taking advantage of the existing partnership programmes with the Ministry of Energy and Power Development (MoEPD), Business Council for Sustainable Development Zimbabwe (BCSDZ), Confederation of Zimbabwean Industries (CZI), Rural Electrification Agency (REA) and Zimbabwe Electricity Transmission and Distribution (ZETDC), SIRDC identified companies in the five major sectors of the economy, that is, industry, agriculture, infrastructure, mining and energy which formed the core participants in the project. These stakeholders were the main source of information to be used for the project and workshop hence they were engaged at the onset of the study. An outreach programme, that involved company visits, questionnaire dissemination and face to face interviews were held.

The stakeholder workshop was held after the initial outreach programme and preliminary results were presented. SIRDC agreed to report independently and objectively under the following key objectives:

- Disseminate information
- Manage the stakeholder workshops objectively and independently
- Channel discussions in a constructive manner
- Support the work of the workshop members
- Find and document outcomes based on consensus
- Consolidate the findings of the studies and conclusions of the multi-stakeholder processes into one investment and programme proposal that can be put forward to investors and donors.
- To present workshop outcomes and research findings to SNV and stakeholders

The extent to which these objectives were achieved is discussed in Section 6 of this report.

2 Purpose and Structure of Report

This report presents the outcomes of the Stakeholder Workshop held on 11 December 2012 at Jameson Hotel, Harare, Zimbabwe. It sets out factual information relating to the establishment of the workshop, reflects on achievements and concludes with recommendations and way forward arising from the deliberations of the participants.

3 Establishing the Stakeholder Workshops

SIRDC and SNV convened stakeholders for the workshop from relevant Government ministries, Non Governmental Organisations, financial sector, research institutions and universities, industries and other private individuals who expressed an interest in solar thermal energy in Zimbabwe. Invitation letters explaining the purpose of the workshop, the workshop programme and discussion points were sent to over 60 stakeholders. All industry players and institutions that participated in the outreach programme and answered the distributed questionnaire were invited.

A total of 49 individual delegates attended the stakeholder workshop. A breakdown of attendees is shown in Figure 3.1 below and a full list of attendees is provided in Appendix 3.

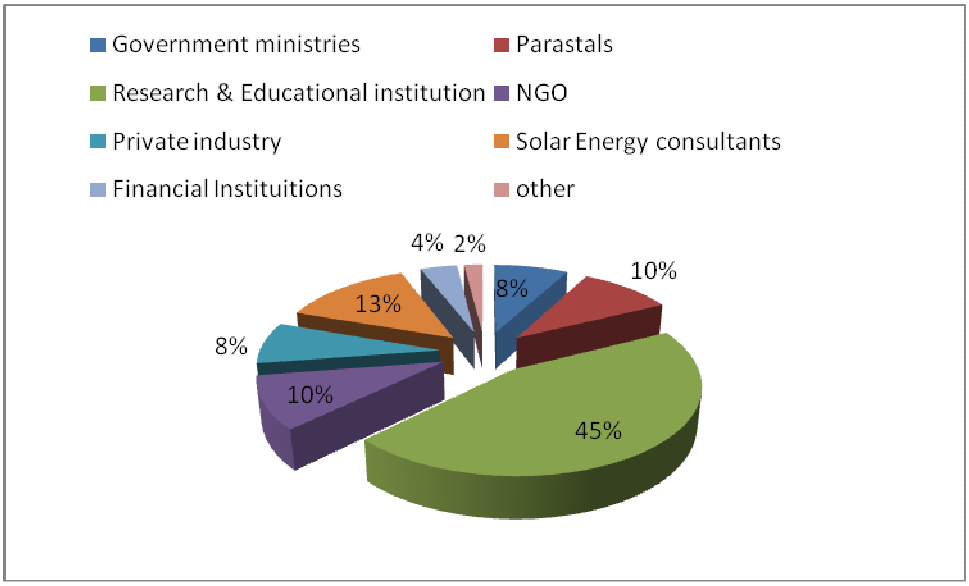

Figure 3.1: Percentage breakdown of workshop attendees

An analysis of the attendees' shows that 45% comprised representatives from the research and education institutions, 13% were from solar energy consultants or companies, 10% were from parastals, the other 10% were from NGOs, 8% come from private industries, the other 8% came from government ministries whilst 4% were from financial institutions.

4 The Agenda and Format of the Meetings

The workshop began with a welcome and introduction to the event by the Chief Executive Officer of SIRDC who outlined SIRDCs mandate, previous successes in research and welcomed the collaboration between SIRDC and SNV. The SNV representative Mr Boonstoppel (Sector leader – Renewable energy) then gave a background to the project and objectives of the workshop. The official opening address was delivered by the Permanent Secretary, Ministry of Energy and Power Development.

After the official opening, plenary session presentations from the invited speakers were delivered. Discussions, and question and answers sessions after each presentation were moderated by the facilitator Mr P Sithole. Session presentations covered solar thermal technologies applicable in industry, perspectives on

opportunities and challenges faced by the solar thermal industry, opportunities for tapping climate change funding opportunities and presentations of preliminary results of by the outreach/survey by SIRDC team.

The details of participants were captured at the registration desk manned by SIRDC staff, shown in figure 4.1.

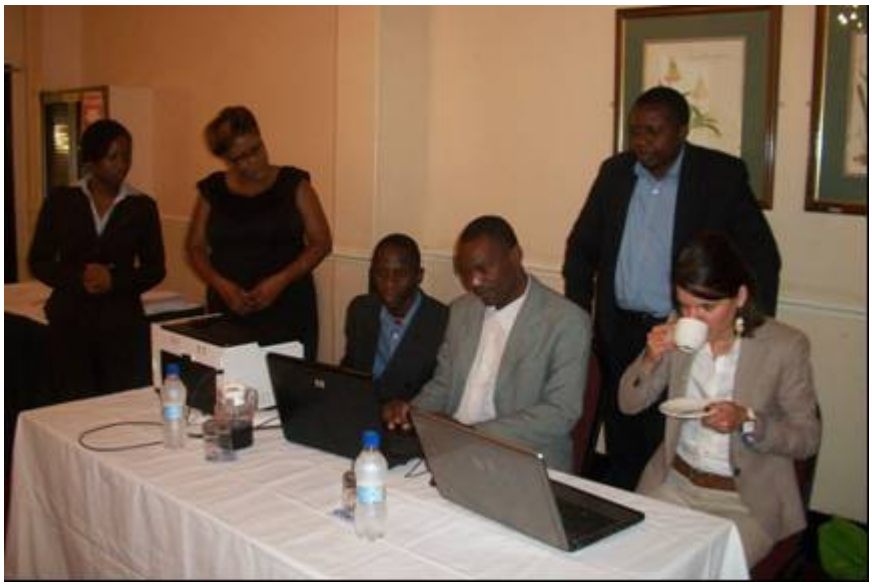

Figure 4.1 Some of the SIRDC staff at the administration desk

During the afternoon session, participants were ushered into three groups to discuss the roles that government, industry and financial sector can take in order to mainstream solar energy into industry's energy supply. A group member was assigned to capture discussions, points and responses and presented the group deliberations to the rest of the workshop delegates. This was very instrumental in allowing all delegates opportunities to participate and have one-on-one brainstorming of ideas. The format of the workshop was devised to give delegates an opportunity to participate in the identification and consideration of issues required to develop the vision, options and a roadmap for solar thermal energy.

The official opening speeches are captured in section 5 of this report while session presentations are summarised in section 6.

5 Official opening session

Three presentations were delivered during the official opening session.

5.1 Welcome address

Figure 5.1 Dr L Madzingaidzo, Executive Director at SIRDC presenting the CEOs welcome address

Salutations

- The Guest of Honour – Mr P Mbiriri Permanent Secretary Ministry of Energy and Power Development
- Permanent Secretaries of Government Ministries
- Senior Government Officials
- Representatives of SNV
- Representatives and Stakeholders from Industry and Energy Sectors
- SIRDC Management and Staff
- Ladies and Gentlemen

Allow me to start by welcoming and thanking you all for finding time, albeit at a short notice, to grace this important workshop convened by SIRDC and SNV of The Netherlands to discuss strategies for the mainstreaming of solar thermal energy technologies in industry, as part of a broader and concerted effort to address energy challenges in the country and in the SADC region at large.

As you might be already aware, SIRDC was born out of an Act of Parliament (the Research act of 1986) and started operating in February 1993. Its mandate is to provide Zimbabwe with locally grown technological solutions that answer to the myriad of challenges faced by our society, industry and the economy at large.

The SIRDC presently has 12 research institutes offering R&D and consultancy services that cover almost all sectors of the Zimbabwean economy. These are namely;

- Biotechnology
- Building Technology
- Electronics and Communications
- Energy Technology
- Environmental Sciences
- Food and Biomedical Technology
- Geo-Information and Remote Sensing
- Informatics
- Metallurgical Research
- National Metrology
- Production Engineering
- Polymer Science

In addition to these 12 institutes, we also have a Business Operation Unit and technical and administrative support departments. The business Operations Unit handles all business aspects of the Centre's projects and interfaces the institute with various sectors of industry and commerce.

The diversity of the institutes means that the Centre's activities encompass almost the entire spectrum of the Zimbabwean economy. This mix of skills and knowledge allows the Centre to constitute multi-disciplinary teams to execute clients' requests, making SIRDC a one-stop shop for technological solutions.

Internally, the Centre encourages innovation among its scientists and engineers because it is only when we are able to invent and transfer technology to industry that we can have positive impact on the growth of the industry in Zimbabwe.

In mid 2003, the Centre adopted a teamwork innovation model called the STAGE GATE PROCESS, which we have used since then with encouraging results in all our projects and business processes. The Stage Gate process in brief entails the following:

- Each project has a multi-disciplinary team made up of the technical people (scientist), finance and business people (i.e. all the people who will in the end make the project a success). These are expected to look at a project in a holistic manner as well as play their separate but co-ordinated roles.
- Benefits of the Stage Gate process include improved discipline and focus, removal of critical errors of omission, timeous completion of the project and market assurance for the product.

The Centre has moved from mere research and development to encompass the practical application of the research results and findings in line with its vision, which in short is reduction to practice.

The Energy Technology Institute (ETI) is the SIRDC strategic unit established to conduct Research and Development and technology transfer in the energy domain. Over the years, the ETI has developed products that have assisted industry and commerce particularly in energy management and, adoption and adaptation of renewable energy technologies. In that regard, SIRDC has provided technical services to almost all sectors of the economy operating in Zimbabwe from the agriculture industry to the manufacturing, mining and utility industries. I am glad to mention we have now added SNV to the list of organizations we have professional and business relationships with.

Zimbabwe has had fair share of challenges largely due to the absence of affordable long term monetary instruments to finance capital projects in the energy sector. The increase in the demand for power due to an ever increasing population vis-à-vis a stagnant energy generating capacity has meant that power has to be imported from neighboring countries. The country's capacity to import power has limited fiscal space in which to operate as a result of the introduction of the multiple currency system and suspension of the Zimbabwe dollar in 2009.

Ladies and gentlemen, it therefore imperative that we adopt and execute a demand side strategy that reduces pressure on the current power generating and distribution infrastructure as a measure address some of the energy challenges faced by industry today. This workshop is a culmination of the technical study done by SIRDC with support from SNV, to come up with an investment proposal that allows the relevant actors in research, government and industry to map a way forward to ensure the successful implementation of ‘’green and renewable technologies’’ in Zimbabwe.

Once again, I wish to thank you all for accepting the invitation to attend this workshop and hope that you will have fruitful discussions and produce a workable plan to steer the energy industry to greater efficiency and environmental sustainability.

I thank you.

5.2 Project Background

Figure 5.2 Mr Erik Boonstoppel of SNV-Netherlands Development Organisation

SNV has been in Zimbabwe since 1983. Since then we have been very much a part of the post-independence development efforts of the country through our work with communities, organisations and institutions that are working towards poverty reduction and sustainable development. We work in three sectors namely, Agriculture, Water, Sanitation & Hygiene and Renewable Energy.

SNV Renewable Energy Zimbabwe's overall goal is to realise access to sustainable, clean and reliable energy sources for domestic households and small and medium enterprises, including small producers, while reducing greenhouse gas emissions. The organisation is also working with key stakeholders in the energy sector to promote the increased uptake of renewable energy and energy efficiency technologies in the country. Our collaboration with SIRDC seeks to develop a roadmap that accelerates the uptake of solar thermal technologies in industry.

The industrial sector production volumes have remained low due to a myriad of economic factors and energy supply is one of them. Since the turn of the century, ZESA has been load shedding domestic and industrial clients due to limited generating capacity. A number of proposals to mitigate the energy challenges, among them, the construction of new power plants have been suggested. It is our

view that the implementation of energy efficiency strategies in industry and the use of renewable energy is benefial in the long term to the country. Solar thermal technologies are a proven source of energy for heating requirements and generation of process heat. In addition, energy savings through energy efficiency strategies actually create a virtual power plant cost effectively.

The existing energy supply gap for domestic consumers and industrial clients has resulted in the increased use of fossil fuels (coal, diesel, and paraffin, wood). The use of wood fuel has resulted in massive deforestation throughout the country and more evidently in and around the major cities. The supply constraints have resulted in consumers shifting downwards from clean energy sources to dirtier forms of energy. Increased fossil fuel utilisation has caused environmental degradation and increased the countries green house gas emission levels.

In Harare 90% of the population is connected to the ZESA grid, 80% of the urban population uses alternative energy for cooking e.g cooking gels, paraffin, gas, etc. The energy deficit is causing citizens to step down on the energy level. SNV as a development organization cannot intervene in electricity generation. Considering the pace of new connections, it is unlikely that the 80% will be migrating upwards in the next 10 years. SNV is exploring domestic and industrial markets for solar thermal technologies and would want to see industry developing the solar technology as the impact would be greater.

The SNV-SIRDC collaboration seeks to work on processes that will culminate in an investment proposal and program design for facilitating market development for solar thermal products. The multi-stakeholder workshop we are participating in today, is expected to produce deliberations that will be consolidated into feasibility and research findings. There is need for feedback on what is possible and what is not possible and come up with an investment plan.The developed investment and implementation strategy will be forwarded to investors and donors for funding.

Thank you.

5.3 Official opening address

Figure 5.3 Eng L. Munyaradzi Director of Policy and Planning in MoEPD delivering the Permanents Secretary's opening address

Protocols

Energy plays an invaluable role in social and economic development as it is a critical factor of production, its cost impacting directly on other services and the competitiveness of enterprises. Every productive sector in the economy relies on the provision of energy.

As a developing country, the majority of the people in Zimbabwe are dependent on traditional and inefficient energy services that constrain their ability to enhance economic productivity and quality of life. The National Energy Policy has been developed and its implementation strategy was a collaborative exercise involving many stakeholders. The thrust of the energy policy is to ensure sustainable social and economic development through universal access to a portfolio of modern energy services to meet lighting, heating and power needs.

The main sources of energy used in Zimbabwe comprise coal, wood fuel, electricity and petroleum fuels. According to the latest (2009) national energy balance, wood fuel provides the bulk (61%) of the total energy supply, followed by liquid fuels

(18%), electricity (13%), and coal (8%). Solar thermal and photovoltaic systems' contributions were insignificant.

Thirty-seven per cent (37%) of households in Zimbabwe have access to electricity that is connected via power lines. There is a significant difference between urban and rural areas in their access to electricity. In urban areas 83 per cent of households have electricity, compared with 13 per cent in rural areas.

The country's solar energy potential of 16 to 20MJ/m^2/day is greatly underexploited. At 3,000 hours a year, this can produce 10,000GWh of electrical energy per year which is a huge potential. Donor-funded solar PV (photovoltaic) installations have been installed in many homes, businesses, schools and health centres since the launch of the Global Environment Fund initiative in the early 1990s. In addition to the Rural Electrification Agency, there are a lot of small and medium enterprises now involved in importing and installing these systems. Solar lanterns have a great potential in improving lighting for rural households and institutions; prices range from US$10 to US$25, depending on their size. With local assembly, these prices can be reduced even further.

Solar water heating for urban households and businesses has the potential to save significant amounts of fossil-fuel and electricity. Its potential is greatly under-exploited because, so far, only a few private-sector businesses are in the market. The Ministry of Energy and Power Development with assistance of South Korea on a Government-to-Government agreement is implementing institutional solar water heating projects valued at US$1,000,000. Stand alone water heating installations are currently being implemented at Harare Institute of Technology and United Bulawayo Hospital and another one planned for Masvingo Technical College to be implemented next year. It is estimated that there are 250,000 to 300,000 geysers in households. If all these are retrofitted with solar collectors, the saving in peak demand could be as much as 350MW to 500MW. Industries could also save a lot of power by using solar for pre-heating water.

The major challenge with solar is the high up-front cost, which many users cannot afford. Several innovative solutions for subsidising access costs have been used elsewhere and can be tried here in Zimbabwe. The SIRDC - SNV solar thermal project is most welcome for up-scaling solar thermal projects. Penalties for energy inefficiency can assist in funding subsidies for a solar geyser roll-out programme. Cost recovery can also be made over an extended period using electricity-bill savings. Local manufacture of imported components can help to lower costs. The power utility can fund this as a DSM (demand-side management) investment. Carbon credits are also another potential source of funds.

According to the National Energy Policy released recently, the Policy Measures for Renewable Energy Technologies are:

- Adopt a long-term, government-driven, renewable energy technologies (RETs) programme, which encourages Independent Power Producers (IPPs) and public-private partnerships to harness sustainable RETs in Zimbabwe.
- Institute innovative funding mechanisms and tap into financing opportunities such as Clean Development Mechanisms, feed-in tariffs, and micro-credit institutions for RETs.
- Institute RETs-sustainable capacity-building programmes.
- Raise awareness about the benefits and opportunities of renewable energy.
- Encourage local production and the commercialisation of technologies.
- Strengthen the institutional framework for research and development and the promotion of renewable energy technologies.
- Promote investment into stand-alone solar energy systems to cater for rural communities.
- Promote the efficient use of biomass for cooking.
- Encourage the use of waste biomass for energy purposes.

- Develop incentives for investment in renewable energy, e.g. subsidies and tax concessions.

The Minister, through the proposed Rural Energy Agency and the power utilities, will establish a fund to promote the use of solar energy as a short-term to medium-term strategy to address the electricity crisis. The immediate strategies and targets that can be implemented in the meantime are as follows:

- Introduction of regulations by 2013 to mandate the installation of solar geysers in all new homes; penalties in the form of higher electricity prices or other methods can be imposed for non-compliance.
- Provision of incentives and raising awareness of the benefits of retrofitting solar collectors on existing geysers.
- Promotion of other proven solar technologies such as solar water pumping for off-grid borehole and river irrigation and solar PV-charged lights.
- Promotion of technology transfer and the expansion of local manufacturing; training of artisans and harnessing of the informal sector in the assembly and installation of solar geysers and solar PV.
- ZERA will establish cost-reflective renewable feed-in tariffs (REFIT) with appropriate subsidy mechanisms and other incentives to promote grid and off-grid power generation using solar and other renewable energy resources.

I am grateful to the organisers of this workshop. Their interventions always compliment our efforts as government in improving energy services. I also would like to challenge other organisation including those represented in this workshop to assist our government in its endeavour to develop sustainable. Together we can make great strides.

I take this opportunity to declare the SIRDC – SNV solar thermal project for industrial application officially open. Have fruitful discussions and enjoy your workshop.

6 Outcomes from Stakeholder Workshop

Five presentations were held during the plenary session.

6.1 Solar thermal technologies: basic theory and application

Figure 6.1 Dr Sosten Ziuku of SIRDC

Synopsis of the presentation

The sun is the source of the majority of primary energies used extensively throughout the world. Solar radiation drives the hydrological cycle which results in rainfall that is harnessed for hydropower electricity supply. Biomass material which was converted to fossil fuels millions of years past and which can also be converted to biogas also depends on sunlight for plant growth. Wind is also a form of solar energy. Winds are caused by the uneven heating of the earth's surface by the sun.

Amongst the various uses of solar energy, solar thermal is a mature, proven and relatively cost effective technology. It can be used for simple applications in industry such as space heating, material and crop drying, and hot water production. In addition, solar thermal technologies can also be used to generate process heat, for example, steam production and evaporative cooling.

Solar thermal technologies (consisted of a collector, a circulating heat transfer fluid, and storage) convert incident solar irradiance directly into heat/thermal energy. In Zimbabwe, global solar irradiance is in the range 4.0 to 8.0 kWh/m^2/day and the country has more than 2500 sunshine hours per year. This solar resource is about twice that of some western/developed countries where solar water heating is

intensively utilized. It is quite evident that solar energy is an abundant source of renewable energy at Zimbabwe's disposal, making it an obvious choice for solar water heating, and process heat applications.

The majority of Zimbabwean industries use coal and other fossil fuels to generate process heat, mainly steam. In simple low-scale applications, solar energy can be used to pre-heat water used in steam boilers. In low temperature applications (temperatures < 80^0C), unglazed collectors (40 to 60^0C), flat plate collectors (40 to 80^0C) and evacuated tube collectors (50 to 200^0C) can be used without sunlight focusing or concentration. In medium-to-high temperature applications (temperatures > 80^0C), sunlight focusing/concentration may be necessary. When using Concentrated Solar Power (CSP) the sun's trajectory across the sky is followed using single axis or double axis tracking in order to maximize the collection of direct normal solar irradiance (DNI). Medium-to-high temperature solar technologies with single axis tracking include the compound parabolic concentrator (100 to 150^0C), linear Fresnel reflectors (100 to 250^0C) and parabolic trough (100 to 500^0C). Typical high temperature solar thermal technologies (HTST) that utilize double axis tracking are the parabolic dish reflector (300 to 1000^0C) and the heliostat field collector (500 to 2000^0C). The heat transfer media used in HTST applications includes, but not limited to, water/steam, molten salt, synthetic oil, liquid sodium, and air depending on application and design. Research on very high temperature solar applications, for example for kiln and smelting, is still ongoing.

In addition to the initial capital investment, other challenges and requirements for high temperature solar thermal application in industry includes space (land area, m^2), proximity to water bodies, a favourable direct normal solar irradiance resource (usually greater than 6 kWh/m^2/day), thermal energy storage, proximity to loads and distribution network, skills base and technical expertise.

6.2 Challenges and opportunities for solar thermal companies/suppliers in Zimbabwe

Figure 6.2 Mr Chamu Muchenje and Mr Chuck Gardner (sitted) of Impact Solar and Solar Edwards respectively.

Synopsis of the presentation

The second presentation was under the theme "Challenges and opportunities for solar thermal companies/ suppliers in Zimbabwe" was delivered by Chamu Muchenje (Impact solar) and Chuck Gardner (Solar Edwards). The two gentlemen are seasoned players in the local solar thermal industry who have been trading for up to 25 years.

The presenters pointed out that the country has been experiencing rolling blackouts/load shedding due to electricity supply constraints. It has been reported that Zimbabwe generates about 1200 MW of electricity against a peak demand of about 2200 MW. The country imports about 35% from South Africa's Eskom, Mozambique's Hydroelectrica Cahora Bassa and DRC's Snel. There's certainly inadequate power generation capacity that has to be addressed.

The country has more than 2.2 million households and over 200 000 installed electric geysers. These present vast opportunities for retrofitting solar water heaters into existing systems and also install them into new domestic and industrial building projects. It is quite evident that residential, commercial and industrial infrastructure

seldomly use the abundant solar resource estimated to be between 4.0 and 7.5 kWh/m^2/day. Something has to be done to address this and the presenters were glad that SNV and SIRDC have presented them the opportunity to discuss and chart the way forward. The presentation pointed out that Zimbabwe must make use of solar thermal energy for its domestic and industrial applications to widen its technology base and make it comparable to other countries in the region and Europe. Mr Muchenje elaborated the advantages of solar thermal energy; identifying it as a cheap, clean renewable energy resource.

He touched on the early use of solar thermal energy in Zimbabwe during the early 1990s and pointed out that its success was limited as compared to solar PVs. At its infancy, during this era, APM Continental made cheap solar thermal energy collectors from galvanised iron sheets. Most of these units failed prematurely because of poor design and this hampered the uptake of this innovation. Industries and domestic households doubted solar thermal energy systems to sustain their energy requirements because of the previously mentioned problem and over the idea that it interfered with normal domestic water piping. On the other hand industrial users doubt whether it would realise benefits because they were not aware of its ability and absence of local case studies were the technology has been successfully utilised.

Mr Chuck Gardner added that to accelerate its uptake for industrial and domestic users it is important to first of all introduce it at small scale domestic application (household or boarding school) then expand it to a large scale (power plants) so that the public can have a basic appreciation and knowledge of solar thermal energy (identifying its optimum working environment and conditions of interface). Another issue highlighted hampering solar thermal energy development in the early 1990s to 2000 was absence of a National energy policy and National solar thermal standards to cover installation and testing of solar thermal systems. In addition, there's no formal solar thermal installation training which needs to be imparted to students in universities, research institutes and technical colleges.

The country has many companies that procure, supply and install solar water heaters at household and institution buildings. It is worth noting that some of these companies, for example, Solarmatics and Impact Solar actually assemble and manufacture solar water heater units locally. This creates employment opportunities, adds income to the government and develops local skills. However, the growth of these companies have has been hampered by poor local demand.

Zimbabwe's electricity is fast becoming an expensive commodity – accounting for far greater household operating costs than it did before the dollarization of the economy in 2009. Coincidentally, the price of solar products particularly solar water heaters has been decreasing. Simple back-of-envelope calculations have shown that the payback period for domestic solar water heater installations is about two years. As a result, the business case for solar thermal technologies is very attractive.

Some of the challenges hindering the uptake of solar thermal technologies at domestic, institutional and industrial scale that were pointed out include, but not limited to:

- Absence of a solar water heating policy at residential, institutional (schools, colleges, university, prison complexes etc) and industrial levels
- Absence of local SWH standards. This has resulted in the importation, dumping and flooding of the local market with cheap sub-standard products. The poor performance of these products leads to client dissatisfaction, and will eventually collapse the solar energy market. A body that enforces the developed standards needs to be set-up.
- Absence of technical and installer training.
- Lack of accreditation for solar products and installers (plumbers, electricians etc).
- Muted support from the main stakeholder - the Zimbabwe Electricity Supply Authority (ZESA)
- Absence of monitoring, evaluation and protection mechanisms. This would help to safeguard quality and enhance customer satisfaction.
- Absence of technology promotion and awareness campaigns. The Government through relevant line ministries and parastatals need to be

actively involved in conscientising industry and the general public about the benefits of solar thermal technology.

- Absence of affordable renewable energy finance mechanisms
- Absence of sustainable energy product pricing mechanisms
- Absence of tax incentives, rebates, credit facilities etc to SWH companies to spur business growth.

6.3 Funding opportunities for climate change mitigation programmes – developing a carbon project

Figure 6.3 Mr Timothy Gotora of Carbon Africa

Synopsis of the presentation

The presentation, Funding opportunities from Climate Change mitigation programs – Developing a carbon project, was prepared by Mr Timothy Gotora of Carbon Africa Limited and presented at the Solar Thermal Heat Workshop organized by SIRDC at Cresta Jameson Hotel. The presentation was divided into 3 main parts that are (i) Institutional Framework, (ii) Project Cycle including costs, rapid carbon assessments and sources of projects financing, and (iii) Common project characteristics.

Institutional Framework

The section summarized the institutional framework forming the basis of carbon project development including, stipulations of the UNFCCC, additionality, project sizes and methodologies. Emphasis was made on the closure of the EU market for non-LDCs on 31st December 2012 and alternative ways to which Zimbabwe as a non-LDC member could still get access to that market, and hence it further discussed on Programme of Activities (PoA) as avenues to market locally developed carbon projects to the EU market. It went on further to discuss on other possible

mechanisms and markets that are opening up in other regions of the world and the general discourse of the climate mitigation global debate.

The Clean Development Mechanism

This section described the CDM (Carbon) project development cycle. Emphasis was made on the cycle itself, project development costs, methodologies for solar thermal projects and initial steps to project development. It was highlighted that a project can take anything between 8 months to 2 years depending on several factors including project financing, level of in-house knowledge as well as the relationship with the consultant hired. Participates and project developers were urged to engage local or Africa based consultancy companies who understand the African context of projects development. The costs of project development were streamlined between single project development and PoA projects development. Costs for project development were reported to be in the range of $100 000 per single CDM project and up to 20 000 for a CPA CDM project. Three methodologies for the sector were discussed in brief and these included the:

1. AMS---I.E. Switch from non-renewable biomass for thermal applications by the user
2. AMS---I.J. Solar water heating systems (SWH)
3. AMS---I.K. Solar cookers for households.

An example of calculating potential using the AMS-I.J methodology was discussed in brief and from it potential revenue generated was calculated.

It was alluded that the essence of developing a carbon project is to reduce emissions, and revenue from emission reduction (ERs) units should be seen as an incentive to the action of reducing itself. As such projects should be able to raise and have extra finance to make sure that project implementation happens regardless of ERs revenue generation and that ERs revenue should be viewed mostly as icing on the cake. The advantages of conducting a short carbon project feasibility study were discussed and advantages indicated included assessment of economic viability, rapidness as

well as assessment of up scaling and or down scaling. Sources of financing were discussed and examples of financing sources were given including World Bank funds, Abu Dhabi Fund for Development, ACAD, GEF and the COMESA carbon facility among others. Participates were urged to continuously follow climate change news and funding news as well as subscribe to some of the multitude web based professional communities.

Common characteristics

The presentation further describing the common characteristics of a carbon project, which included innovativeness, replicability, approaches, broadening energy access, meeting development goals, and accelerating the uptake of renewable energy. During the question and answer segment a discussion ensured on project cycle length, price of ERs units, REDD+ and future of the CDM among other issues. In conclusion the way forwards were summarized as follows:

• Access potential in solar thermal heat industry CER generation.

• Access how to in-cooperate carbon project development in the broader business case/financing.

6.4 Assessment of thermal energy requirements in industry

Figure 6.4 Ms Tijana Radojicic of SIRDC presenting the preliminary results of the study

Synopsis of the presentation

The presentation on the methods used by SIRDC to execute the 'Solar thermal in industry project' was presented by Ms Tijana Radojicic of the Energy Technology institute of SIRDC. She was one of the key team members involved in the industrial outreach program.

The presenter noted that SNV Zimbabwe is working on Renewable Energy Programs in Zimbabwe since 2010. Of late the organization decided to explore the use of solar energy in industry in order to broaden the scope of the renewable energy sector and also having realized that significant thermal energy savings can be realized in industry.

A desktop analysis through internet and published literature was made to ascertain experiences and studies of financial, cultural, technical and external barriers to solar thermal projects implementation, within and outside Zimbabwe. It was reported that up to thirty industries made up of primary, secondary and tertiary industrial sectors, which use hot water and/or steam, were selected in and around the capital, Harare. Primary industries targeted included agriculture and mining, secondary industries were made up of manufacturing companies and the tertiary industries were service

providers such as schools, colleges, universities, hotels, banks and hospitals. Relevant ministries and industrial groupings, multilateral and non-governmental organizations, donors and investors with solar thermal applications interest were also engaged.

The ETI team developed a questionnaire which was distributed electronically and also hand delivered and completed during the industrial visits. The questionnaire (see appendices) data gathering exercise focused on client current water heating demand, cost of heating and energy sources and quantities used (coal, electricity, diesel etc). Data logging records of electric heating systems at a hotel and manufacturing company were also used as primary data in addition to records from SIRDC energy audits. The presenter also reported that telephone interviews with five financial institutions were also held.

The processed data revealed that thermal requirements in industry depend on the processes of each particular sector. For instance, the services sector (hotels, boarding schools, colleges etc) require hot water in the range 50 to 90^0C, tobacco and tea drying 50 to 80^0C, textile 50 to 120^0C, diary 60 to 150^0C, and heavy manufacturing processes 100 to 500^0C for steam generation. Consequently, there's no one-size-fits-all solar thermal technology for the various processes. The questionnaire results also revealed that the manufacturing and process industry has 83% interest in solar thermal systems while the services sector has 100% interest. The presenter noted that the services sector and agricultural process industry should be the starting point for the project since their thermal energy requirements are usually less than 100^0C.

Some of the interviewed stakeholders in industry doubt the effectiveness of the technology and indicated that they need to see a working system. Other barriers cited are the high upfront investment costs and space limitation. More importantly a great concern prevails of how to retrofit the solar thermal technology into an already existing thermal system in industry.

The presenter informed the workshop that five companies/institutions that have solar water heating systems were visited (3 in services sector, one in the manufacturing, and one in the tobacco industry). The challenges facing the installed systems are

inadequate system performance due to poor orientation of collectors, poor tank and pipe insulation, breakages of tubes in the evacuated tube collectors as a result of improper handling of the systems, and lack of product support. However, the SIRDC team's considered opinion is that these challenges would be easily overcome by standardising solar thermal products, accrediting installers and implementing a sustainable maintenance plan.

6.5 Business case for solar thermal applications

Figure 6.4 Eng Peter Nyekete of SIRDC presenting the business case for solar thermal systems

Synopsis of the presentation

The solar thermal project is being promoted by the SIRDC and SNV as a way of harnessing solar thermal energy to heat water as an alternative to heating the same with other forms of energy. This was seen as a way of reducing the energy burden while increasing the share of renewable sources of energy in the total energy mix. Put simply, it is a way of making freebies reflect in the "bottom lines" of companies. Solar thermal energies were chosen, as opposed to solar lighting since empirical evidence had shown that at both household and industrial levels, solar thermal constituted about 80% of the total energy needs. So it was envisaged that once solar thermal was used, it would have a greater impact on the total energy bill.

Financial services sector

The major piece of legislation that governs the sector is the energy sector. It sets out the energy prioritises of the country and sets the context of renewable energies in light of developments in the sector. It is seen as an enabler of new investments to ameliorate the energy challenges that the nation faces.

Local sources of finance were cited as Pension funds, Commercial Banks, DFIs, Discount houses, Private equity firms and Venture Capital. These finances could be packaged as equity, debt, PPP and grants.

Offshore sources of funds were also seen as a viable option given the lower costs of capital and the current economic challenges that the western world was facing following the global economic recession of 2008. These potential investors could realise a higher return on their investment than they would in developed countries.

In order to successfully realise the benefits of the project, the business models that could be used are:

(1) Private Entity/ZESA Implementing partnership
(2) Private Entity/ZESA Supplier mode
(3) Private Entity
(4) Industry Body

Bankability Issues

The project would have to be viable in order to attract capital while at the same time affording its financiers an attractive rate of return. In the same vein, the SPV created to spearhead the project would have to have adequate security to act as a fallback. Another key tenet would be to inject loans with long enough tenure coupled with well identified and mitigated risk assessment models.

The development of a bankable document was seen as a first step in making sure that the plans for solar thermal energies were consummated.

7 Group discussions

A broad summary of the discussions in relation to each Group task is set out below.

7.1 Group task A – What can industry do?

The first group task related what industry can put in place or do to accelerate the development of solar thermal energy in their existing functions so as to cut on electricity, coal and liquid fuel costs. The discussion group is shown in figure 6.1.

Figure 7.1 Participants discuss and recommend steps industry may take to upscale the uptake of solar thermal technologies.

A representative of the group noted that for industry to implement solar energy systems up to reasonable, visible and measurable levels it must:

- Prepare bankable and well researched project documents
- Setup solar industry body such that the industry can speak with one voice objectively.
- Carry out energy/carbon audit to identify energy gaps
- Lobby government for incentives for renewable energy
- Register projects with UNFCCC to get carbon funding
- Develop standards for solar water heaters together with SAZ

- Standardise solar water heaters
- CZI and ZNCC should raise awareness on solar water heaters in their respective capacities
- Carry out research and raise awareness on solar advantages/ benefits
- Support capacity building activities at all levels (Education curriculum and Workshops)
- Branding of products that they were made using sustainable renewable energy

7.2 Group Task B – What can government do?

The second group task began with a heated discussion on the strategies in which the government should implement to promote the development of solar thermal energy to augment electricity and coal demand for heating. Major points raised were on government policy, budgets, education and solar technology transfer.

Figure 7.2 Participants discuss and recommend steps government may take to upscale the uptake of solar thermal technologies.

The Group began the discussion by identifying the key issues that should be addressed. The spatial visions suggested to the government by the Group were as follows:

- Policy for green projects, mandating that financial companies invest a certain portion of their investment funds in green projects
- Seek direction from SNV and SIRDC and other stakeholders
- Encourage effective use Renewable Energy in the country to alleviate poverty in low income communities and promote cleaner production mechanisms in industry.
- Reduce or eliminate taxes regimes on solar products
- Budget allocations to ensure a sizable percentage is channelled towards renewable energy projects
- Invest in pilot solar projects (housing units/solar farms). This will act as case studies or sustainable energy demonstration sites to stimulate interest
- Subsidisation of solar projects through tax credits, reduced tariffs etc
- AIM sector for emerging small entities
- Solar thermal Prescribed Status assets
- Guarantee solar projects to enable them to access funding locally and internationally
- Energy bond market for renewable projects
- Direct intervention from the Ministry of Finance
- Align the education policy, that is, renewable energy to be included in school curriculum
- Technology transfer agreements to be put in place
- Promote local manufacturers to boost solar technology through cheap finance mechanisms
- Introduce cost reflective and profitable tariffs for renewable energy generated power
- Clarification of financial position in terms of currency regime since these renewable projects are long term (government assurance that currency regime will stay in place for a longer period of time)
- Public awareness of solar as an alternative source of energy.

- Government buildings, governement academic institutions, parastatals and government owned companies should take lead role in installing renewable energy technologies at their premises.

7.3 Group Task C – What can the financial sector do?

The third and final group task discussed options available for the financial sector to help leverage renewable energy into industry. The group proposed the the establishment of a green fund for renewable projects, research and development and participations in energy forums in order to understand the energy supply industry. The group suggested the following:

Figure 7.3 Participants discuss and recommend steps finance sector may take to upscale the uptake of solar thermal technologies.

- The financial sector needs to understand financing renewable energy sector. The majority of Investment officers have no technical background (capacity building for the financial sector).

- Have a clear vision that clearly outline their support of the renewable energy industry with specific targets and time frames
- Outlines their requirements and expectations for renewable projects to make it easier for project developers in industry
- Set up officers who specifically assigned to deal with renewable industry
- Set up a fund Green Fund for renewable projects.
- Act as a conduit for external environmental/green funds (lines of credit for renewable projects)
- Structure retail financial products for renewable items. Solar geysers/solar panels etc
- Participate in energy forums and realise the role they should play in the energy sector
- Incorporate sustainable housing systems and facilities in support of renewable energy facilities like solar PV and solar water heaters

8 Recommendations and way forward

The participants were of the view that the technology knowledge base on solar water heating is available in Zimbabwe. In addition, the presentation by the solar thermal companies showed that the technology is available locally and can be sourced from countries that have made significant progress in solar thermal systems. However, it was felt that the draft and final document have to be clear and explicit on:

- Achievable energy savings through solar thermal use
- Short term and long term cost savings
- Methods or ways of integrating the technology into the existing water heating and steam generation infrastructure
- Initial capital investment costs
- Maintenance and operation costs
- Thermal energy storage systems during period of low irradiance and during the night.
- Sources of finance for leveraging solar thermal technologies in industry

The attendance list of the workshop revealed that the finance/banking sector was not adequately represented. Consequently, inputs from the sector were not fully captured. The SIRDC team resolved to further engage this sector after the workshop so that the additional data is captured and incorporated into the final proposal. Other attendees also felt that the energy demand and consumption data was inadequate. Further data logging in order to get 30 minute electricity usage profiles will be done to address the shortfall. Feedback from the workshop also revealed that the 'solar thermal uptake financial models' need to be refined and expanded. The ETI team resolved to incorporate additional manpower from the Business Operations Unit (BOU) and TIPS of SIRDC to bolster the financial models.

During the outreach program and also during the workshop deliberations, industrialists repeated emphasised that they need to see a working solar thermal system at industrial scale for them to be convinced that solar thermal technologies can be used for medium to high temperature applications (temperatures greater than 80^0C). The SIRDC team is of the view that a large scale solar thermal system needs to be installed in any of the identified industrial sectors so as to dispel the "seeing is believing attitude" of the majority of captains of industry.

APPENDECIES

Appendix I: Programme of activities

08:00 Arrivals and Registration

OFFICIAL OPENING

08:30 Chief Executive Officer
Scientific and Industrial Research and Development Centre (SIRDC)
"Welcome"

08:40 Ministry of Energy and Power Development
(Permanent Secretary, Ministry of EPD)

GUEST OF HONOUR
"Official Opening Address"

PLENARY SESSION

Session Facilitator: Mr Panganayi Sithole

09:00 Solar thermal technologies
Presentation 1: *"Solar thermal technologies: basic theory and application"*
Presenter: Dr Sosten Ziuku (SIRDC)
Discussion points:
Flat plate systems, Evacuated tube designs, Concentrated Solar Power (CSP) for high temperature and steam production, Cost and implementation issues

09:30 Service providers for solar thermal systems
Presentation 2: *"Challenges and opportunities for solar thermal companies/suppliers in Zimbabwe"*
Presenters: Chamu Muchenje (Impact Solar)
Chuck Gardner (Solar Edwards)
Facilitator: Panganayi Sithole
Discussion points:
Technical capabilities, quality and standards, installation, back-up and product support

10:00 Tea break

10:30 Funding opportunities from climate change mitigation programmes
Presentation 3: Presenters: Mr Washington Zhakata (National Coordinator, Climate Change Office, Ministry of Environment & Natural
Resources Management)
Timothy Gotora (Carbon Africa)
Facilitator: P Sithole
Discussion points
Climate change funding, CDM, carbon credits, others

11:00 Assessment of thermal energy requirements in industry: preliminary results
Presenter (a): SIRDC
Discussion points: Feasibility study, questionnaire, data logging, fossil fuel consumption

Presenter (b): SIRDC

Discussion points:
Investment proposal and model for solar thermal systems, Implementation matrix

12:30 Lunch break

13:30 Financing green technologies: banking sector perspectives
Presenter: Betty Murambadoro (Stanbic bank)

14:00 Mobilisation of financial resources in Zimbabwe
Facilitator: Panganayi Sithole

14:05 **Break away groups**
What can industry do?
What can government do?
What can the financial sector do?

14:30 Reports and feedback discussion from (a), (b) and (c)

15:00 Vote of thanks and closure
Executive Director – technical
SIRDC

Appendix II: List of attendees

Name	Organisation	Contact Details
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41. Makoni J. S	SNV	0777799972
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Appendix III: The questionnaire

Call for participation:

Zimbabwe has been experiencing electricity supply constraints in the past decade and industry and commerce were not spared. In addition, the country has experiencing adverse effects of climate change as a result of extensive use of fossil fuels. Against this background, the country has abundant solar resources which, to date, have not been fully utilised. Solar energy can be used in industry for thermal applications such as hot water production, space heating and drying. The Scientific and Industrial Research and Development Centre (SIRDC) and SNV Netherlands wish to develop an investment proposal and program design for the uptake of solar energy technologies in Industry. We wish to invite stakeholders, companies, lodge owners and hoteliers to join us in this exercise by completing this short questionnaire. You will be given an opportunity to further participate in this project if you so wish.

Please provide answers where possible ***(incomplete questionnaires are still of value to this project if you are unable to answer every question)***. If you have any further comments or questions about this project, please include these on a separate sheet and submit them with this questionnaire.

1. Do you have a solar thermal heating system at your company?

   Yes ☐ No ☐

   If yes, what is it used for?

   i. _____
   ii. _____

2. What is the current source(s) of energy used for heating at your company (e.g. coal, electricity etc) ?

Energy Source	**Application**
	Water heating
	steam
	boilers
	Space heating
	Cooking and ablutions
	Other (specify) …

3. What are your key thermal energy requirements (e.g. hot water, steam etc)
   i. ----------
   ii. ----------
   iii. ----------
4. What is the quantity or amount of fuel or energy used for each application (kg, litres, kWh etc)?

Application	**Consumption (per day or per month)**
Water heating	

5. What is the number of households at your company?

   ----

6. What is the average capacity of the electrical geyser (boiler) at your institution (litres)?

   ----

7. What is the average family size?

   ----

8. What other sources of energy do workers use for heating?

Energy source	**Answer (N/Y)**	**Optional notes** **(approx. quantity per day/month)**
Coal		
wood		
paraffin		
solar		
LPG		
other		

9. What is your energy bill
   i. Total _____
   ii. For heating _____

10. Are you interested in solar thermal heating?

Yes ☐ No ☐

If yes, what are the challenges affecting uptake of solar thermal heating by your organisation?

_____

_____

_____

11. Any suggestions for funding solar thermal systems in industry?

_____

THANK YOU