Solar energy co-operation Austria – Zimbabwe
A contribution to sustainable development

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With a share of 25% of renewable forms of energy out of overall energy requirements and an installed collector area of 2.2 million square meters by means of which 2.8 PJ of energy are produced each year for hot water and space heating, Austria is amongst the leaders when it comes to using of renewable energy.
If renewable energy in general and the direct use of solar energy – such as is required for sustainable energy scenarios – are to make a relevant contribution towards the global supply of energy, then the corresponding technologies have to be spread and used throughout the world on a large scale. In particular this is true of countries in which radiation from the sun – compared with Europe – is relatively constant throughout the year as a whole. Here in particular one thinks of African states where the energy supply frequently depends on the import of fossil energy sources.
In co-operation with the University of Zimbabwe and four local companies the AEE INTEC[1] is carrying out a project within the framework of which skilled workers are being trained on the one hand and on the other hand the infrastructure is being built for consulting services as well as the production and sale of solar plants.

The energy supply of Zimbabwe

At the current moment in time almost 50% of the energy supply in Zimbabwe is based on non-renewable sources of energy such as coal and crude oil which together make up for about 48% of primary energy requirements. The remaining 52% is accounted for by renewable sources of energy, mainly biomass and hydro power.
In rural regions fire wood is the most important source of energy. In the last 25 years forests have been depleted by 50%; an ongoing process rated at 2% every year. In terms of covering local needs for fire wood, more than half of Zimbabwe's 52 districts are already considered deficit areas /1/.
Soil erosion, the aftermath of deforestation, and the infertility of the soil connected with this are one of the reasons why the rural population will be forced to migrate in the long-term.

Of the 4.7 million tons of coal mined each year 53% is used to produce electricity in thermal power stations /2/. From a technical point of view the power stations are obsolete which means that the emissions are high. Apart from the thermal power stations which account for 71% of the electricity produced nation-wide, some 29% is catered for by a hydroelectric power station on the Zambesi river in Kariba. This national production, however, only accounts for around 60% of the overall electricity requirements. In 1998 Zimbabwe imported 40% of its electricity requirements from South Africa, Moçambique and Zambia. This dependency on imports would appear to be an upwards trend. In 1997 the import share equalled 35% (1996/97 ZESA Annual Report) /2/.

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Background for using solar technologies

Depending on the weather conditions and the geographical location the annual amount of global radiation varies between 1000 kWh/m^2 (Europe) and over 2200kWh/m^2 in part in the sunniest parts of the earth. Zimbabwe would appear to be predestined for solar energy with values between 1950 and 2000 kWh/m^{2}a. To these very high radiation values we can add one other thing in favour of solar energy; namely a very well balanced distribution of global radiation throughout the year (see diagram 1).

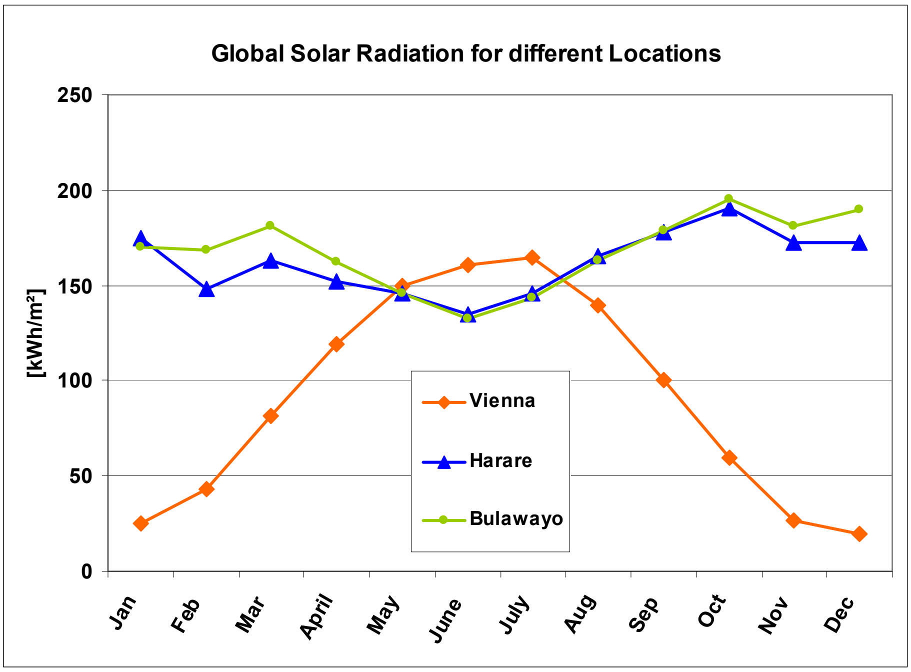

Fig.: 1: Mean monthly global radiation amounts on the horizontal surface

Given the background provided above the technical pre-requisites for the use of solar energy are very favourable. The political and economic pre-requisites for solar technologies in Zimbabwe are characterised by the following conditions. At the governmental and University level efforts were made in the mid 1990's to make solar technologies more popular by means of hosting international conferences. Thus in 1995 the „ISES Solar World Congress" took place in Harare and the „World Solar Summit" in 1996 in co-operation with UNESCO. These conferences provoked a great deal of interest in the use of solar technologies at University level as well as on behalf of some companies. The founding of the „Solar Energy Industries Association of Zimbabwe" is further proof of this upbeat attitude.

The first large-scale concrete project was a photovoltaic project financed by the UNDP (United Nations Development Programme) for the installation of Solar Home Systems. In the solar thermal field plants or plant components were in the main imported from Australia or Europe. The piece numbers sold were, however, limited due to the high price involved. To overcome this obstacle together with co-operation partners from Zimbabwe the AEE INTEC initiated a project in 1996 aimed at developing thermal solar plants adapted to suit local requirements.
Following initial activities a project followed as of 1996 which has been financed within the framework of the Austrian development co-operation of the Federal Ministry for Foreign Affairs since 1998.

Development of a thermo siphon system

Since in most cases imported solar plants are beyond the financial means of large sections of society one of the central goals of this project was to develop a thermo siphon system which can be manufactured from materials locally available. Following extensive research into materials, a plant concept was developed which can - with a few changes - be used both in the rural area, where no water supply is available via a supply network, as well as in the urban area. Moreover, the concept should be modular which means it should be possible to adapt it simply to different requirements regarding water consumption.
These requirements led to a plant concept which comprises a vertical pressure-free storage tank and one to three flat plate collectors depending on the size of the storage tank. The absorber is made of 0.2mm of copper sheet metal and copper pipe and coated with solar varnish.

Fig.: 2: Assembly of a plant with a storage volume of 100 litres. The vertical, pressure-free storage tanks can be easily manufactured and have a very good stratification behaviour. They are filled using a float valve.

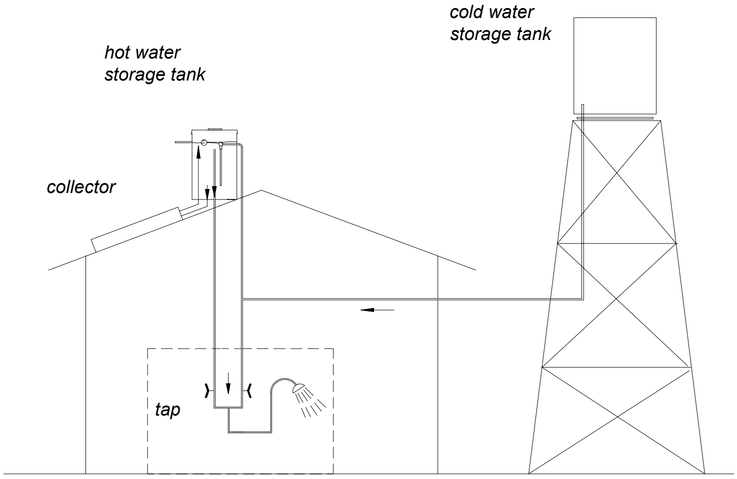

Fig.: 3: Principal design of the solar heating systems

To date the companies involved have manufactured around 200 plants based on this system. The majority of the plants were installed in the urban area. The distribution of these solar heating systems in rural areas has proved to be difficult due to transportation problems as well as for financial reasons.

Following success with small plants it was possible to create demand for larger plants in the preceding year. The very first large-scale plants with an overall collector area of $20m^2$ each and hot water storage tanks with a volume of 1,200 litres each were started up in the middle of December 2000 at the St Johns Secondary School approximately 60 km north-east of Harare. The plants are the first two of a total of six plants with an overall collector area of $120m^2$ to be erected at this school.
The erection of these relatively large plants, operated according to the thermo siphon principle, only became possible after changing from the small ($0.6\ m^2$) serpentine collectors to large ($2m^2$) collectors with a register absorber.

This new plant size opens up a completely new market to the participating companies since it is now possible to erect plants for smaller hotels, hospitals or boarding schools.

Fig.: 4: One of the plants erected at St. Johns Secondary School. The solar heating systems have a collector area of $20m^2$ and a hot water storage tank with a capacity of 1,200 litres.

Training programme

To guarantee the further development of the system and the adaptation of the plant concept to different users and requirements with skilled workers in Zimbabwe itself, an extensive training programme has been conducted since the beginning of the project in co-operation with the Development Technology Centre of the University of Zimbabwe. The courses of study target students at the University of Zimbabwe and technical college graduates as well as tradesmen. Until now a total of 72 people have attended 5 training courses. Figure 5 shows how the participants divide into individual sectors.

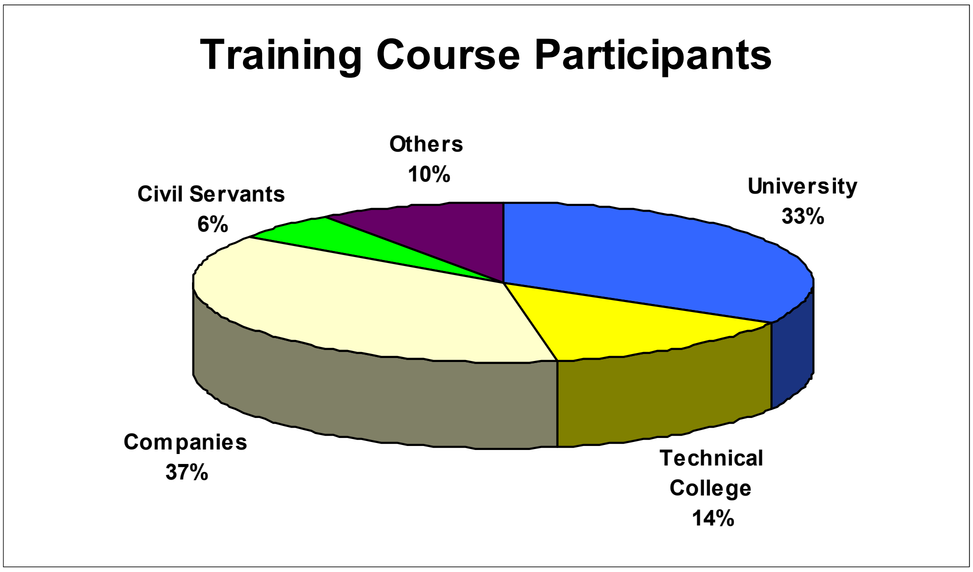

Fig.: 5: All in all 72 people have attended the training courses. Almost half of all of the participants came from Universities and technical colleges, a third come from companies.

Within the framework of the training courses plants were manufactured in the course of practise-oriented exercises in addition to theoretical training. These plants were installed on the roof of the Department of Mechanical Engineering and equipped with corresponding monitoring devices (see figure 6). They are now used as test and reference plants for University courses. Within the framework of two studies measurements were carried out to identify the plant characteristic quantities and detect potential for improvements and optimisations.

Fig.: 6: The pilot and test plant in the Department of Mechanical Engineering of the University of Zimbabwe in Harare.

Establishing production facilities for craftsmen

Beyond the scope of the training courses four companies have been supported until now with solar plant production equipment. On the one hand this was accomplished via original equipment to companies with the tools necessary to manufacture these plants and subsequently by subsidy for each plant sold.
It was possible to achieve several important goals at once with the production of solar heating systems. Jobs were created in an environmentally relevant field with a promising future in a country in which solar energy is available in abundance and the sensitive ecosystem was now treated with care since there was a reduction in deforestation in the rural area, a reduction in the emissions in townships in the towns and an increase in the standard of life by removing the labour load.

The current economic situation and a look at the future

The economic situation in Zimbabwe has taken a dramatic turn since the middle of 1999. The country is currently in the throes of the greatest economic crisis since gaining its independence in 1980. Amongst other indicators this is most clearly reflected by the inflation rate which totals 70%. In addition the rationing of fuel is practically bringing the economy to its knees. As a result the production and assembly of solar plants have ground to a halt since it was not possible to supply the materials respectively there were enormous delays regarding the supply of basic materials. The situation was aggravated by the political scenario in the aftermath of the parliamentary elections and the occupation of „white farms“. The unstable political situation unnerved potential buyers of solar plants causing them to play the waiting game. Still we anticipate that the set goal will be achieved: namely to erect 300 plants before the project draws to an end.

References:

/1/ Cornaro, Astrid: Zimbabwe: Das afrikanische Hochland zwischen den Flüssen Zambesi und Limpopo, Köln, 1991

/2/ Mackenzie Consulting: Development of a Business Plan to promote Solar Water Heating in Zimbabwe, Draft Report, September 1998

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Dr. Anton Schwarzlmüller is a member of the team at the AEE INTEC and in the project he is responsible for the co-ordination of project partners, the training of companies and the establishment of an infrastructure for distribution.