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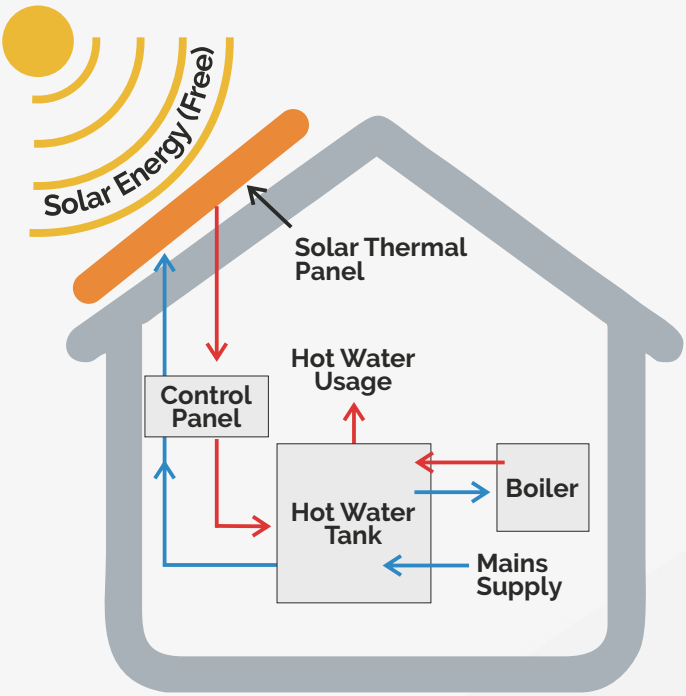
Swiss Agency for Development and Cooperation SDC

IIEC International Institute for Energy Conservation
eds MEGHRAJ BASE

Solar Thermal Technology

A solar thermal system works by harnessing the sun's energy and converting it into heat which is then transferred into home or businesses heating system as hot water or space heating. Solar thermal panels are used in conjunction with a boiler, collector or immersion heater. The solar collector will use the sun's rays to heat a transfer fluid which is a mixture of water and glycol, to prevent the water from freezing in the winter. The heated water from the collectors is pumped to a heat exchanger inside a water cylinder.

After the liquid releases its heat, the water will flow back to the collectors for reheating. A controller will ensure that the fluid will circulate to the collector when there is sufficient heat available. Solar thermal technology is proven, reliable and low maintenance.



Solar Thermal Application and Potential End Use

Output energy	Application	Suitable Building type	Specific requirement
Heat (Hot Water, Low Pressure steam)	Domestic hot water, Cooking, laundry, cleaning, space heating	Residential, Hotel, Hospital, Hostels, institutes	Shadow free rooftop area

Benefits of Solar Thermal

Solar thermal offers compelling benefits to building owners and/or tenants.

(a) **No, or reduced, dependence on fuels that need to be transported to the site:** As an on-site renewable energy technology, solar thermal can replace other fuels normally used for heating purposes, such as oil, natural gas, LPG, coal, biomass and electricity. This can be of special importance, where transportation of fuel is cumbersome and/or costly.

(b) **Applicable everywhere:** Thermosiphon (Thermosiphon (or thermosyphon) is a method of passive heat exchange, based on natural convection, which circulates a fluid without the necessity of a mechanical pump. Thermosiphoning is used for circulation of liquids and volatile gases in heating and cooling applications such as heat pumps, water heaters, boilers and furnaces) systems using natural convection can be deployed even without access to electricity. This makes them especially interesting in off-grid (e.g. rural) regions and where power outages occur frequently. The storage tank of these systems also brings security of water supply at locations with poor water supply.

(c) **Healthier environment:** Local air pollutants from (water) heating systems are a major hazard to health in many countries. By avoiding or reducing the need to burn (fossil) fuels, solar thermal can help create a healthier environment.

(d) **Public support:** In many countries, governments support the installation of solar thermal systems with financial incentives (direct grants, cheap loans, tax incentives etc.). Home owners and developers can benefit from financial support by installing a solar thermal system.

(e) MNRE has been implementing the scheme on 'Off-grid and Decentralized Solar Applications' since May 2014. The scheme was continued as 'Off-Grid and Decentralized Concentrated Solar Thermal (CST) Technologies for Community Cooking, Process Heat, Space Heating & Cooling Applications in Industrial, Institutional and Commercial Establishments' from 2017-18 till 2019-20 for the promotion of CST projects for off-grid solar thermal applications. Ministry was providing Central Financial Assistance (CFA) of 30% of the benchmark cost or the total project cost, whichever is lesser for projects in all states and 60% of the benchmark cost or the total project cost, whichever is lesser for projects in Non-profit making bodies or institutions in special category states. **This was a priority for MNRE however the scheme has been discountinued now.**

Solar Thermal Cooling

Solar thermal energy power stations may also be used for cooling: this refers to either cooling buildings (air conditioning) or industrial processes (refrigeration). Through evaporation and condensation, the solar thermal energy is processed as cold.

There are open and closed systems. Most widely used are closed systems like absorption refrigeration machines and open cooling and dehumidifying processes, such as sorption-supported air conditioning.

Solar Thermal Heating

Solar heating is the utilisation of solar energy to provide process heat, especially in crop drying, water heating, cooking or space heating and cooling.

The technology of solar thermal water heaters is present worldwide and significant deployments occur already in emerging economies and developing countries. Technologies include glazed flat plate collectors, evacuated tube collectors, and lower-temperature swimming-pool heaters made from plastic tubes.

Table below shows Solar Thermal based system installed in India for space cooling

A typical system of 30-ton capacity for commercial complexes and institutions require about 250–300 sq. m. of CST area depending on the type of technology used which may cost around Rs 60–70 lakh. This system should be able to save 18,000–22,000 litre of diesel per year depending on the solar radiation available at the place of installation. It should be able to recover its cost in 5–6 years at the current price of diesel at the rate of Rs 55 per litre.

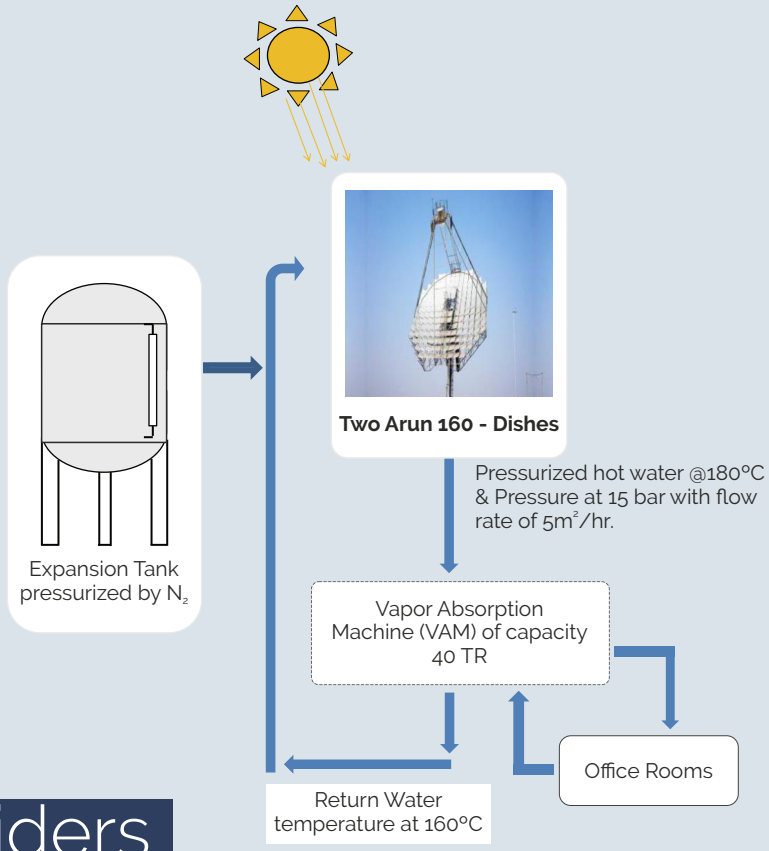
Place	Capacity in TR & type of VAM	Type and size of solar field	Solar heat fed to VAM	Year of installation & Manufacturer	Solar Cost (Rs in Lakhs)
NPCIL, Kota, Rajasthan	100 TR with triple effect VAM	100 nos of PTC, 641 m^2	Pressurized water at 17 bar and 200°C	2013 (Thermal)	245
Honeywell Tech. Hyderabad	100 TR with triple effect VAM	128 nos of PTC, 821 m^2	Pressurized hot water at 17 bar and 165°C	2013 (Thermal)	213
NTPC, Noida, UP	50 TR with 2-day storage and double effect VAM	2 nos of Arun 160,338 m^2	Stream at 15 bar and 170°C	2012 (Clique Solar)	250
Turbo Energy Ltd. Chennai	50 TR with double effect VAM	2 nos of Arun 160,338 m^2	Pressurized water at 15 bar and 180°C	2011 (Clique Solar)	80
Civil Hospital, Thane	212 TR (160 TR with VAM and 52 desiccant cooling) double effect VAM)	150 nos of Scheffler Dishes, 2040 m^2	Stream at 7 bar and 150°C	2011 (Sharda Inv.)	399

Solar Assisted Cooling using Arun Dish

The first cooling system assisted by ARUN solar boiler has been installed at the office building of Turbo Energy Limited (TEL), Paiyanoor, which is about an hour's drive from Chennai. TEL is a leading manufacturer and supplier of turbochargers to many Automobile Manufacturers in India. TEL has successfully installed one ARUN solar boiler system for fulfilling its hot water requirements for operating a Vapor Absorption Machine (VAM) for air-conditioning/comfort cooling for its administrative block. It is in the process of installing another dish for increasing its air-conditioning capacity. The process of hot water generation for operating the Vapor Absorption Machine for air-conditioning with the help of ARUN solar boiler is as explained in the figure on the right.

Description of schematic:

The vapor absorption machine (VAM) installed at TEL, is hot water driven. Pressurized water at 180˚C is required for the machine to operate at an optimal level. The return temperature of the hot water is 160 ˚C. The machine with 40 TR capacity requires 5 m^3/hr of the pressurized hot water which can be catered to by 2 ARUN dishes. The solar circuit is kept pressurized at 15 bar using the nitrogen pressurization system. The nitrogen cylinders are connected to the expansion tank in the circuit for this purpose. The cooling system is used for air conditioning of the administration office at the plant.



Technology Providers in India

- Ascent Solar Thermal Pvt. Ltd.
- Greenergize India
- Solar Power Solutions Pvt. Ltd.