Training Manual

for

Solar Water Heater Consultants

Prepared By

Greentech Knowledge Solutions Pvt Ltd
New Delhi

Under

UNDP/GEF Global Solar Water Heating Project
Ministry of New & Renewable Energy
Government of India

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MNRE

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PREFACE

As a part of the UNDP/GEF Global Solar Water Heating Project a "Programme for Solar Water Heater Market Development in the Himalayan States" was undertaken during the year 2011. The main aim of the programme was to accelerate the market development of solar water heating in the Himalayan region. This manual is prepared under this assignment for training of local consultants, SNAs and SWH dealers of the region. Through this manual, it is tried to provide a clear insight into the SWH technology, its design aspects and prefeasibility study for SWH application.

TEAM

Greentech Knowledge Solutions Pvt. Ltd.

Dr. Sameer Maithel

Mr. Prashant Bhanware

Mr. Dheeraj Lalchandani

Mr. Sonal Kumar

Mr. Richard Sequeira

Mr. Arif Abbas

***Partner organisations*:**

NB Institute for Rural Technology

HIMCON Himachal Consultancy Organization Ltd

SCALE Society to Create Awareness towards Life and Environment

ISO 9001:2008

Society to Create Awareness towards Life & Environment

Cover page picture: Courtesy Inter Solar Systems Pvt. Ltd.

Content:

Overview of Solar Water Heater Technology

1. Introduction:

The sun supplies energy in the form of radiation, which is the basic source of energy for all life on earth. The solar radiation is composed of two radiation fractions, these are called direct radiation and diffuse radiation. Direct radiation comes from the direction of the sun, thereby producing sharp shadows of any object. By contrast, diffuse radiation does not have a specific direction. The sum of direct and diffuse radiation is known as global radiation.

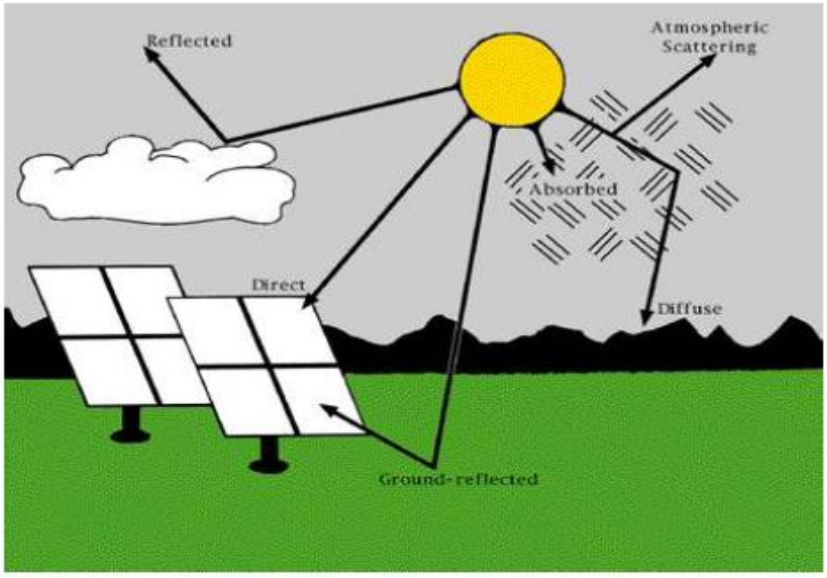


Figure 1: Direct & Diffuse radiation

Solar Water Heater is a simple device which utilizes global solar radiation and provides hot water at a temperature of 60-80°C. Its typical applications are in residences, hotels, hospitals, nursing homes, guest houses, hostels and industries.

Figure 2: A Domestic SWH system in Dehradun (Source: GKS)

Solar water heating is one of the most mature and is one of the fastest growing renewable energy technologies. Between the years 2000 to 2009, the world-wide solar water heating market has shown a six-fold increase. In India, the annual growth in the sale of solar water heating has been around 20%.

2. Solar Water Heating- Worldwide:

- 2nd largest Renewable Energy Technology after Wind Energy
- The market for Solar Water Heaters has increased 6 times during last decade
  - 6,000 MWth/year in 2000
  - 35,000 MWth/year in 2009.
- Chinese installed capacity is almost 50 times that of India.
- China
  - Majority of the sales are in the urban residential sector (both multi-storey as well as independent houses). Almost 10% of the households are using SWH ; China is targeting that 30% of the households become SWH users by 2020
- Europe
  - 90% installed capacity in residential sector
  - Predominantly independent houses
- India
  - Overall Installation : 3.5 million m^2 till 2009
  - Residential Sector: 75-80% of total installation
  - Karnataka & Maharashtra are leading states.
  - Karnataka + Maharashtra > 65% of the total installed capacity

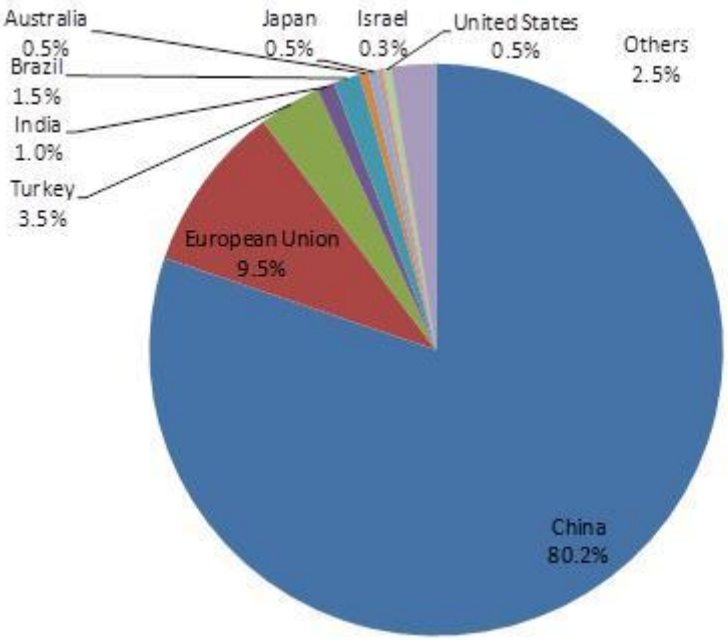


Figure 3: Worldwide SWH Sales -2007 (Source: REN, 21)

3. Working Principle:

The Sun's rays fall on the collector panel (a component of solar water heating system). A black absorbing surface (absorber) inside the collector absorbs solar radiation and transfers the heat energy to water flowing through it. Heated water is collected in a tank which is insulated to prevent heat loss. Circulation of water from the tank through the collectors and back to the tank continues either automatically due to thermo siphon effect or through a circulation pump.

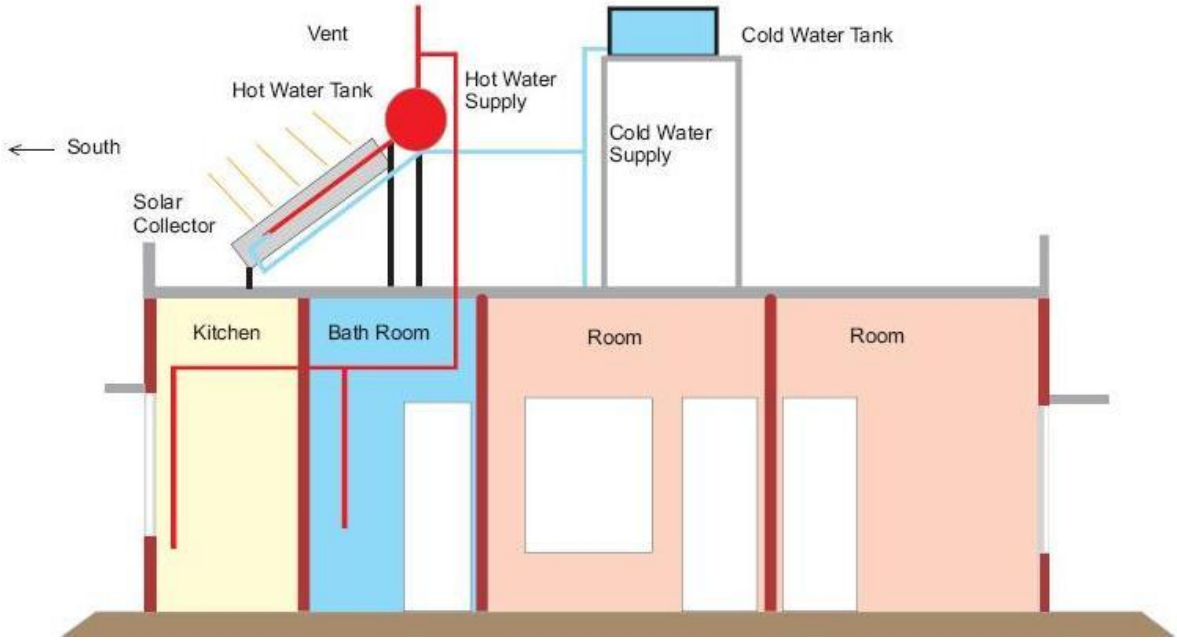


Figure 4: Working of SWH System (Source: User Handbook on SWH)

Generally three types of solar water heater are available in the market:

1. Flat Plate Collector System (Figure 5) - Solar radiation is absorbed by a thin metal plate (usually black coloured copper plate). The absorbed heat is transferred to water flowing through metal tubes attached to the metal plate. The absorber is enclosed in a metallic box, covered on the top with a glass sheet, and insulated on the back and sides.

2. Evacuated Tube Collector System (Figure 6) – The collector consists of evacuated tubes. Each evacuated tube is similar to a thermos in principle. An internal glass or metal tube containing the water is surrounded by a larger glass tube. The space between the two tubes is evacuated for providing insulation.

Figure 5: Flat Plate Collector System

Figure 6: Evacuated Tube Collector System

3. Heat Pipe (Figure 7): In this type of evacuated tube, there is a pipe (usually made of copper) filled with a fluid of low boiling point. When the pipe is heated by the sun the fluid boils and rises up in the pipe due to the thermo siphon effect. At the top, there is a connection of this heat pipe to a header pipe where this heat is transferred to the water flowing through the header pipe. The fluid in the heat pipe condenses on cooling and flows back to the bottom of the heat pipe.

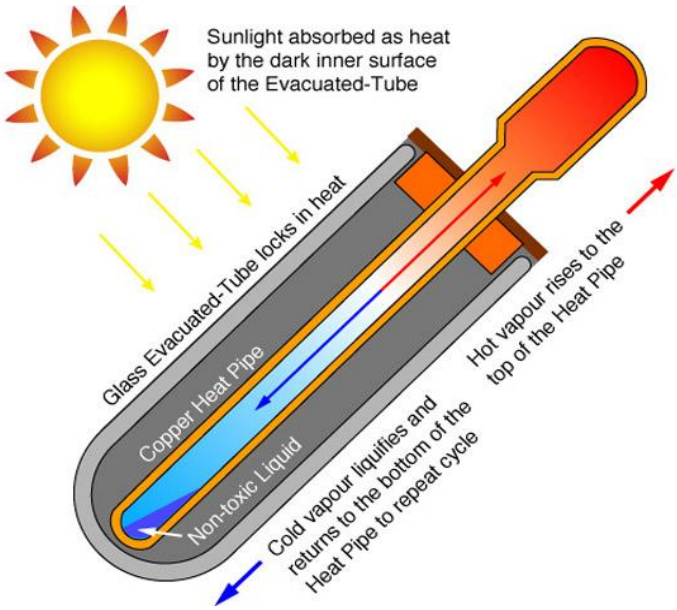


Figure 7: Heat Pipe (Source: Inter Solar Systems Pvt Ltd)

4. Components of SWH System:

1. Collector:

The collector captures the solar energy in the form of heat. As explained earlier it could be of three types.

Figure 8: Flat Plate Collector

Figure 9: Evacuated Tube Collector

2. Storage:

Because the sun is not shining all the time, a storage in the form of a well insulated metal/polymer tank is necessary to store the water heated by solar energy. Usually the storage is designed for overnight storage i.e. the hot water generated is available for use till next day morning.

Figure 10: Hot Water Storage Tank
(Source: Training Course on Solar Technologies Volume 1: Solar Thermal Systems for Engineers)

3. Piping:

For connecting different components of the solar system and for distributing hot water, piping is necessary. Right choice of material, dimensions, junctions, valves in the piping and insulation of hot water pipes to decrease heat losses, is important for a well-functioning solar water heating system.

Figure 11: Interconnection and Delivery (Source: Nuetech Solar System Pvt Ltd)

4. Mounting:

How the collectors are mounted and installed depends mainly on the installation site - is it a flat roof, a tilted roof, a facade or just a free space on the ground?

Figure 12: Metal frame structure for mounting on flat roofs (Source: GKS)

Figure 13: Metal frame structure for mounting on slopping roofs (Source: Vatsalyam Enterprises, Shimla)

5. Applications:

Solar Water Heaters are widely used in hotels. There are more than 200 hotels in the Himalayan region which are using solar water heaters. Manali, Shimla, Solan, Leh, Dharmshala and Dehradun are some of the places in the Himalayan region where several hotels have adopted solar water heaters. Solar Water Heaters are also used extensively in institutions, which includes school and college hostels, army/police establishments, government guest houses, hospitals, religious establishments etc. Apart from these, SWH systems are also widely used in residences and industries.

Figure 14: Manali Hotel
(Source: Inter Solar Systems Pvt Ltd)

Figure 15: Shimla Hotel
(Source: Vatsalyam Enterprises, Shimla)

Figure 16: Residential (Source: GKS)

Figure 17: Hostel (Source: GKS)

Figure 18: Hospital
(Source: GKS)

Figure 19: Industry
(Source: Inter Solar Systems Pvt Ltd)

Important Design Considerations

1. Space Availability:

The basic requirement for SWH is the availability of south facing shadow free area, usually on the roof of the building. As a thumb rule, the requirement of shadow free area is around 3 sq. m for each 1x2 m collector.

2. Sub – Zero Areas:

Wherever temperature goes below sub-zero in winter months, usually heat exchanger type systems are used. Mixture of ethylene glycol and water, having a low freezing point, is normally used in primary circuit. In summer seasons, it is advised to replace ethylene glycol solution with normal soft water.

3. Water Quality:

- Hardness of Water: Salts dissolved in water causes the water to become hard.
- Temporary Hardness: Temporary hardness is a type of water hardness caused by the presence of dissolved carbonate minerals (calcium carbonate and magnesium carbonate). When heated the salts separates from water and accumulates. In case of solar hot water systems, it leads to scaling in the collector tubes, hot water tank and piping.
- Permanent Hardness: The salt doesn't separate on heating, so doesn't cause any scaling in solar water heating systems.
- Use of hard water in SWH leads to scaling and eventual clogging of piping and collector tubes. If hardness of water > 300 ppm, Use of indirect/ Heat exchanger SWH system is generally recommended.
- In indirect system, soft water is used in collectors which in turn heat the water to be used through a heat exchanger.

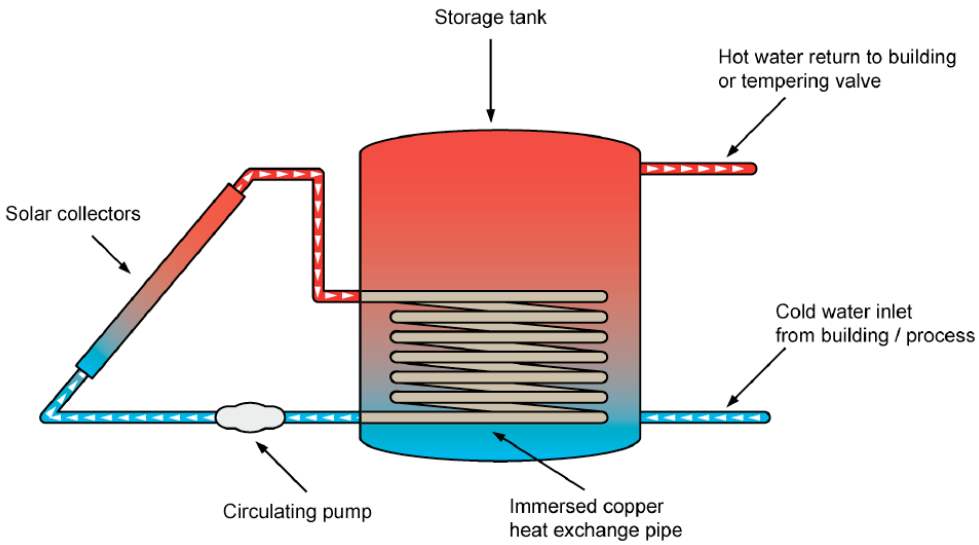


Figure 20: Internal Heat Exchanger System (Source: Training Course on Solar Technologies Volume 1: Solar Thermal Systems for Engineers)

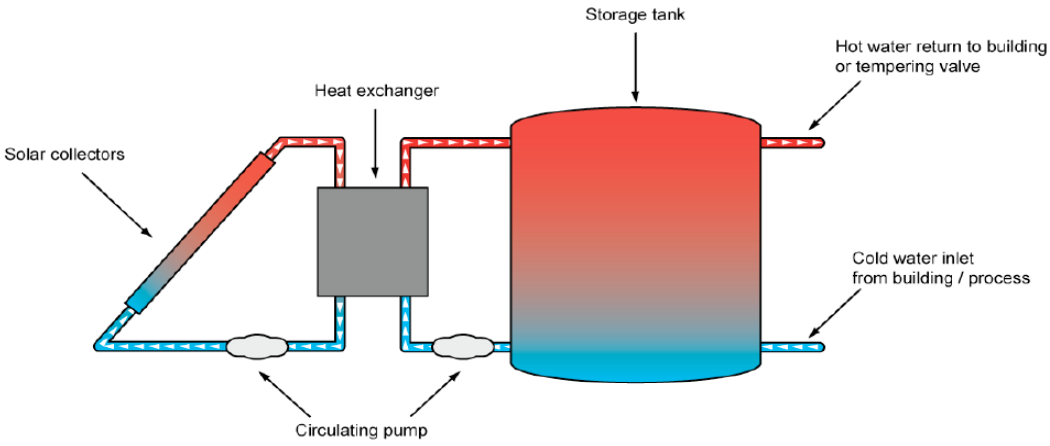


Figure 21: External Heat Exchanger System (Source: Training Course on Solar Technologies Volume 1: Solar Thermal Systems for Engineers)

4. Solar Collector Selection:

As mentioned earlier, two different types of collectors – Flat Plate Collector technology (FPC) and Evacuated Tube Collector technology (ETC), are used in India. ETC systems with heat pipes are also available but these are not being used commonly. Right technology should be chosen as per specific hot water requirement, site conditions and customer's concern for the performance, durability and reliability.

Comparison of Technology	
FPC	**ETC**
Thermal insulation is not as good as that of ETC so slightly lower efficiency in cold climatic conditions and for high hot water temperature requirements. For normal hot water temperature requirement (50-60 degree), both have comparable efficiencies.	Evacuated tube provides better thermal insulation and hence relatively lower heat loss from the collector. ETC are claimed to have higher efficiencies under cold climates and for high hot water temperature requirements.
Indigenously Manufactured.	Mostly Imported from China.
In case of hard water, collector is prone to scaling and chocking	Less prone to scaling
Heavy in weight, Lifting problems but robust technology	Light in weight but prone to breakage due to physical and thermal shock
BIS standards available	BIS standards yet not available
Proven life cycle of 15-20 years	Life depends on product quality. No conclusive data on life of the system under Indian conditions.

- In areas where hail storms are likely, ETC systems are generally not preferred.
- Similarly in areas where monkey menace is common (hilly region) either use FPC system or use ETC system with proper wire mesh (jaali).

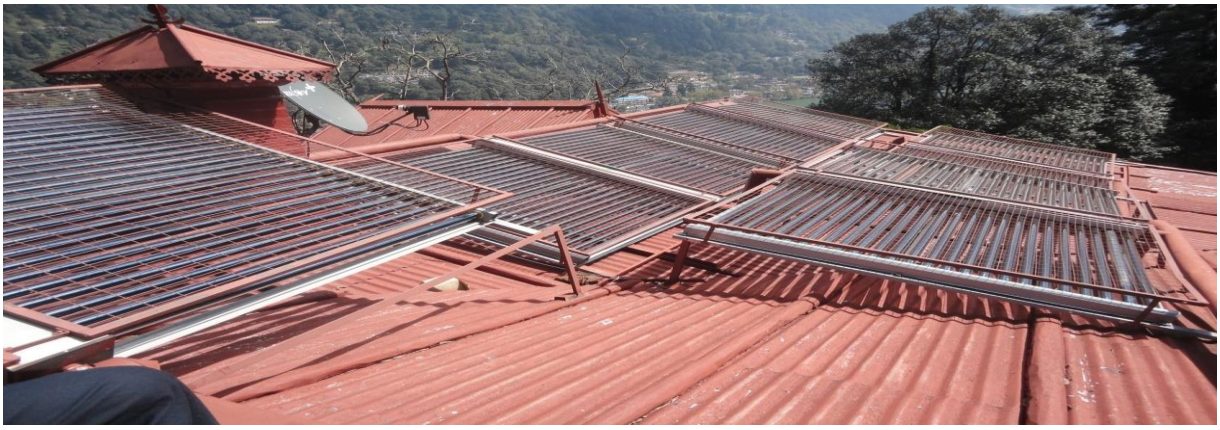


Figure 22: Wire mesh over ETC system to protect it from monkeys (Source: GKS)

5. Orientation & Slope of collectors:

The position of Sun with respect to Earth changes from summers to winters. It is southward in winters as compared to summers. To optimise the performance of SWH systems in winters the collectors should be south facing and their slope should be around 10^0 more than the latitude of the installation site.

Orientation: – South facing

Slope: – Latitude of site + 10^0

The latitude of a particular site can be estimated with the help of following figure:

Figure 23: Map of India showing latitude (Source: GKS)

6. Type of system:

- Thermo siphon flow system – No pump is used. Preferred option for sizes up to 2000-2500 LPD capacity
- Forced flow system – Requires a pump. Generally used in higher capacity systems

7. Insulation:

Insulation is required for hot water tank & every part of hot water line including vent pipe. If the hot water pipe is not insulated or the insulation is damaged or is wet, the hot water cools down before the point of use. Every inch of hot water pipe & storage tank should be properly insulated. The insulation should be properly clad with aluminum cladding.

Insulation of solar tanks	Insulation of hot water pipe
• Commonly used insulation material – Rock wool: density 48 kg/m^3 – Glass wool – PUF: density 28 – 32 kg/m^3 • Minimum thickness* – 50 mm for PUF – 100 mm Glass wool or Rock wool • Aluminium cladding of 24 or 26 SWG	• Commonly used insulation material – Rock wool: density 48 kg/m^3 – Glass wool – Nitrile rubber • Minimum thickness* – 50 mm Glass wool or Rock wool – 12 mm Nitrile rubber • Aluminium cladding of 24 or 26 SWG or PVC pipe cladding
*Thickness of the insulation should be doubled for sub – zero regions	

Some Defects of Insulation

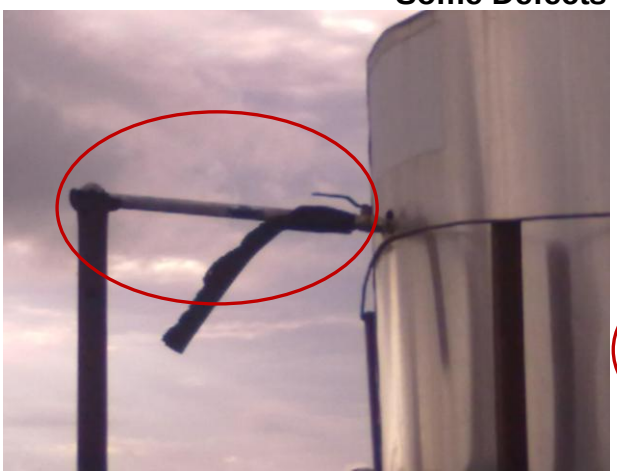


Figure 24: Insulation Defects (Source: GKS)

8. Back-up heating:

For totally cloudy days/heavy rain the output of SWH system would be very small. On partially cloudy days some output can be expected. But, the system can be designed with a suitable back up to take care of hot water demand on cloudy days. Backup heating can be in two forms:

i. Integration of SWH system with the existing system for water heating (eg. geyser, boiler, etc.)

ii. Electrical heating element (Figure 25) inside the solar tank: A separate switch should be provided for electrical element, so that the element can be used only when needed. the electrical element should be placed near the hot water outlet in the tank.

9. Sacrificial Anode in SWH tanks (Figure 26):

Sacrificial Anode rod is used to avoid corrosion of tanks. The rod is made up of either aluminium or magnesium alloy and saves the tank by getting itself corroded first. The anode runs horizontally along the inside of the tank. It corrodes over time and must be replaced periodically.

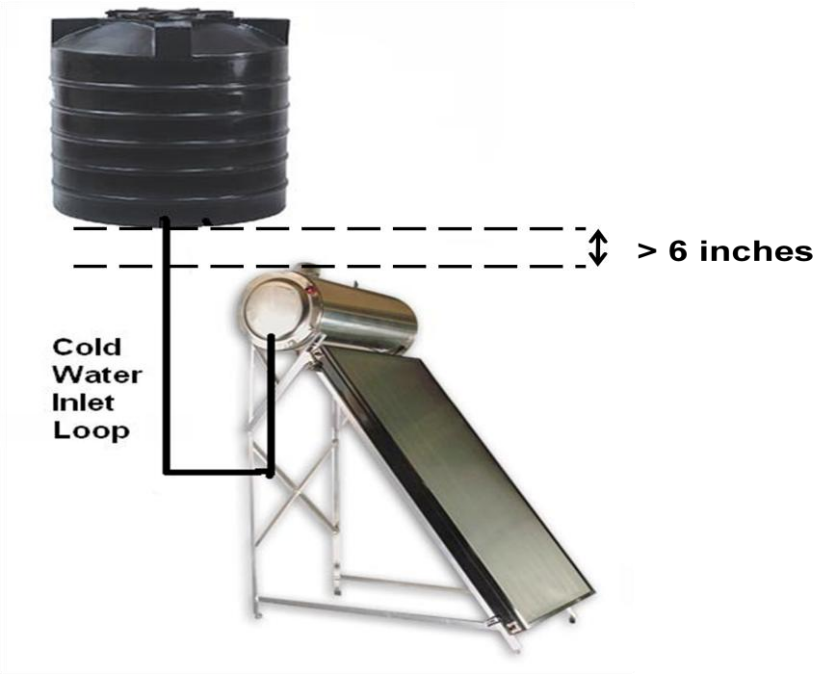
- Should be checked after every six months
- Make sure that rod is always dipped in the water

Figure 25: Electrical Heating Element

Figure 26: New & Used sacrificial Anode

10. Over head cold water tank (OHT):

This tank provides cold water supply to the solar storage tank. It can be a normal plastic tank. The capacity of OHT depends on the size of solar water heating system. Normally OHT size should be greater than the size of solar hot water tank.



Bottom of over head cold water tank should be at least **150 mm (6 inches)** higher than the top of solar tank.

Figure 27: Overhead Cold Water Tank (Source: Nuetech Solar System Pvt Ltd)

11. Vent Pipe:

The purpose of vent pipe is to release the air/steam/vapour from hot water tank. The exit of vent pipe should be above the cold water tank.

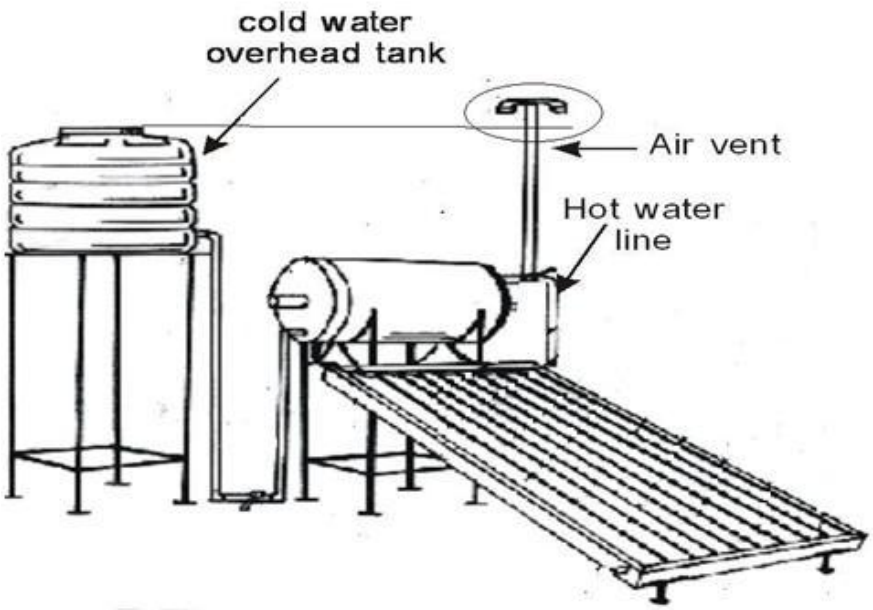


Figure 28: Vent Pipe (Source: Nuetech Solar System Pvt Ltd)

12. Circulation Pumps:

In forced flow systems water is circulated through the collector loop by a circulation pump.

13. Non-Return Valve:

When the hot water storage stands lower than the collector which is cold, the thermosiphonic effect causes a flow out of the storage through the pipes to the collector. This return flow cools out the water which has to be avoided. Therefore at least one non-return valve is necessary in the solar loop.

14. Gate valves and Drain valves:

These are necessary for filling and draining purposes.

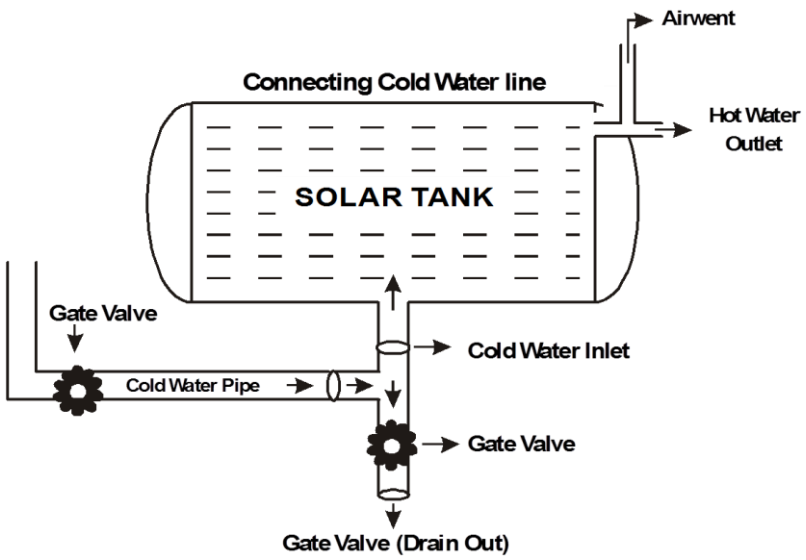


Figure 29: Gate & Drain Valves (Source: Nuetech Solar System Pvt Ltd)

15. Control unit with necessary sensors:

In forced systems a control unit is necessary to switch the pump on and off. Usually it is a simple temperature-differential-controller with 2 temperature sensors. One of them is positioned in the hottest part of the collector, e. g. collector outlet. The other one is in the storage, mostly on half of the height of the solar heat exchanger. The pump is switched on when the collector temperature is higher than the tank temperature and it stops when it is the other way round.

16. Cold Water inlet line:

Always form a loop while making a connection between cold water tank and hot water storage tank (Figure 30).

17. Hot water pipeline:

No reverse loop should be formed while plumbing on Hot water delivery side (Figure 31).

Figure 30: Cold Water Inlet (Source: Nuetech Solar System Pvt Ltd)

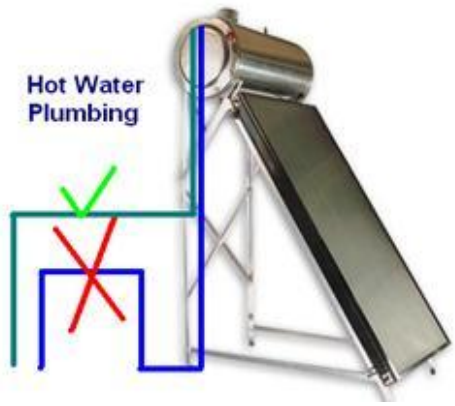


Figure 31: Hot Water Delivery (Source: Nuetech Solar System Pvt Ltd)

18. Internal Connection (Hot water from collector to solar tank):

No loop should be formed while making connection between collector panel and insulated tank with the help of hose pipe.

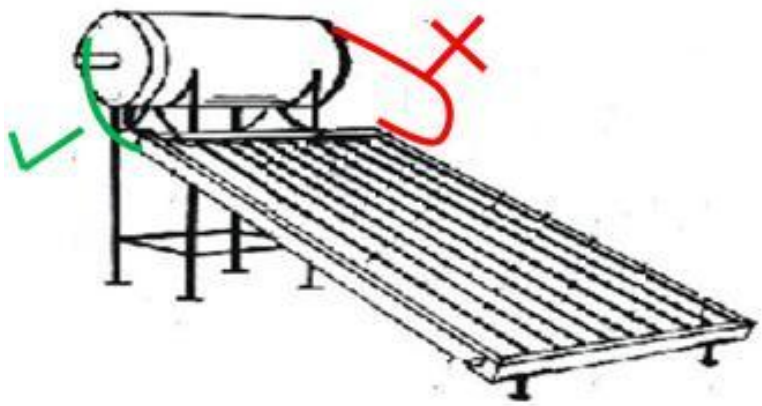


Figure 32: Internal Connection (Source: Nuetech Solar System Pvt Ltd)

Prefeasibility Report Preparation

Basic objective of this chapter is to provide a simple guideline to determine the right size of the solar water heating system, it's design specifications and financial analysis.

It is extremely important to select the correct size of the solar water heating system. The solar water heater sizing needs to be done based on the hot water requirements and the hot water usage habits of the client. The basic idea of having a solar water heater is to reduce electricity/fuel consumption for water heating. An under-sized system is insufficient to meet the hot water requirement, an over sized system will increase the capital cost and would also result in overheating of the water. As back-up system is required for cloudy days, it may be possible to manage with marginal back up use in extreme weather to optimize the size of the system for use in the rest of the year.

1. Hot Water Demand Assessment:

The requirement of hot water varies from person to person. The requirement depends on

- Climatic condition
- Type of user segment
- User Behavior

Following tables can be used as thumb rule for estimating hot water demand for different applications in Indian households, and commercial establishments:

Per Person Hot Water Requirement in Household (@40^{0}C)		
Type of Usage	**High End Housing (LPD)**	**Average Household (LPD)**
Bathing	80	40
Wash basin	20	10
Kitchen wash	15	15
Cloth wash	10	10

Hot Water Requirement in Commercial & Institutional Sector (@40^{0}C)	
Segment	**Hot Water Usage (LPD)**
Large Hotels (4 & 5 Star)	300 – 600 LPD per Room
2 & 3 Star Hotels	200 – 300 LPD per Room
Low end Hotels	100 LPD per Room
Large Hospitals (more than 30 bed)	50 LPD per bed
Small hospitals (less than 30 bed)	30 LPD per bed
Hostels	25 – 40 LPD per student

2. Site & Resource Assessment:

- South facing shadow free space availability (On roof as well as on ground)
- Type of roof (Flat/Slopping) (RCC/Tin)
- Water Quality (Hardness of water)

- Solar Insolation
- Average daily hot water requirement
- Hot water demand pattern (morning % & evening %)
- Month wise occupancy details (for hotels, hospitals & institutions)
- Existing water heating system
- Month wise fuel/electricity consumption in water heating
- Cost/unit of fuel/electricity
- Estimated length of pipeline required for hot water distribution

3. SWH System Sizing:

RETScreen software can be used to determine the optimised size and Solar Fraction of the SWH system as per customer's specific requirements. RETScreen is a Microsoft Excel-based free software package used to determine the feasibility of clean energy projects, which includes renewable energy installations. The software provides the user with a broad range of options for assessing the technical, financial and environmental suitability for an investment in a 'clean energy' project. It integrates a number of databases to assist the site assessor, including a global database of climatic conditions obtained from 4,700 ground-based stations and NASA's satellite data. For more details about the software and to download it free of cost, kindly visit www.retscreen.net/ang/home.php
It is easy-to-use software and its user manual is also available with the software.

- Solar Fraction: Solar fraction of a SWH system is defined as the fraction of total annual energy required to meet the hot water demand of an establishment that can be delivered with the SWH system. Generally SWH systems in residences/ hotels meet 60 – 70 % of the total demand.

4. Design & Specification of the SWH system:

Based on system size & site conditions, following design parameters and specifications would be determined:

- Choice between thermo-siphon and forced flow system
- Capacity of the system
- Slope of the Collectors
- Orientation of Collectors
- Type of Flow Circuit – Direct/Indirect Flow
- Type of System – Pressurized/Non-Pressurized system
- Hot Water Storage Tank
  - Capacity of tank
  - Material of construction
  - Insulation
  - Cladding
- Hot Water Piping including return line

  - Length of piping
  - Type of Pipe (GI/PPR/Composite)
  - Insulation
  - Cladding
- Cold Water Storage Tank
  - Capacity of tank
  - Material of construction
- Cold Water Piping
  - Type of Pipe
- Other Civil Works
  - Framed structure
  - Grouting of collectors and tanks
- Other Accessories
  - Valves
  - Pumps
  - Sacrificial Anode
  - Anti freeze solution
  - Control unit and sensors
  - Protection from monkeys
- Backup Heating
  - Integration with existing water heating system
  - Electrical heating element

A schematic diagram of the proposed SWH system should also be attached with the DPR

5. Financial Analysis:

- Estimation of Savings:
  As per system size and solar fraction determined by RETScreen software, we can evaluate savings in the cost of fuel/electricity with the introduction of SWH system. Solar fraction is the fraction of total hot water demand which can be met by the SWH system. Hence SWH system can reduce fuel/electricity consumption in water heating by that fraction.

- Total Cost of the system:
  - System cost (collector + insulated tank + frame structure for collector and tanks + grouting) = Rs. 10000 – 15000/ sqm (Indicative cost), depending on the type of system & site conditions
  - Other civil works & additional support structures, cold water tank, if required
  - Cost of insulated hot water line = Rs. 350-400/m (Indicative cost)
  - Cost of pumps, valves & accessories
  - Cost of transport, haulage & installation
  - Better to ask for a detailed quotations from recognized SWH dealers

- Central Financial Assistance:
  Under 'Jawaharlal Nehru National Solar Mission' (JNNSM), central govt is providing financial assistance in the form of capital subsidy or soft loan. A customer can avail either capital subsidy or soft loan (@ 5% interest on 80% of the system cost). The details of subsidy scheme for Himalayan Region are as follow:
  i. Commercial Establishments:
     - Subsidy
       - 30% of total system cost or Rs. 3300 per sqm capacity of the system, whichever is minimum, for FPC system.
       - 30% of total system cost or Rs. 3000 per sqm capacity of the system, whichever is minimum, for ETC system
     - Income Tax Benefit
       In addition to subsidy, commercial customers can also claim for Income Tax benefit from accelerated depreciation of the system (@ 80% depreciation per year).

  ii. Non – Commercial/Domestic Establishments:
     - 60% of total system cost or Rs. 6600 per sqm capacity of the system, whichever is minimum, for FPC system.
     - 60% of total system cost or Rs. 6000 per sqm capacity of the system, whichever is minimum, for ETC system

- Simple Payback Calculation:

Financial Analysis of the SWH System	
Capacity of the SWH system (sqm)	A
Solar Fraction (%)	B
Annual expenditure on fuel/electricity in water heating (Rs)	C
Annual Saving (Rs)	D = B*C
Total cost of the system (Rs)	E
Subsidy Applicable (Rs)	F
System cost (Net off subsidy) (Rs)	G = E – F
Income tax benefit from accelerated depreciation (Rs)	H = 30% of G
Annual O&M cost of SWH system (Rs)	I
Simple Pay Back Period (in year)	J = (G – H)/(D – I)

A Sample Prefeasibility Report

Details of Project Beneficiary

Name	
Address	Nanital, Uttarakhand
Phone No	
Type of establishment	Hotel
Commercial/Non-Commercial	Commercial
Reason for considering SWH	Reducing Diesel consumption in water heating

Site & Resource Assessment

Bathrooms	34 Bathrooms • 3 suits with bath tubs • 13 suits with tap & shower • 18 double occupancy rooms with tap & shower
Kitchen	Dishwashing Purposes
TDS/water quality	Water is slightly hard (300 – 315 ppm)
Space availability	Sufficient shadow free south facing space on the roof (slanted Tin roof)

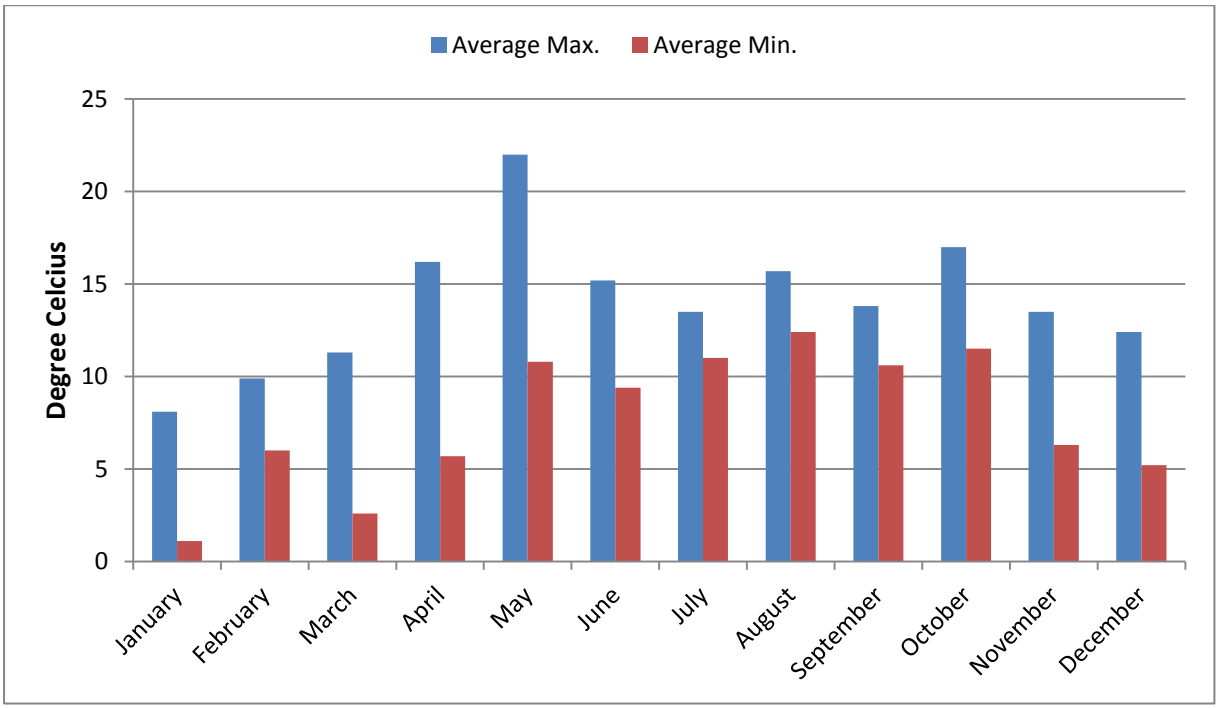


Figure 33: Ambient temperature of Nanital (Min & Max) (Source: www.meoweather.com)

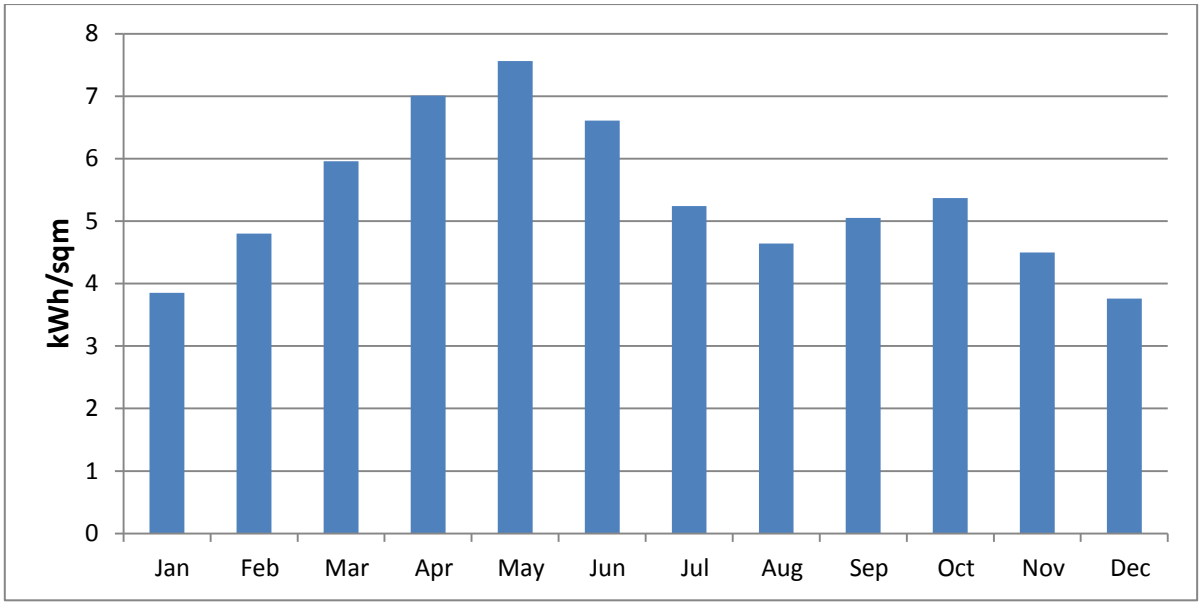


Figure 34: Monthly average Global Horizontal Irradiation at Nanital (Source: www.synergyenviron.com)

Hot Water Demand Assessment

No. of Rooms			34 Bathrooms • 3 suits with bath tubs • 13 suits with tap & shower • 18 double occupancy rooms with tap & shower			
Kitchen Requirement (At 40^{0}C)			400 lpd			
Laundry Requirement (At 40^{0}C)			Nil			
Hot water Demand (At 40^{0}C)			Norm • 300 LPD for suits with bath tubs • 200 LPD for suits with tap & shower • 150 LPD for double occupancy rooms			
Total hot water demand (At 40^{0}C)			• 300 X 3 = 900 lpd • 200 X 13 = 2600 lpd • 150 X 18 = 2700 lpd Total Hot Water demand = 6600 lpd			
Present Hot Water Generation Method			Diesel Boiler and electric geysers			
Occupancy	JAN	FEB	MAR	APR	MAY	JUNE
	15 %	20 %	30 %	40 %	75 %	95 %
	JULY	AUG	SEP	OCT	NOV	DEC
	50 %	40 %	40 %	50 %	50 %	45 %

SWH System Sizing

RET Screen software is used to determine the size of SWH system. No. of collectors required for FPC SWH system is estimated to achieve a solar fraction of 60-65%.

No. of collectors	34
Capacity of the System (sqm)	68
Capacity of the System (lpd)	3400
Shadow free area required (sqm)	102

Availability of required shadow free are on roof top (Yes/No)	Yes
SWH System Size (sqm)	**68**
Solar Fraction	**64%**

Design & Specification of SWH System

Thermo siphon/ Forced	Forced – Flow System
Capacity of the system	68 sqm (34 collectors of 2 sqm each) OR
Slope of the Collectors	37^0 - 42^0
Orientation of Collectors	South Facing
Type of Flow Circuit	Indirect Flow (Heat Exchanger System)
Type of System	Non – Pressurized
Hot Water Storage Tank	*Capacity of Tank* • 3400 Liter *Material of Construction* • Stainless Steel - 304 (Thickness: 2.5 – 3.0 mm) *Insulation* • PUF (CFC Free)(Thickness: 50 mm)(Density: 28-32 Kg/cum) OR • Rock Wool (Thickness: 50 mm) OR • Glass Wool (Thickness: 50 mm) *Cladding* • Aluminum (SWG 24)
Hot Water Piping including return line	*Type of Pipe* • Composite/G.I. Pipe *Insulation* • PUF (CFC Free)(Thickness: 50 mm)(Density: 28-32 Kg/cum) OR • Rock Wool (Thickness: 50 mm) OR • Glass Wool (Thickness: 50 mm) OR • Nitrile Rubber (Thickness: 12 mm) *Cladding* • Aluminum (SWG 24)
Cold Water Pipeline	*Type of Pipe* • Composite/G.I. Pipe
Other Civil Works	• Framed Structure • Grouting of collectors & tanks
Other Accessories	*Valves & Pumps* • Non Return Valves • Gate Valves • Air release Valve • Circulation Pump *Others* • Sacrificial Anode • Make up water (tank 34 ltr.) • Protection from monkeys.
Back-up system	Integration of SWH system with existing Diesel boiler system.

Estimation of Savings from SWH system

No of Collectors	34
Capacity of the System (sqm)	68
Solar Fraction	64%
Annual Diesel Consumption (liter/year)	5831
Diesel Saved (liter/year)	3732
Rebate in Electricity Bil (Rs/year)	40800
Annual Savings (Rs/year)	**Rs. 2,04,000**

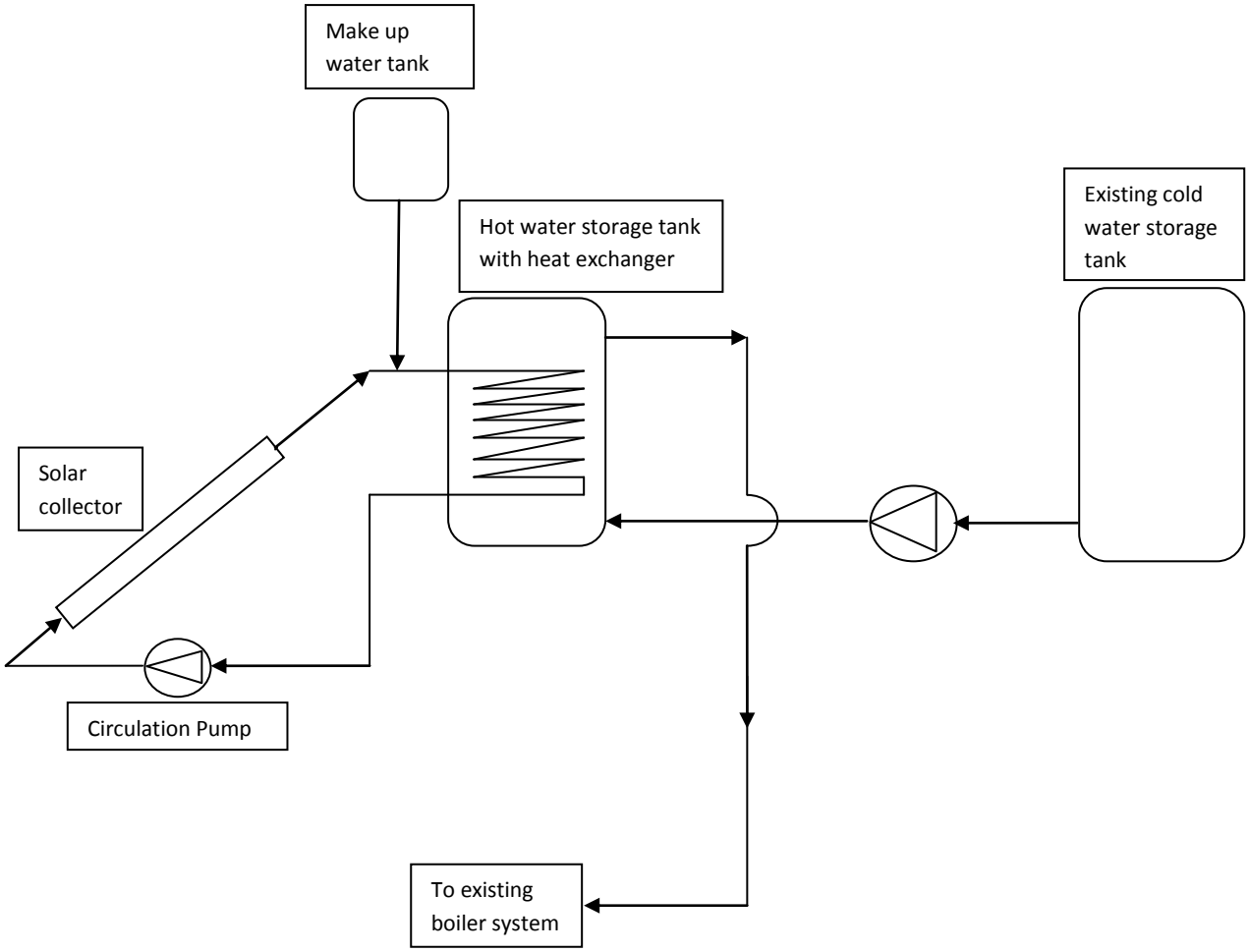
Total cost of the system

Cost of Hardware (Collector, Tank, Heat Exchanger)	Rs.5,78,000
Cost of Piping and Insulation of lines	Rs.50,000
Cost of Civil Work and other Accessories (Angle Frame)	Rs.1,70,000
Cost of Transport, Haulage and Installation	Rs.85,000
Miscellaneous Costs, Valves, Pumps, Controls and Accessories	Rs.1,00,000
Taxes (VAT@5%)	Rs.49,150
Total cost of the System	**Rs.10,32,150**

Financial Analysis

Subsidy Norm (Rs/sqm)	Rs.3,300
Subsidy amount as per sqm installed	Rs.2,24,400
Subsidy amount as 30%/60% of project cost	Rs.3,47,145
Applicable subsidy from MNRE	**Rs.2,24,400**
Net System Cost (Net off subsidy)	**Rs.8,07,750**
Income tax savings from Depreciation Benefit (80% accelerated depreciation benefit)	Rs.2,42,325
Annual Savings	Rs.2,04,000
Annual operation & maintenance cost	Rs.25,000
Payback period (Years)	**3.2**
IRR	**31.1%**

Schematic Diagram



MNRE National Programme on Solar Water Heating

The Ministry of New and Renewable Energy is implementing a National Programme on Solar Water Heating aimed at peak shaving, conservation of electricity and fossil fuels and providing a clean, non-polluting solution for water heating in housing, institutional, commercial and industrial sectors. Various promotional incentives in the form of capital subsidy or interest subsidy are available for solar water heating projects under the Jawaharlal Nehru National Solar Mission (JNNSM). A target of 20 million sq.m. collector area has been set for solar thermal projects for 2022 under JNNSM.

UNDP/UNEP/GEF "Global Solar Water Heating Market Transformation and Strengthening Initiative"

The India Country Project on solar water heating has been taken up under a UNDP/UNEP/GEF "Global Solar Water Heating Market Transformation and Strengthening Initiative". The Ministry of New and Renewable Energy, Government of India, is implementing the Project in the context of its National Programme. The objective of the project is to accelerate and sustain the solar water heating market growth in India and to use the experiences and lessons learned in promoting a similar growth in other countries. The project will contribute partially and leverage the 11th Plan target through installation of two million sq. m. of solar water heating systems. This will result in GHG Emission Reduction of 11 million tonnes of CO_2.

Greentech Knowledge Solutions Pvt Ltd

Greentech Knowledge Solutions Pvt. Ltd. (GKSPL) offers research and consultancy services for deployment of energy efficiency and renewable energy solutions. Solar thermal is a focus area of work at GKSPL. GKSPL is credited with conducting the first-ever market assessment study on solar water heating in India. GKSPL has been actively working for the promotion and deployment of Solar Water Heating in industrial, commercial, institutional and residential sectors. The range of services offered include: feasibility studies, Detailed Project Report (DPR) preparation, project management support, market research, policy advice and training services.

For more information, please contact

Dr A K Singhal National Project Manager Global Solar Water Heating Project, Ministry of New & Renewable Energy, Block 14, CGO Complex, Lodi Road, New Delhi – 110003 Telefax: 011 – 24362488	Dr Sameer Maithel Director Greentech Knowledge Solutions Pvt Ltd. 342, Abhiyan Apartments, Plot 15, Sector 12, Dwarka, New Delhi – 110078 E-mail: sameer@gkspl.in Mobile: +91 9811392256 Web: www.gkspl.in