Symposium on Solar Water Heating

Moderation and reporting by
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A symposium organized by the Ethiopian Energy Agency / EEA in cooperation with GTZ – German Technical Cooperation / GTZ Energy Coordination Office / GTZ-ECO

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I. Background on the Symposium

This symposium is organized with the intention to enhance the public awareness regarding solar water heating technilogies in general and that of entities that use hot water frequently (for commercial and non-commercial purposes) in particularly. The main purpose of using solar water heater technology is to save electricity, by reducing the demand for electric power especially during peak hours, by switching water heating in households and institutions from electricity to direct solar energy. In addition, the promotion of this technology creates vast opportunities for developing the market of solar water heaters, local manufacturing business and hence employment opportunities in the local economy in the whole business from manufacturing, installation and maintenance.

This report is organized to give as much insight as possible into what has transpired during the whole day of the symposium. In the main body of the report, presentations made by resource persons are presented in a synthesized form, highlighting only the major points. The presentations are then followed by the captured discussions on the topic being presented. The whole presentations have been annexed for anyone interested in going further into detail. Official welcoming remarks and opening speeches delivered by the guests of honour have been presented here intact.

A. Main Objectives and Expected Outcomes of the Symposium

- Create awareness about the benefits of solar water heaters among city planning authorities, Ministry of Urban Development and Construction, professional bodies of architects & engineering professionals, as well as the general public;
- Experience sharing between the participants (domestic as well as international);
- Explore appropriate financing mechanisms for manufacturers, vendor companies and consumers;
- Conceptualise program to promote solar water heater technology;
- Suggest standards and guidelines for integrating solar water heaters in existing buildings;
- Suggest technical standards, certification schemes and testing procedures for SWH systems;
- Suggest legal and regulatory requirements to facilitate integration of solar water heating systems in new and renovated buildings;
- Suggest training modules for local engineers and technicians to develop local capacity to: install, maintain and manufacture solar water heating systems.

B. Targeted Participants

Targeted participants include:

- Commercial service providers and related associations such as hotels, bath service providers, clinches, restaurants, guesthouses, gymnasiums, hairdressers, service providers and related associations;

- Educational and training service providers such as technical universities, technical & vocational schools and training centres as well as boarding schools;
- Financial and related service providers such as micro-finance institutions, commercial banks and real estate companies;
- SWH system manufacturers, importers and system users;
- Promoters such as relevant federal & regional government offices, NGOs, housing cooperatives, etc.;
- Sector development partners.

II. Summary Plenary Sessions

A. Welcoming and Opening Speeches

Welcoming adressess were held by officialls from both co orgainizers, GTZ and EEA. The first speaker Dr. Chrisitan Jan, Deputy Country Director of GTZ Ethiopia, highlighted that that GTZ has been supporting various energy programs in Ethiopia over the past 12 years. The support in the field of solar energy with focus on solar PV was enhanced in the last for years and now int is adding solar thermal applications in its portfolio and with a special focus on solar water heating as this is believed to be the main application feasible in ethiopia today.

He elaborated that GTZ collaborates with several stakeholders in the field and this symposiym is aimd at enhancing this collaboration with indepth discussion on the issues of program concept development, developing financing strategies, assessing local manufacturing options and application options for industrial use. He further noted that for GTZ the sustainavble impact of all its engagements as well as the involvement of the private sector as the a vital factor for sustainabilty are issential. (full speach on Annex 1)

The Second speaker, Ato Getahun Moges from EEA highlighted that as the consequence of the recently copleted business process reenginering that his agency went through, EEA is now vested with the additional responsibilty of managing energy efficiency and conservation. He explained that the legal framework for EEA to officially assume this resoposibility is under preparation and in the mean time EEA is engaged in promotional activities to create and enhance awareness on issues of energy efficiency and conservation.

Ato Getahun further noted that solar water heating technology is matured & relatively simple to manufactur, install and use. He also underlined that there is a huge potential market for it and, though it is cost effective, economicaly rewarding and ideal for energy conservation, its market penetration is very low.

Finally he remarked that the symposum is timely, would adress and profile pertinent issues regarding the application of the technology in the economy and shall result into actions that lead to wider market penetration of thetechnology (full speach on Annex 2) .

Ato Getahun invited the third speaker, HE W/ro Sinkinesh Ejigu, State Minister, Ministry of Mines and Energy, to deliver her Key not adress. The key note adress follows in full below.

A KEY NOTE ADDRESS BY W/O SINKNESH EJIGU, STATE MINISTER, MINISTRY OF MINES AND ENERGY

Distinguished participants of this Symposium,

Representatives of government institutions,

Development partners and stakeholders,

Ladies and Gentlemen,

On behalf of the Ministry of Mines and Energy and on my own, it is my honour and pleasure to welcome you all to this Symposium, which is going to focus on “Solar Water Heater Technology and Business”, organised by the Ethiopian Energy Agency in collaboration with GTZ Energy Coordination Office (GTZ-ECO).

Here, I would like to appreciate the organisers for their effort to organise a technology and business areas focused symposium. We believe that such symposiums and conferences organised on selected specific solar energy technology, would help promote the “direct renewable energy technology use like Solar Water Heaters” suitable to our country and accelerate their dissemination. Also, the organisers are appreciated for inviting stakeholders relevant to the business. Fruitful result is expected through discussion, dialogue & consultation of the symposium participant stakeholders, which include government institution representatives, private developers, promoters, cooperatives and researchers in the technology.

Distinguished participants,

Ladies and Gentlemen,

Before forwarding specific opening remarks on the current agenda, I would like to point out few critical points on the importance of the energy sector, the energy development direction of the country and the effort being made by the government to develop the resources and the energy system as a whole.

As you know, energy is an indispensable ingredient required for supporting life. Also, it is a crucial factor for every aspect of development such as agriculture, industries and social infrastructures. Overall, development is mainly attained by developing the energy sector first. Since it is a critical input or an engine and fuel to sustainable economic growth and to move forward for a better life style. In recognition of this reality, the Ministry of Mines and Energy has formulated and issued an energy policy, aimed at the sustainable development of the sector. Some of the main objectives of the policy are:

- To ensure a reliable supply of energy at the right time and at affordable prices, particularly to support the country’s agricultural and industrial development strategies adopted by the government;

- To ensure and encourage a gradual shift from traditional energy sources to modern energy sources;
- To streamline and remove bottlenecks encountered in the development and utilisation of energy resources and to give priority to the development of indigenous energy resources with a goal towards attaining self sufficiency; and
- To set general guidelines and strategies for the development and supply of energy resources.

The main policy issues highlighted in the documents are targeting energy resource development, energy supply enhancement, energy conservation and efficiency, among others.

Distinguished Participants,

Ladies and Gentlemen,

It is worth to note that, since the formulation of the policy, the country has been involved in energy development programs guided by the policy priorities. Efforts have been made to meet the Millennium Development Goals which include the Universal Access Program focusing on the provision of electricity to the community. Renewable energies like hydropower and solar have got special attention in the past twenty years. Development of large hydropower is almost solely carried out by the Government, primarily by undertaking stringent environmental and social impact assessments. In the past, the use of solar energy technology was mainly for telecommunication services in rural areas. However, currently through the off-grid program large numbers of institutional solar PV systems are being under expansion in schools, health posts and clinics in remote areas, where grid access is difficult. Solar home systems technology is gaining popularity and being widely used in remote areas rich in cash crop potential. Studies and preparations for large scale geothermal energy development are under way by the government. Rehabilitation of the 7 MW Aluto Langano geothermal field is started and to be upgraded to 30 MW soon. This resource is getting attention as it is not easily impacted by climate change. Also, recently, the government has been involved in the construction of large scale power generation plants in selected wide potential areas.

The issue of renewable energy technology development like solar is one of the first priorities of our country, for the fact that it is a domestic resource and suitable to secure sustainable development and to expand basic infrastructures and social services.

Ethiopia, because of its proximity to the equator, which enables the country receive many hours of clear sky sunshine has high radiation intensity, which is about 5.6 kWh/m^2/day on horizontal surface. As a result of the availability of this potential, it is expected that solar water heater technology is among the renewable energy technologies which can contribute substantial energy supply to the country and attract the interest of the private sector at this time. The use of this technology can substitute the electricity consumed and ultimately reduce electricity demand for water heating in commercial, industrial and residential sectors.

In fact, it is infant technology for our country. There is much to be done in this area. The first step is to create awareness on the importance of the technology in contributing energy demand satisfactions to consumers. Secondly, what is important is the establishment of enabling environment for a maximum production of Solar Water Heaters and market development for the systems.

Distinguished Participants,

Ladies and Gentlemen,

Here, I would like to stress that Solar Water Heating is an important energy technology that should be developed because it helps to respond to the hot water demand of our growing industries, hospitals, learning institutions and domestic applications. At present, many tannery and textile industries that demand much hot water are under construction. According to the designed economic growth and transformation plan of Ethiopia, the industry is expected to lead many of the economic sectors at the end of the transformation period, by undertaking massive development. This situation undoubtedly, increases the demand of hot water for processing products at large and small scale industries. Similarly, the demand in hospitals and learning institutions will grow as these sectors will share the opportunity of the development and transformation program.

Apart from energy provision and financial benefit in reducing electricity tariff, there are many reasons why this technology is important. As a clean energy technology, it has numerous environmental benefits. If manufactured in mass locally, it helps create jobs, strengthen the economy and increasingly reduce the costs.

The program enables the government to deliver environmentally friendly energy supply thereby benefiting saving expenses for hot water supply. With the implementation of the Solar Water Heater development program, the electricity demand will be substantially decreased in many of the sectors mentioned earlier. Furthermore, it helps reduce the consumption of fuel wood, especially at small-scale industries and in the residential sector, which in turn assist the conservation of forest and hence lead to environmental conservation. It is such type of technology that helps reducing deforestation and to manage climate change that threatens the natural capital of the rural population, especially the Ethiopian Framers. The dwindling natural capital of rural Ethiopia is affecting the social capital.

Distinguished Participants;

Ladies and Gentlemen,

The private sector, development partners and NGOs enrolled on the development of renewable energy resources and energy conservation are encouraged by the Government policy. Currently, the government has taken appreciable policy measures like tax exemption or duty-free importation of renewable energy equipments and energy efficient end-use devices. I hope that this measure would encourage the private sectors to involve in the business.

I would like to thank once again the organisers for organising this symposium. I would like, also to express my appreciation to participants coming to this symposium to forward valuable suggestions for the development of the solar water heating technology.

Finally, I would like to assure you that the Ministry of Mines and Energy is ready to provide any technical and logistic support for renewable energy developers as long as their program conforms to the Government policies that bring fundamental change in the life of our population.

I wish you all the best in your deliberations.

I thank you, God Bless You!!

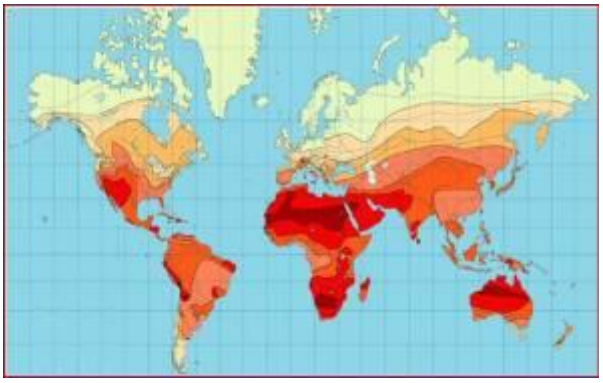
B. Paper presentations

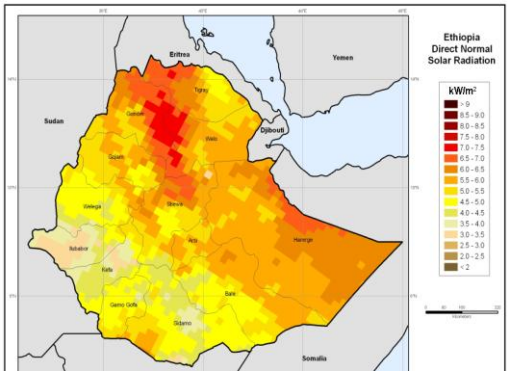
1. SOLAR WATER HEATING TECHNOLOGIES: By Dr.Eng. Abebayehu Assefa, Associate Professor – Mechanical Engineering Department, Head of Energy Center, Addis Ababa Institute of Technology (AAiT)

Background

The concept of the solar water heating technologies all starts with the SUN. The figures below indicate the annual average solar radiation of the world and Ethiopia.

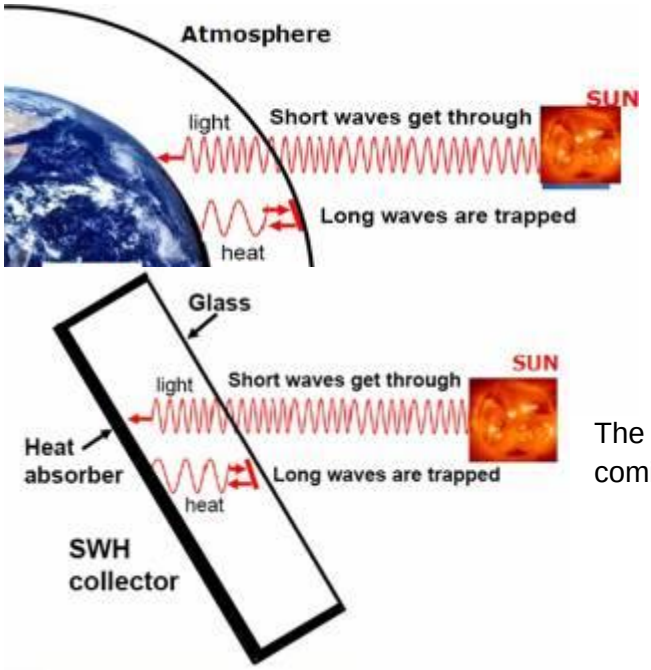
The semi-arid and desert areas in the eastern part and the northern-central part of Ethiopia have the highest radiation intensity 6.5-7.5 kWh/m^2/day, while the other parts of the land have radiation in the range of 4.5-6.0 kWh/m^2/day.





Solar water heating (SWH) is not a new idea. Over hundred years ago, black painted water tanks were used as simple solar water heaters. The technology has greatly improved during the past century. Today there are more than 30 million m^2 of solar collectors installed around the globe.

Essential Physics: The basic principles in SWHs



Rays from the sun pass through through the atmosphere of the earth and light the surfaces of the earth. These shortwave rays are then reflected back from the surfaces of the earth. These long-wave rays are trapped within the earth's sphere by the atmosphere as shown in figure 3. This same natural technology applies when it comes the system of Solar Water Heating technologies.

The SWH apparatus traps the shortwave rays coming from the sun and passing through the

glass. The heat absorber absorbs most of the heat and like in the case of the earth's surface reflects back some of the heat in long-wave rays. The long-wave heat rays are then again trapped within the collector as additional heat. The glass serves as the atmosphere and the absorber is synonymous with the surface of the earth as in the previous illustration.

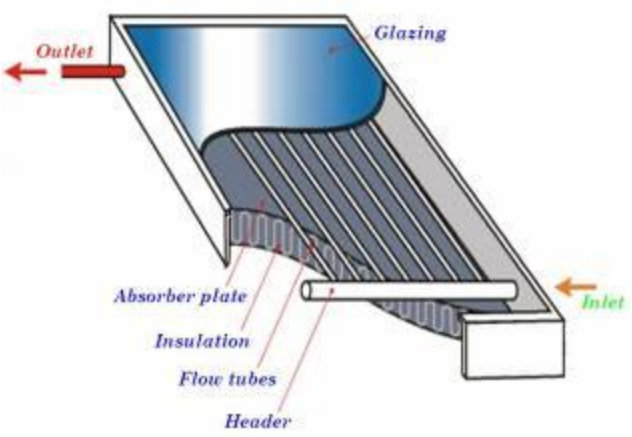
The sun transmits 100,000 times as much energy as the world's present electric power generation capacity. The sun radiates about $3.5x10^{23}$ kW of energy into space. Thereof, only $2x10^{14}$ kW reaches the earth. About $9/10^{th}$ of this is lost by reflection, refraction and absorption, the quantity available at the surface is about $2x10^{13}$ kW, which is equivalent to burning of about 17 million tons of coal.

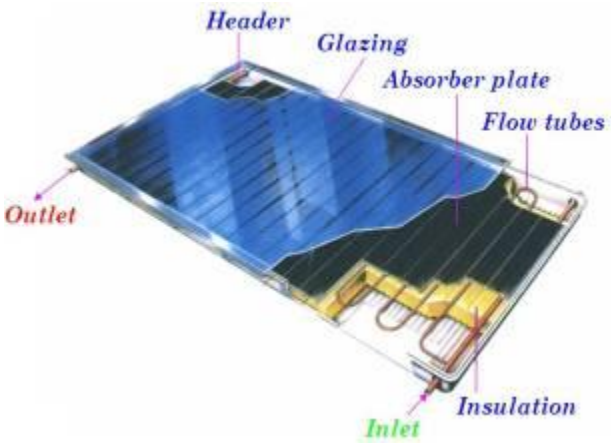
Types of Solar Collectors

Three types of Solar Water Heaters are commonly used.

FLAT-PLATE COLLECTORS:

Flat-Plate collectors comprise of an insulated, weatherproof box containing a dark absorber plate under one or more transparent or translucent covers.





EVACUATED-TUBE COLLECTORS

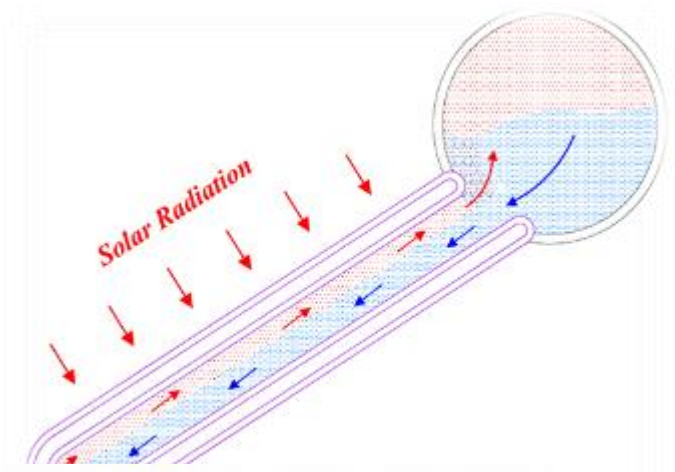
There are several types of evacuated-tubes. Some of these are:

- *Glass-glass tubes,*
- *Glass-metal tubes, and*

- *Glass-glass water flow path tubes*

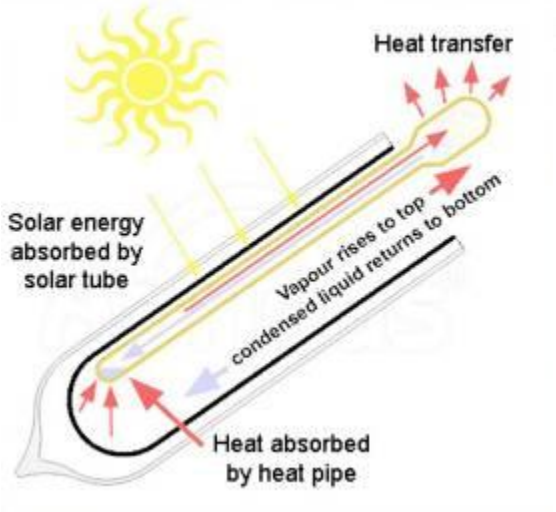
Fig. 6 Glass-Glass Evacuated Tubes Absorber

These glass tubes work with the principle figuratively explained below.



Working Principle of Evacuated Tubes Absorber

Solar radiation hits he glass surface and transform the cold water into warmer, and later into hot water. Inside the container, all the cold water is eventually replaced by warm water through circulation.



Heat Pipes

The heat pipe is hollow with the space inside evacuated, much the same as the solar tube. Inside the heat pipe is a small quantity of purified water and some special additives. At sea level

water boils at 100^{O}C. At the top of a mountain the boiling temperature will be less than 100^{O}C. This is due to the difference in air pressure. If about 5 kPa vacuum pressure is created, water vaporises at about 30^{O}C.

Fig. 8 Heat pipe absorber

SOLAR CONCENTRATING COLLECTORS

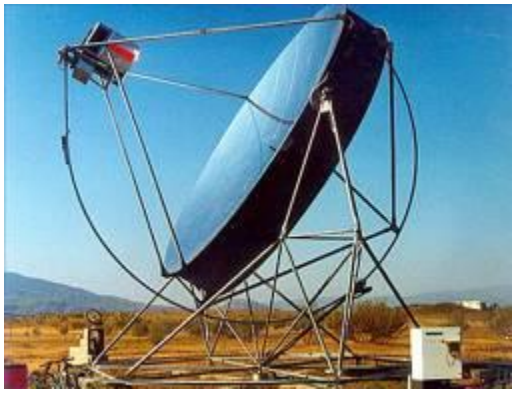
The 4 most intensively studied forms of large solar steam generators are:

- *Solar parabolic trough system,*
- *Solar parabolic dish – engine system,*
- *Solar power tower system, and*
- *Fresnel reflector system.*

Currently, experimental investigation is being conducted on solar parabolic trough system with a solar tracker attached to it in the Faculty of Technology, Addis Ababa University.

Parabolic Trough

These are the most proven solar concentrating technology. Parabolic mirror reflects solar energy onto a receiver. Heat transfer fluid such as oil or water is circulated through pipe loop. Collectors track sun from east to west during day; and thermal energy transferred from pipe loop to process.



Parabolic Dish

With parabolic dish, the receiver absorbs solar energy and transfers it to the engine's working fluid. Systems are easily hybridized since Stirling engines can run on any external heat source. Solar energy drives a Stirling engine or Brayton cycle engine (gas turbine).

Fresnel Reflector

These are several mirrors which have been arranged and sharing the same receiver. Frensel reflectors have the advantage of reduced tracking mechanism complexity. They are also stationary absorbers.

Fig. 9 Frensel Reflector

Solar Water heating Applications

Solar water heating can be classified based upon the end-use application of the technology. The most common solar water heating applications are:

- Service (Domestic) water heating

  The most common application is the use of domestic hot water systems (DHWS), generally sold as “off-the-shelf” or standard kits as depicted in the figure.

- Commercial/Institutional water heating

  Commercial and institutional applications, include:

  - *Multi-unit houses and apartment buildings, housing developments (Figure 13), and Schools;*
  - *Health centers/Hospitals, Office buildings, Restaurants and hotels;*
  - *Flat-Plate Solar Collectors Integrated into Multi-Unit Housing and commercial housing development.*

- Swimming-pool water heating

  The water temperature in swimming pools can be regulated using solar water heating systems, which results in conventional energy costs savings. The basic principle of these systems is the same as with solar service hot water systems, with the difference that the pool itself acts as the thermal storage.

Solar Water Heating Systems Analyses

Thermal analyses are executed on solar water heating systems (SWHS) to:

- Optimise and predict performance;
- Determine the feasibility of the system; and
- Select the appropriate technology.

Service water heating analyses have been conducted for Hilton Hotel and Ras Hotel. Swimming-pool water heating analysis has also been performed for Hilton Hotel. Thermal analyses for some breweries have been done.

The analyses of solar water heating project generates:

- Energy models solar water heating systems;
- Solar heating load calculations;
- Cost analysis of solar heating systems;

- Greenhouse gas (GHG) emission reduction analysis; etc.

Some Observations and Remarks

Thermal performance of SWHS depends on a number of parameters: the intensity of solar radiation, the orientation and inclination (slope) of the solar radiation absorbing surface, etc. Here, the effects of the orientation and slope of a solar collector on the total energy absorbed by the surface are presented. Solar radiation data and temperature values of Addis Ababa as obtained from NASA weather station (averaged over 5 years) are utilized in the analyses.

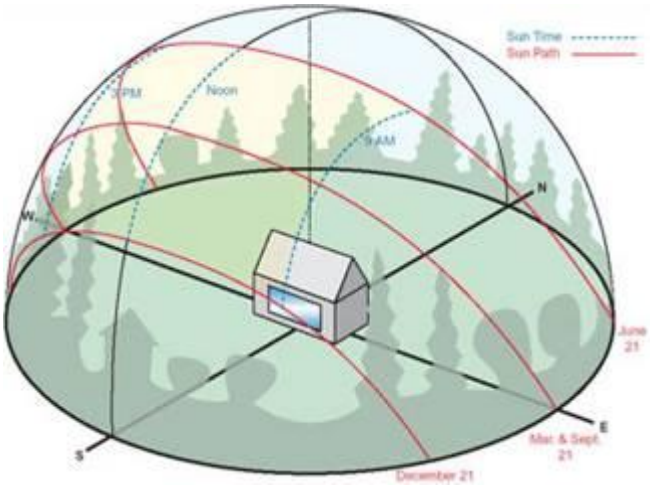
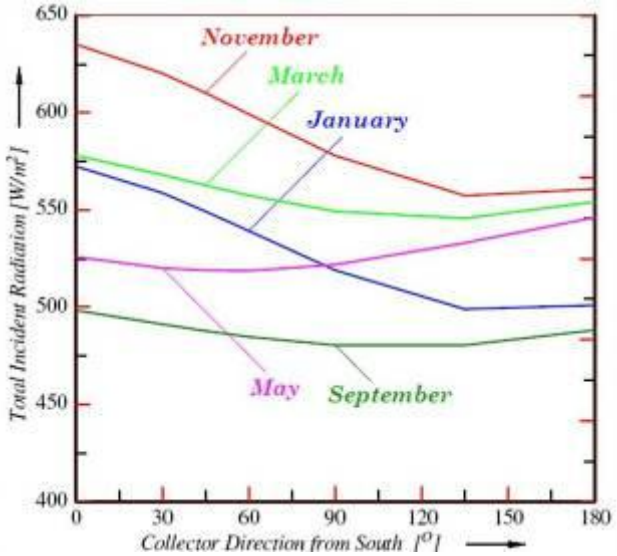


Fig 16. Solar Window

The various locations of the sun in the different hemispheres of the earth affect the power of the solar window.

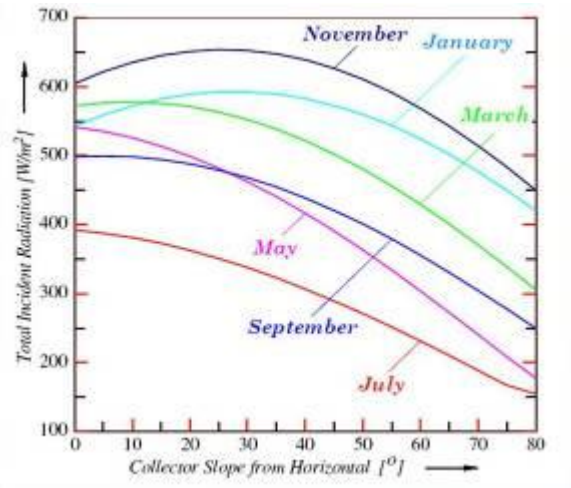
For any country, if we place the SWH at the equator, the junction point of west, east, north and south, on March and September 21st , the sun will be overhead. On December 21st, if we place the SWH still at the junction point, the path of the sun will be 23.5 degrees south and on June 21st the path of the sun will be 23.5 degrees north. So if we are having a trapping mechanism from East to west, this should be carefully considered when placing collectors to trap as much energy as possible. The technique is that SWHs in the northern hemisphere should be facing south and SWHs in the southern hemisphere should be facing north. In the case of Ethiopia, as we are located 9 Degrees north of the equator (Addis Ababa), SWH collectors should be facing south.



Effect of Collector Direction from South on Total Incident Radiation at Noon

As indicated on the previous figure, considering the 0 degree south in November collects around 630 watts per square meter. This is the highest amount of energy that could be collected by the SWH facing south. If we increase the degrees of the SWH facing 90 degrees east, we would have lost a lot of energy as a result of this change in direction. If the SWH is facing North in November alone, the amount of energy gathered will be much lower at around 579 watts per square meter.

The other most important factor is the inclination of the solar water heating system. The angle at which it should be tilted has an impact on the amount of energy that it is able to trap. As shown in the graph, as the slope or tilt of the SWH increases the amount of the energy its garners reduce proportionately according to the months.

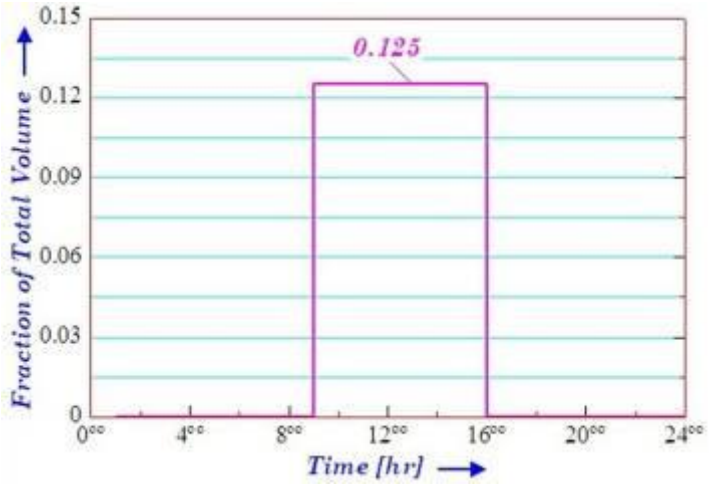


Economic predictions

Economic prediction of domestic solar water heating system with the following parameters is performed:

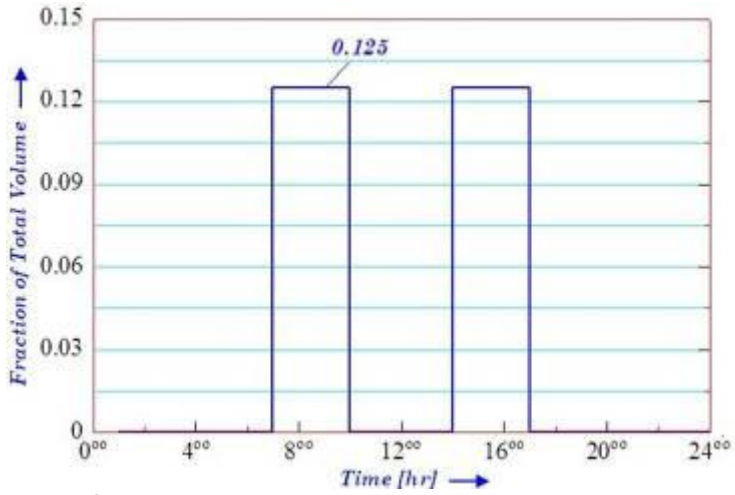
- Collector area = 2 m x 1 m = 2 m^2;
- Daily water consumption = 250 l;
- Capital cost of the solar collector = Birr 4,000.00 (this cost is for locally made SWHs – the calculation was done 4 years ago);
- Auxiliary electric heater incorporated.

Patterns of hot water consumption are varied to predict the annual electrical energy saving; the net present value (NPV) of the system for 10 years of plant life; and the pay-back period of the SWHs.



Annual energy saving	*2219.77 kWh*
Net present value	*2398.8 Birr*
Pay-back period	*5 y & 4 m*

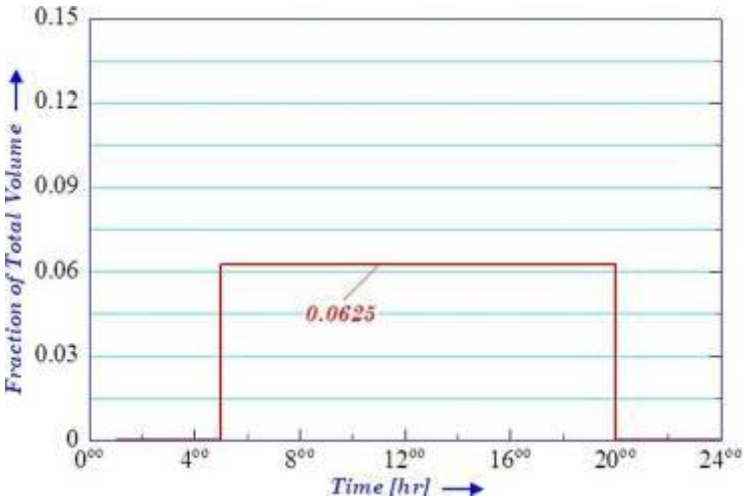
If the utilisation of the water is such that it is distributed over the day from 9 a.m. to 4:00 p.m., in other words 12.5% of the volume of water will be utilised by the household. The annual energy saving as a result of this pattern of consumption by the household is 2219/77 kwh. The NPV for this pattern is 2398.8 Birr and the household will get their investment payback in 5 years and 4 months time.



If the household uses the same volume of water but a different pattern as indicated in the adjacent figure between 7 a.m. and 9 a.m. and from 1 p.m. to 5 p.m., the annual energy saved and the NPV are less and the payback period is more: 6 years and 3 months.

Annual energy saving	*1917.64 kWh*
Net present value	*1680.40 Birr*
Pay-back period	*6 y & 3 m*

If on the other hand we distribute the consumption of the water throughout the day from 5 a.m. to 20 hours, annual energy saved and the NPV are even much lower and the payback period for the 4000 Birr investment is 8 years.



Annual energy saving	*1740.77 kWh*
Net present value	*690.90 Birr*
Pay-back period	*8 y & 0 m*

In conclusion, the 1st consumption pattern is the most efficient one and in terms of payback period the best.

Discussion

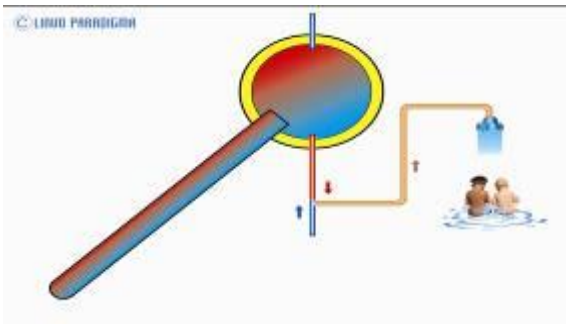
- It was inquired whether the findings of the research and related documents presented by Dr. Abebayehu were available for public consumption? To this, Dr. Abebayehu has replied that these are public knowledge and should be accessed by all. Therefore they are available for the consumption of the public or anyone else. It is not only these documents but, there are also other examples and case studies from other countries such as Malaysia, which can be shared with anyone interested. Dr. Abebayehu also advised that there are a lot of books available on SWH and that these should be shared widely with anyone interested on the topic as information should be available for all.
- In relation to the above question it has also been inquired what the research capacities of the Addis Ababa University are with regards to expanding the knowledge and understanding on the topic and linking it with the end users in the different parts of the country. To this Dr. Abebayehu has replied that the Technology Faculty of the University is conducting research at Masters and PhD level that could help inform actors in the industry. Dissemination of these research outcomes requires networking and collaboration with the private sector who are the main promoters of the technology. In addition, the research works of the students are presented at the end of the academic year and all are welcome to participate on these presentations. The workshop of mechanical engineering exhibits all research outcomes. The university now allows any interesting manufacturers to access these outcomes and produce them.
- In his presentation, Dr. Abebayehu has indicated that he used information about the solar coverage on Ethiopia obtained from NASA. A representative from the Ethiopian Meteorological Agency inquired why this has been so while the same data is available or can be produced by the Ethiopian Meteorological Agency locally. Data on this research was done based on correlation. For this correlation sources from Ethiopia, Canada and NASA were used. It revealed that the NASA data were closer to our estimation than others. This is the only reason why they were used for this research. In other similar research data on wind, solar and other energy issues from the Ethiopian Meteorological Agency are used extensively.

2. SOLAR WATER HEATING BUSINESS IN ETHIOPIA: Solar Water Heater Technologies for Residential & Commercial Buildings – By: Ato Dereje Walelign, President, Solar Society of Ethiopia, Managing Director of LYDETCO PLC

This presentation delivered an insight into the solar water heater technologies currently in application in Ethiopia and the business aspect of expanding the services. The presentation also delivered a comparison of the cost and benefits of SWHs as they relate to instant heaters currently on the market. The experiences shown in this presentation were from LYDETCO PLC which has more than 10 years of experience in SWHs. LYDETCO is a private limited company formed in 1996.

The products and the system:

Solar water heater systems are two types **stand alone** and **central systems**. Both of these systems are used to supply hot water for households, hospitals, condominiums and hotels.



As the key components of the solar collector, the evacuated tube is a product optimised in geometry and performance. The tubes are composed of two concentric glass tubes which in each case are half spherically closed on one side and fused together on the other side. The gap between the tubes is evacuated and afterwards hermetically plugged (vacuum installations). In order to make solar power usable, the internal glass tube is provided on its external surface with an environmentally friendly, highly selective layer and is thus designed as an absorber. This coating is thus protected within the vacuum gap. It is an aluminium nitrite spulter layer which is characterised by very low emission and very good absorption.

Stand Alone SWHs

In his presentation Ato Dereje stated that the application of stand alone solar water heaters by the private sector has been in the function of single family use for up to 6 persons, for farming and camping areas, for sowers at sports and swimming areas, holidays residences and guest houses. The technical advantages have so far been that the SWH being supplied by LYDETCO PLC are made of evacuated tubes with high performance. They are made from polyurethane foaming HFC-245FA blowing agent which is harmless to the ozone layer and strong and durable aluminium brackets.

Comparison of SWH with Electrical Water Heaters:

A 200 liter Solar Water Heater can supply hot water for 5-6 persons per day throughout the year. The estimated prices of such a 200 liter capacity SWH is currently ETB 13,000. The

estimated lifetime of such a system is 20 years. This estimation is for areas in coastal setting with high salt concentration in the waters. For countries like Ethiopia, it might even be higher than this. The system works through this lifetime without any maintenance or running cost. On the other hand, an electrical water heating system with two 6 kW instant electrical boilers works in a different mechanism. The estimated price of a 6 kW instant water heater is ETB 1,150. The estimated running cost for such a system is ETB 204.92 per month. This capital and running cost for the first year are summarised in table below.

Description	Instant Heater	Solar Heater
	Price	Price
Capital Cost	2,300	13,000
Running Cost per Annum	2,455.92	30
Capital + Running cost on First Year	4,755.92	13,000

Taking this comparison over a period of twenty years, it generates the following results as depicted in the table below. It reveals that within a period of twenty years, the use of instant water heaters would cost the household a total of ETB 54,874.72 in investment while the SWH would have been only ETB 14,500 in twenty years.

Year	Solar Heater 200 Ltr	Instant Heater 6 kW
1	13,030	4,755.92
2	13,060	7,211.84
3	13,090	9,667.96
4	14,020	12,123.68
5	14,050	14,579.60
6	14,080	17,035.52
10	14,200	29,315.32
20	14,500	53,874.72

Central Systems

The central system is used when large quantity of hot water is needed. It is used to feed in preheated water to existing boilers in Industry, hotels, hospitals, etc. to save energy. The application of such a system so far has been for hotels that need immediate hot water. The Central system has two types of classifications. These are the Closed Loop Collectors and the open loop collectors. The closed loop collectors work in such a way that primary water heated and transferred to secondary water. Then secondary water is used by the end user. On the other hand the open loop systems function in such a way that the primary water is heated and the same water is used by the end user.

Current application in the country

The notable application and supply of such a system by LYDETCO have been presented. As can be seen below, the installation for SORAMBA Hotel in Addis Ababa and the central system at the UNECA building have been mentioned.

1000 liters water tank at the UNECA and the central heating system at the UNECA building

Solar heater Tank of 3000 liters capacity at Soramba Hotel A.A.

Discussion

Service and Capacity:

- Does LYDETCO conduct design service, installation, and maintenance? What does the service that LYDETCO provides include? How much are the installation prices for the works done for the hotels shown in the presentation?
    - Ato Dereje stated that the service that LYDETCO provides includes demand analyses, installation and maintenance. With this package for example the 3000 liters system setup for SORAMBA Hotel is around Birr 210,000 according to last year

rates. The closed loop system done for the UNECA is more expensive than what has been done somewhere else in this country.

Local production, standards and testing

- Does LYDETCO have the capacity to produce locally? In line with this, does it also have the standard and testing facilities that go along with it?
    - It has been stated that LYDETCO does have the capacity to produce locally. What is missing is the economic scale and sufficient demand locally for SWHs. If the government and other institutions are included in it and support in creating the economies of scale, it would be quite easier to produce it locally. Ato Dereje also stated that the private sector should be the prime mover in such sectors. The fact is that the private sector alone cannot be the prime mover in this country as it has little capacity and is quite young. In the energy sector, Government still has the stronghold and is the prime mover in this case.
    - The testing facilities shown in the presentation originate from China. It is called ***Linuo-Paradigma*** and is a collaborative effort of the German and Chinese government initiative. They provide a large testing and standard facility. This facility does not currently exist in Ethiopia.

Recycling large scale systems and steam generation

- A remark from the Ministry of Health enquired if LYDETCO and its partners are also responsible for recycling the components of the SWH system. In addition to this, does the central system have the capacity to generate steam as well, which could be useful for larger hospitals and health facilities? Furthermore, hospitals like Black Lion and others of similar size have larger demands such as more than 3000 liters. Does LYDETCO have the capacity to supply such capacity systems?
    - The SWH systems components have little to be recycled. It is largely composed of glass and metal framework that have longer years of service. Mostly likely, it is only the foam that could have environmental concern and might need to be recycled. We have not been concerned with this so far, but it shall be considered in the near future. The Solar Society of Ethiopia will consider this in the future.
    - Concerning supplying larger scale SWHs for hospitals and other health facilities, it has been stated that this is not at all a problem. Rather the concern is a space issue. It would require larger installation areas and so long as this is available, it would be possible to do so. Ato Dereje also stated that there is not even a need to install such large magnitudes of SWHs. It is best to think in terms of integrated systems. We should think in terms of integrating various sources of energy instead of depending on only one type. SWH alone will not be best; it should be combined with other sources for better results and efficient generation of energy.
    - SWHs do not generate steam and it is not possible from the existing technology to generate sufficient steam to serve the needs of health centres. It has also been reconfirmed by Dr. Abebayehu that the systems have some steam but not sufficient to consider it for other uses.

Further collaborations and Preconditions for local production

- It has been stated that sufficient economies of scale are the prerequisite for local production as presented by Ato Dereje. What other preconditions do private companies such as

LYDETCO have in place to strengthen local production? Is it possible to collaborate with other international companies in order to jump-start the local production?

- Are you cooperating with regional government authorities?
    - Ato Dereje answered that in order to attract international partners, it must be possible to produce a minimum 1000 units of SWHs per year for the industry to grow well. Other than this growth in demand, there are no other preconditions needed in this process.
    - Currently LYDETCO works with all levels of government to expand such energy generation. It has worked on a number of projects with the Oromia region. Ato Dereje said that we need to work on more awareness and public relations issues in order to attract more regional government partners.

Condominiums for boosting local economies of scale

- Getting the economies of scale to grow through using the condominium housing project is a good idea. However, with the current design of houses, the central heating system will not work in the condominiums. Is it not better to have individual units?
    - Currently most of the condominiums have instant heaters. As they are, it is not easy to install central heating system without changing the design of the houses. We are working closely with the Ministry of Works and Urban Development to improve the design of the houses so that they could make use of efficient energy systems. Most of the people who live in condominiums are not really the poor people. They are middle class people who can afford to buy instant heaters, which also mean that they can also eventually afford such SWH systems.

Government is there to addresses market failures

It was noted by Ato Getahun that the industrial application looks very good so far. The private sector should do more in promoting the service and the technology. It is left for the private sector to penetrate the market. The role of government in our economic system is to addresss market failures. This is why government is engaged in providing the infrastructure and housing services. The rest should be covered by the private sector actors.

3. Ethiopian Electric Power Corporation: Perspectives on Solar Water Heaters – By Ato Gulilat Wami, Demand and Planning Department, EEPCO

The Ethiopian Electric Power Corporation, EEPCO, presently uses mainly two sources of power generation. These are hydropower generation and & diesel plants, through the systems of ICS & SCS. The ICS is manly based on Hydro & SCS on Diesel. In addition to this, the corporation

is projected to use energy generation mixes. These consider wind power and geothermal energy.

Some examples of energy mix options currently underway include the Ashegoda & Adama wind farm projects and the Aluto Langano geothermal project are among the notable ones. It is also intended to use the solar energy and solar water heating energy as it is one of the main green energy sources. The corporation is interested in participating with other actors involved in the energy development and also contribute & play a significant role on the demand supply balance.

EEPCO's Progress in Generation and Transmission Capacity

EEPCO's power generation capacity has been growing through the years. In 1991 it had the capacity to generate a total of 340 MW electricity. This capacity has grown to 2000 MW in 2009/2010. Through the realisation of its projects under construction and projects at the initial stage of launch, the cooperation is expected to boost its capacity by 2090 MWs and 6000 MWs respectively. The main projects currently under construction incude FINCHA AMERTI NESH, ASHEGODA Wind and GIBE III. With regard to transmission lines, the corporation had 3578 kms installed in 1992. This number grew to 8868 kms in 2009/ 2010. When the projects under construction currently are completed, they will deliver additional 2132 kms of transmission capacity. In addition through the realisation of the projects which are currently at the initial stage, EEPCO aims to deliver additional 6000 kms of transmission lines.

Customers and Demand:

The customers have grown both in number and consumption. In 1992 EEPCO had 428,841 customers. Currently in 2010, EEPCO has 1,896,000 customers. Analysis made on historical sales and GDP data for the period 1973 to 2007 reveals that the electricity demand has an elasticity of **2.15** to changes in the overall GDP. If an economic growth rate of 7-10% can be achieved in the coming years, it could be translated to an electric energy demand growth rate of about 17% (as projected in the target scenario) based on the above elasticity estimate.

Looking at the most determinant factors of energy demand growth factors, GDP and Population, the recent good economic performance of the country is demonstrated in three consecutive years with GDP growths of more than 10%. The coming five years growth assumed to be same. Similarly population growth expected to be 2.2 to 1.8 %. In compliance with prescribed reliability and system reserve criteria, an updated schedule for implementation of new generating plants and transmission additions is designed to meet the projected demand. The generation development plan consists mainly of hydro projects. Generation from wind and geothermal power plants are foreseen to compliment hydro generation.

Regional Interconnection:

The development of regional infrastructure projects (power system **interconnection projects**) is important for most African countries as they are typically very small to generate the **economies of scale** that can be found in larger markets. In light of the present world energy crisis, interconnection of the regional electric energy networks is the best alternative to displace expensive thermal generation in regional as well as international power markets. In harmony with this belief, Ethiopia has devised a strategy for accelerating cross-border electricity trading

with the neighbouring countries and further to other nearby countries to spur regional economic growth through developments of the untapped hydro resources for electricity.

Benefits to be expected from developing regional interconnections and operating as a power pool, when considering further strategic links such as the Southern African power pool (SAPP), East African power pool (EAPP), North African power pool (NAPP) and West African power pool (WAPP) include:

- Strategic partnership among the parties, which will have significant contribution for regional economic cooperation and stability.
- Lower unit energy costs for the receiving system (s) from displacement of more expensive and environment unfriendly thermal generation.

Discussion

Cooperation in reducing Peak Load

Issues were raised with regard to what the plans of EEPCO are to reduce the current peak load and how and in what modalities EEPCO is planning to cooperate with such energy efforts and partners. It was also stated that the Ethiopian Energy Agency tried to lure EEPCO into discussion with regards to alternative energy generation mechanisms such as this one. The CEO of EEPCO had also been invited and promised to come to this Symposium. It is very important that EEPCO as an organisation plays a role in this process as it is a major stakeholder. It will be a challenge for the further expansion of SWH systems without the involvement of EEPCO.

The contribution of SWH and such energy generation systems to reduce the peak load was discussed. EEPCO is foreseeing a rise in demand which would mean more peak load. As a result, and in due consideration of the limitation in investment capacity by the government, the EEPCO representative has stated that any energy investors and solutions would help a lot in curbing the growing demand and addressing peak load issues. In addition, more marketing and publicising work needs to be done in order to make the public aware about such energy sources and solutions. EEPCO is willing and ready to cooperate on this matter with all relevant stakeholders and developmental investors.

4. CONCEPTUAL NOTES ON SOLAR WATER HEATER PROGRAM – By Ato Takele Mekonen, Ethiopian Energy Agency/ EEA

The starting point for this concept is the realisation of the high potential that SWH have to reduce peak load. In this regard, the public awareness is very low about these systems and there is little use of solar energy compared to its potential. In addition the price SWH is currently high; even if the import duty is removed SWH prices are still high on the market.

Objectives

The objectives of the Solar Water Heaters Program are as follows:

- To increase market penetration of SWHs
- To increase local capacity for the production of SWH systems: Material and Human
- To provide employment opportunity to the youth
- Achieve energy conservation at large scale

This program has three components.

Special rebate to domestic SWH:

The objective of this component is to provide partial cost coverage. With the ownership of EEPCO, this component targets domestic power users. It is a voluntary program and the partial cost for the system will be covered via utility bill reduction through a 12 months period. Installation certificates will be provided; the SWHs must in a sound and operational condition. Some of the potential challenges associated with implementing this component are that this intervention might have negative revenue implication on EEPCO. In addition, the program also entails additional cost on EEPCO for managing the program. On another note, the ability of the average domestic customers to finance the full cost of the system poses as a challenge as well.

Loan financing for SWHs

With the ownership of the Ethiopian Energy Agency, this component envisages to develop the market for large scale SWH systems. It targets commercial & industrial users. The activity is to provide loan systems for these commercial and industrial users to install the SWH systems. There is a need to set up legal frameworks for the establishment of the fund. The willingness of the banks to provide these loans needs to be investigated. Another challenge in implementing this component of the program could be the cost of fund administration; in that service charges from commercial banks may increase the cost of borrowing.

Local Capacity and business development sub program

The objective in this component is to strengthen the local local SWH systems manufacturing capacity in terms of human capacity and small SWH enterprise development. It seeks to do this through technical assistance to potential manufactures in form of; training, design,

maintenance etc. It is also envisaged to establish product test & certification mechanisms and training on business operation. As in the case of the other two components, the process of establishing the financing structure and loan security is a challenge.

Program implementation and evaluation

The Ethiopian Energy Agency/EEA will lead the overall SWH program at the national level. It is also proposed that the local capacity and loan finance sub program shall be owned and run by EEA. On the other hand, the rebate Sub-program will be owned and run by EEPCo and regular evaluation program on a national level will be owned and run by EEA.

Discussion

- The next steps of the concept note and what is the expected timeframe of commitment and implementation. From EEPCO's side, when can we expect a move on the rebate program?

  It has been stated that it is not possible to make a specific time and commitment with regard to the implementation of the concept note as it is still at concept level and needs to be nurtured further and there are a lot of issues to be discussed and covered. There need to be discussions held with potential donors like the World Bank and others, as EEPCO might have financial limitations to be able to implement the program and specially the rebate component. The EEA would welcome any additional ideas to develop this program and concept note further. There needs to be necessary legal and administrative frameworks to be put in place and EEA, as the owner of this program, is working on this issues with all the relevant stakeholders.

- What are the strategies for addressing the customer? How is it designed to reach out to them and create as much public awareness as possible and how does the information reach the customers?

  Currently, there is not a comprehensive strategy for this. A policy framework is being formulated at the moment that would create enabling grounds for public outreach with much more organised information. This policy framework would include all facets of promoting SWH. The public awareness and outreach strategy will also be part of this policy. The policy itself is currently a work in progress. The involvement of the private sector and partner organisations in developing these strategies and realising the policy framework is imperative.
- The clean development mechanism should be considered in this policy framework and strategy either by EEPCO or the EEA.

A challenge from the Netherlands Embassy

- There is a program at Addis Ababa University called the demand driven action research, which the Netherlands Embassy is supporting financially and technically. The program also provides financial assistance up to Euro 3,000 for students conducting their master's thesis in collaboration with public and/or private institutions. The issues of raising awareness for the utilisation and expansion of the SWHs could be a very good master thesis topic to be addressed.

Group Discussions

After the end of the presentations which have taken place in the morning session, the symposium was then divided into four groups for further and in depth discussion. After a brief lunch break, the groups deliberated on their specific issues for 1½ hours and reported back to the plenary. The group themes which are also based on the components of the SWH program concept note, were:

Group 1: SWH Program Concepts

Group 2: SWH System – Financing Strategy

Group 3: SWH System – Local Manufacturing Options

Group 4: SWH Application Options for Industrial Use

Group Discussion outcomes

During the group discussions, emphasis was given to the existing **challenges** with regard to each specific working group topic provided and the potential **opportunities** for taking the issues further and what activities could be implemented to implement the program as a **way forward**.

Group 1: Program concepts

This group was entrusted with the task of discussing the mechanisms of nurturing the program concept note further by discussing what could potentially be included in the program and what activities should be included and implemented to develop it further.

The group agreed that the targets of this program are hotels, industries, hospitals and households. The group has discussed that hot water and water heating is not a main priority, rather a largely growing demand with the changes in lifestyle and the process of urbanization in the country. As a result the following has transpired:

Group 1: Solar Water Heater Program Concepts	
Challenges	SWH have quite high initial costs and investments.
	There is lack of public awareness with regard to the SWH systems.
	Standards and certification mechanisms are not in place.
	The price of energy and electricity in Ethiopia is very low. This works as a disincentive to seek alternative mechanisms of energy.
Opportunities	The use of SWHs promotes the concept of clean energy throughout the country.
	SWHs have a high energy saving capability at all levels, be it household, industry, etc.
	SWHs could serve as a support for the reduction of peak demand and peak loads. This further helps in improved load management possibilities as SWH serve as alternatives.
	The expansion of SWHs can help stimulate the market and create a number of economic opportunities through job creation and establishment of service providers. In addition, the implementation of this program will help EEPCO with its export program and boots its potential.
	Once installed, SWHs have low running and maintenance costs.
	SWHs have improved safety compared to electrical heating systems.
The Way	It is very important to involve EEPCO in this process as they have a larger stake in

Forward	promoting the program and for the realisation of its implementation.
	As certification and quality management are vital for the success of this program, it should involve QSAE (Quality and Standard Assurance of Ethiopia).
	As part of the program intervention, it is important to promote energy conservation as it will aid a lot in the utilisation of alternative energy sources such as SWHs. A wider awareness creation activity should be implemented in order to get everyone on board.
	More data is needed with regard to understanding the potential on the market, the business response, the demand of people and the inclination for use of alternative energy sources. A comprehensive baseline study should then be conducted to inform the process.
	In addition to the baseline study, a pricing study should also be conducted. This should also include the potential incentives for importers, local producers and users at all levels.
	Target groups of this program should further be specifically defined and addressed.
	The promotion of local production and the production process should also be emphasised. There are lots of innovations to be promoted within this area.
	Technical and Vocational Education and Training (TVET) centres in collaboration with private institutions have a large role to play in promoting local production of SWHs. The program should then incorporate technical capacity building for this process.
	Long-term loan and subsidy schemes should be envisaged in the program. Private financial institutions would be good partners in this context.
	Sufficient budgets should be allocated for public customers to help them adopt alternative energy options.
	Clean Development Mechanism co-financing options should also be considered. In line with this, the SWH program should be integrated into the Green Growth Strategy of the Government which is being led by the Prime Minister's Office.

Group 2: SWH System – Financing Strategy

This group was entrusted with the task of discussing potential mechanisms for financing the SWH program and deliberate on the existing challenges, identify opportunities and propose the way forward. The following points have transpired from the discussion.

Group 2:	**SWH System – Financing Strategy**
Challenges	Lack of awareness about the issue at social and organizational level.
	Growing demand for energy in the country as a result of growing economic activities.
	SWH technology is new and financial institutions are not confident to disburse loans. Financial institutions do not have financing models for energy technologies.
	Weak cultural acceptance and low level of awareness about its economic impacts.
	Insufficient information on payback period and high upfront cost for consumers. Consumers have low purchasing power and are price-sensitive. Narrow sales strategy and no credit sales.
	Limited knowledge and awareness about the technology and its importance. The technology is new and not yet matured.

	Lack of focused policy and elaborate strategy for SWHs.
	No specific pack of incentives (policy and financial) for SWHs.
	SWHs may not pay back and even if they do, they take longer periods.
	Electricity is too cheap in the country compared to somewhere else.
	No clear information with regard to government readiness to further this program.
	Public private support mechanisms are missing.
Opportunities	Development of infrastructure such as roads and transport is easing access to the rural areas which could also benefit from SWH technologies.
	High population means bigger market for SWHs.
	Fast growing construction of private and public facilities, hospitals, hotels etc.
	Existing trend for real estate development.
	Abundant solar resource in the country and easily available energy.
	No additional cost or running cost for SWHs.
	Increasing awareness on importance of energy and its impact on economic development.
	The already installed effects could serve as a promotion.
	The rising price of fossil fuel worldwide could aid the shift to alternative energy sources like solar.
	There could be potentially international funding for such interventions and in relation to environmental protection projects.
	The promotion of clean energy is a recent agenda and there are potential financiers for this effort. It also gives green image to businesses.
	Availability of research and technology transfer at international level.
	Promising policy directives and good government policy on investment. In addition, government tax exemption should help reduce the price on the market. There is good policy emphasis on supporting the manufacturing sector.
Way Forward	Funds: Introduce creative financing schemes by linking distribution of SWH systems with EEPCO.
	Instill incentive schemes.
	Consumer credit systems should be in place and anchored with EEPCO.
	Establish a fund for SWH as well as mobilising local funding.
	Awareness: Education should be provided at all levels.
	Stronger lobbying and consultancy support to the Ministry of Mines and Energy and other relevant ministries.
	Strong institutional linkage bringing knowledge, money and policy together.
	Convince political institutions on employment creation potential.
	More information and promotional services in local language.
	Prove to the public and the stakeholder that SWHs do really payback.
	Policies and strategies: bring in best practices from other countries.
	Strong and consistent government regulations regarding standards to protect the market.
	Increase tax on all imported SWHs – decrease VAT on locally produced SWH.
	Government should work on stimulating available renewable energy technologies to meet the demand in the country.
	Decrease the price of SWH through subsidy mechanisms.
	Introduce special set of incentives for local manufacturing and cost reduction

	mechanisms.

Group 3: SWH System – Local Manufacturing Options

This group was entrusted with the task of discussing the option for manufacturing the SWH system locally. The group looked into the challenges of local production, opportunities that would promote such initiatives and the way forward.

Group 3:	SWH System – Local Manufacturing Options
Challenges	Shortage of customers for the technology (not based on any concrete data).
	High cost of manufacturing locally.
	Customers are unaware of quality differences.
	Competition from imported products.
	Lack of finance for R&D in SWH system.
	Lack of incentives.
	Lack of data.
	Absence of media coverage.
Opportunities	Educational institutions could engage in research and development.
	International collaborations could be fostered.
	Ethiopia is a country of 13 months of sunshine.
	Designing products suited for Ethiopia.
	Power shortages.
Way Forward	Identify, categorise and understand potential customers.
	Standardisation and certification.
	Identify the institution that will lead and direct.
	Solar Society of Ethiopia should play a major role.
	Solar Society of Ethiopia should push for incentives.

Group 4: SWH Application Options for Industrial Use

This group was entrusted with the task of discussing and proposing SWH applications and options for industrial use. The group discussed current challenges with regard to industrial application and opportunities and the way forward for promoting industrial applications.

Group 4:	SWH Application Options for Industrial Use
Challenges	Lack of information at all levels about the SWH technology and weak promotion of the product.
	Lack of confidence in the product.
	Lack of integration of the different actors and stakeholders.
	Lack of commitment and support for the expansion of the technology.
	Lack of sufficient suppliers and options of the technology on the market.
	High initial investment cost.
	Lack of professional and experts about the subject.
	Additional cost for adaptation.
	The technology requires a wider area for industrial installations.
	Poor saving system among individuals and customers.
	Lack of quality standards at the national level.
	Lack of clear policy and lack of energy audit.

Opportunities	Tariff increment in the future with regards to the electricity supply.
	SWH is hazard free investment and has more durability as well as environmentally friendly.
	The technology is imported duty free.
	It is a renewable technology and helps individuals and businesses to become self-sufficient.
	Green house gas reduction and carbon trading options can be incorporated.
	There is lots of high potential customers.
	Short payback time on the investment and low running cost.
	Creates additional job opportunities and technological transfer.
	Helps increase the saving of energy and is an encouragement for other industries.
	The country is geographically advantageous.
Way Forward	Conduct a feasibility study to inform the expansion of the technology in the country, and additional studies on solar technologies.
	Involvement of investors and promotion of the technology.
	Technology adaptation and promoting local production.
	Bridge the skills gap through training and TVET involvement.
	Awareness creation and promotion.
	Clear policy should be drafted and ratified.

The next steps

After having presented and discussed on the outcomes of the group discussions, the symposium has deliberated on what the next steps of this gathering should be and what actions should be laid on the ground to ensure the further promotion and implementation of SWH program in the country and putting the suggested ideas and way forward into concrete actions and commitments. The following next steps have been proposed by the participants:

- With the leadership of the Ethiopian Energy Agency, the presented concept note should be further developed, with inputs from today's sessions as well as additional consultative meetings with other stakeholders at various levels. It is important that one institution takes the lead and promotes the concept and the EEA is best placed for this.
- Partnerships should be fostered between relevant stakeholders such as the government, private sector and NGOs. In addition, a working group of all actors and potential stakeholders should be established. SWH technologies are low hanging fruits, therefore it would be easier to add value through integration of partners.
- The Ethiopia Cities Day, which is an even run under the Ethiopian Cities Network and other partners, should be a good forum to promote this program and raise much more awareness to urban areas and their leaders about this technology and the whole concept of energy efficiency. The next Ethiopian Cities Day is being organised in Hawassa City, it is expected that close to 70 cities will participate from all around the country, and a large portion of private sector representatives will be gathered as well. This event could serve as a good promotional event.
- The GTZ has its monthly energy meetings. This forum should incorporate industrial representatives, hotels, hospitals and others to attend and benefit from the sessions as well as raise their awareness with the current state of affairs on energy technologies.

- Potentials for export of energy should be further studied and exploited.
- Universities could participate in certification and standardisation of the products. In addition, universities, such as the University of Mekelle, could participate in generating the necessary technical and economic data that helps promote the technology and address more research and development issues.
- An online forum could be established for promoting the SWH program and as a communication strategy on the progress of implementing the technology in Ethiopia. As we stand, the GTZ Engineering Capacity Building Program is working on a similar strategy and it could be integrated for similar purposes.

Annex 1 - Welcoming Address by Dr. ChriStian Jahn, Deputy Country Director of German Technical Cooperation/ GTZ

Honorable State Minister, Ministry of Mines and Energy, Weizaro Sinknesh Ejigu,

General Director of Ethiopian Electricity Agency, Ato Getahun Moges,

Distinguished guests from government and non-government organisations, private sector and development partners,

Ladies and gentlemen,

It is an important step for the energy sector community in Ethiopia that we get together today for the first symposium on Solar Water Heating in the country. Therefore, it is a great honor and pleasure for me to address welcoming words to you on behalf of the GTZ country office and our energy coordination office in Ethiopia, briefly called ECO.

GTZ has already supported various energy programmes in Ethiopia over the past 12 years and in the field of solar energy over the past 4 years, however, with focus on photovoltaic systems for electricity generation. We are now enlarging our solar activities to cover also solar-thermal applications, in particular water heating which will be the main application in Ethiopia. This we do in close cooperation with the Ethiopian Government, especially our partner Ministry of Mines and Energy and specialised organizations under the Ministry such as the Ethiopian Electricity Agency and the power corporation EEPCO, but also with private associations such as the Ethiopian Solar Society and private sector companies some of which will also give presentations today.

Although in Ethiopia to date still few private companies are engaged in the sales and after-sales-service business of Solar Water Heaters and their dissemination is rather limited, it is internationally proven that the technology is cost-effective and competitive with other water heating options. There is a large demand for hot water in the country, not only in households, but also in public service institutions, such as health facilities, private service companies, especially from hotel and tourism sector, as well as industry, which could well and efficiently be met by solar water heaters. In addition, for the national power corporation EEPCO, the stress on load management would be relieved by a considerably reduced peak demand following a wide dissemination of Solar Water Heaters replacing electric heaters.

Thus, the purpose of this Symposium is to bring all relevant stakeholders together in order to get necessary information for awareness creation and start discussions on elements and priorities for establishing a framework for a future Solar Water Heating Program. To facilitate such discussion, we will also have 4 working groups dealing with key issues, such as (i) program concepts, (ii) financing strategy, (iii) local manufacturing options and (iv) application options for industrial use. I wish to encourage all participants of this Symposium to actively engage in these working group discussions.

Annex 2- Opening Introduction by Ato Getahun Moges, Director General of Ethiopian Energy Agency

Your Excellency Sinknesh Ejigu, State Minister for Mines and Energy,

Participants, invited guests, ladies and gentlemen,

It is a pleasure to welcome you all including those of you who traveled a long way to be here to take part in this Symposium organised in collaboration with GTZ Ethiopia. Over the years, the Ethiopian Electricity Agency (EEA) has hosted a number of workshops on various themes related to energy. Today we are delighted to meet face to face with you the stakeholders on yet another important issue in the energy domain namely Solar Water Heater technology and its use & dissemination in Ethiopia.

In the wake of a rapid economic development, it is obvious that electricity demand in general and peak demand in particular is usually accelerating. Recent forecasts unequivocally projected this development.

It is true that there is broad based power sector strategy and program to develop the country's power sector. We have over the years and recently as well witnessed commissioning of power supply facilities. This is more than encouraging. However there is also the concern of the government to better manage demand in order to relieve and defer pressure put up on the supply side.

As energy efficiency and conservation and therefore managing demand requires adequate and conducive framework, our Agency, after recently going through business process re-engineering, is vested with additional responsibility for managing energy efficiency and conservation. Thus this has brought about a new and additional portfolio activity within the agency structure as defined by the newly designed processes. To accommodate this new responsibility, a legal framework is under preparation. We are endeavoring to execute this part of our new responsibility. Therefore beyond preparing the frameworks we have been engaging in promotional activities on many areas of energy efficiency and conservation.

Dear participants;

This symposium on Solar Water Heaters has come to play in this context and we believe this shall be a valuable event in profiling issues related to Solar Water Heating technology and its application in our economy. This technology is matured; relatively simple; cost effective; rewarding; ideal for energy conservation; has huge potential market with low cost options, yet market penetration is very low as it stands today.

The deliberations we will have today at this Symposium through professional paper presentations, experience sharing, breakaway group discussions, will be used to develop actions in view of increasing market penetration of the technology. Your participation, therefore, is of paramount importance and highly regarded by the organisers.

Once again my appreciation goes to all of you who have come to take part and to those as well who prepared themselves to actively participate in this symposium via presentations, experience sharing and exhibitions of various forms.

With this few words of welcome, I invite Excellency Sinknesh Ejigu, State Minister, Ministry of Mines and Energy to deliver the key note address and officially open the Symposium.

Annex 3- Closing Remarks, Dr. Gerd-Henning Vogel, Program Director, Energy Coordination Office, German Development Cooperation, GTZ

In his concluding remarks, Dr. Vogel thanked all participants for having made the time and the sacrifice to have stayed all day long and participate on this symposium. The symposium today has been attended by approximately 135 people in total.

Dr. Vogel also stated that in order to make the immediate steps towards strengthening the application of SWHs in the country, the dialogue with EEPCO needs to be intensified. It is vital to reach a common understanding with EEPCO on SWHs. Above all, it is also important to have a continuous and full commitment by the government of Ethiopia. A positive signal in this case is the ***green growth strategy*** initiated by the Prime Minister's Office. The Ministry of Mines and Energy will take the lead in this process and set the ground for further implementation.

The contribution of the private sector is very well appreciated. Special thanks goes to Ato Dereje for having represented the private sector as well as the Solar Society in this symposium. Entrepreneurs should take a calculated risk in promoting SWHs. They need, of course, more information and data on the market and the demand aspect. It is important to strategically address the various heterogeneous customer groups and segments of the society who have strong need and potential for utilising energy systems like SWHs. It is imperative that we involve all stakeholders for the success of such energy efforts. Engineers and Architects associations, Ministry of Works and Urban Development, other ministries, the construction sector, finance institutions, development partners, the media and many more.

In conclusion, Dr. Vogel warmly thanked the State Minister, W/Zo Sinknesh Ejigu, who gave an encouraging opening speech this morning despite her busy schedule. He also thanked Ato Getahun Moges, Director General of the EEA for his commitment and leadership for the realisation of this workshop. Dr. Vogel also thanked the Moderator for having ensured a participatory symposium taken place. Lastly, he stated that the issue of Solar Water Heating has not come to an end with this symposium only. It shall be followed up by ensuring the establishment of the working group or task force as proposed in the discussion on the next steps.

Annex 4 - Ato Getahun Moges, Director General/ Ethiopian Energy Agency

Ato Getahun thanked all participants, and specially those who have come from far, for having been present all day and dedicated to taking part in this symposium. He appreciated and specially thanked the GTZ and their staff and leadership, Dr. Vogel, Dr. Jahn, Mr. Gaube, Ato Samson Tolessa and others, for the preparation and realisation of this symposium. He also thanked the EEA staff who have worked hand in hand in getting this symposium organised and launched with success.

The group discussions and presentations were quite articulated and clear in stating the challenges and proposing the way forward. This symposium has been very productive in this regard. He stated that we need to go much more deeper in the coming future in pursuing the SWH agenda and realise the implementation of the program. Other venues and media would also be used and more discussions and consultations will also be conducted.

With regard to the way forward, Ato Getahun stated that we are on the consumers side. We are users of policies and not the makers. So we will join hands in supporting the Ministry of Mines and Energy and others for more immediate and effective policy steps. Some of the suggestions of this group on the way forward are timely and quite relevant. EEA will make sure that they are picked up by the Ministry's expert group. When it comes to funding, we would have to try and secure sufficient financial support for this program. The arrival and timely drafting of the policies will help a lot in this process. The other most important thing that goes along with this is the development of sufficient human capital and professional base. EEA itself is suffering from migration of well trained human resources. Ato Getahun stated that more work needs to be done with the universities in developing curriculum.

The participation of EEPCO in this program is imperative, however, not taken for granted. EEA with its partners will push for more participation and keep an eye on the existing incentive mechanisms to get everyone concerned on board. Awareness creating at all levels is indispensable. The Ethiopian Television has been invited to this symposium, but did not show up. But the efforts will not stop here and we will pursue more in getting the media on board as well.

With these final remarks, the symposium was closed at 6:30 p.m.

2nd September 2010

N.B

The list of participants and the schedule of the day are found in separate files inclosed

All 4 presentations are to be provided on CDs on reqest.