

Frequently Asked Questions (FAQs)

Solar Thermal and Concentrated Solar Thermal (CST) Technologies



Q1. What is Solar Thermal Energy and Solar Thermal Systems?

Solar thermal energy is the heat obtained from sunlight. Unlike solar PV panels, which convert sunlight into electricity, solar thermal systems use sunlight to produce useful heat.

This heat can be used for:

- Hot water
- Steam generation
- Drying
- Cooking
- Washing and cleaning
- Industrial process heat
- Space heating
- In some systems, cooling

Q2. What is Concentrated Solar Thermal (CST)?

Concentrated Solar Thermal (CST) is a technology that uses mirrors or reflective surfaces to concentrate sunlight onto a receiver.

The concentrated sunlight heats a working fluid (water or thermic fluid), which can then provide heat directly to an industrial process or generate steam.

Simple principle:

Sunlight → Mirrors/Reflector/Concentrators → Concentrated Heat → Hot Fluid/Steam → Industrial Process

Q3. What is the difference between Solar PV and Solar Thermal?

Solar PV	Solar Thermal / CST
Converts sunlight into electricity	Converts sunlight into heat
Produces electrical energy	Produces thermal energy
Used for electrical loads	Used mainly for heating processes
Requires electrical equipment	Uses thermal equipment such as collectors/concentrators pumps and heat exchangers
Suitable for all electrical appliances like lighting, fan, motors, electronics, etc.	Suitable for hot water, steam, drying, washing, cooking and process heat

Example:

If a factory needs electricity to run a motor, PV may be suitable. If it needs hot water or steam for a process, solar thermal is more appropriate.

Q4. What temperature can a solar thermal system provide?

It depends on the technology. Broadly:

Solar thermal technology	Indicative temperature range*
Flat Plate Collector	~ 30 – 90°C
Evacuated Tube Collector	~ 50 – 150°C
Compound Parabolic Concentrator (CPC)	~ 80 – 200°C
Parabolic Trough	~150 – 500°C
Linear Fresnel	~ 150 – 400°C
Paraboloid Dish Reflector	> 500°C
Fixed Focus Elliptical (Scheffler) Dish	Up to 200°C

*Actual operating temperatures depend on system design, solar conditions, heat-transfer fluid and application.

Q5. Can CST be used in small and medium-sized industries (MSMEs)?

Yes. CST can be used for MSME industries. Systems can be designed for specific processes.

MSMEs can consider CST when they have:

- Regular thermal energy demand
- Significant fossil fuel consumption
- Suitable roof or ground area
- Good solar radiation
- Daytime operations
- Appropriate process temperatures

Q6. What types of industrial processes can use CST?

CST is particularly useful where an industry requires low- to medium-temperature heat. Potential applications include:

- Food processing
- Dairy
- Textile
- Dyeing
- Pharmaceutical
- FMCG
- Chemical
- Paper and pulp
- Agro-processing
- Tea processing
- Tannery/Leather
- Spices and food drying
- Fish / seafood processing
- Jute processing

- Rubber processing
- Timber/Wood/Plywood
- Metal processing
- Engineering and Steel fabrication
- Cleaning and washing
- Hotels and hospitals

The actual suitability depends on the process temperature, heat demand, operating hours and available solar resource.

Q7. Why should an industry use solar thermal when it already has electricity?

An industry does not only utilise electricity but heat also. Therefore, solar thermal is feasible for any such industry. For example, a factory may use electricity for motors but to generate steam or hot water, may use:

- Coal
- LPG
- Diesel
- Furnace oil
- Natural gas
- Biomass

Solar thermal can replace a portion of these fuels and therefore reduce fuel consumption, energy costs and emissions.

Q8. Can CST work when there is no sunlight?

A solar thermal system produces heat primarily when solar radiation is available. However, this does not necessarily mean the industrial process must stop when the sun goes behind the cloud or at night time operation.

Systems can incorporate:

- Thermal Energy Storage (TES)
- Hot-water storage

Solar supplies as much heat as possible, while the backup system provides the remaining requirement.

Q9. What happens on cloudy or rainy days?

CST performance decreases when solar radiation decreases. However, the impact depends on the technology and weather conditions. The system can be designed with:

- Thermal storage
- Backup heating
- Hybrid operation
- Appropriate system sizing

During periods of low solar availability: CST output ↓ → Conventional heating system compensates.

The system can therefore continue meeting the process requirement even when solar production is low. Proper system design should analyse monthly and seasonal solar availability, rather than relying only on annual average radiation.

Q10. Does CST require a lot of area?

It depends on the required thermal capacity and the CST technology. The required area depends on:

- Solar radiation
- Collector efficiency
- Required temperature
- Daily heat demand
- Operating hours
- Storage requirement
- System design

A simple way to understand it is:

Higher heat demand → Larger collector field → More area required

During feasibility assessment, the available shadow-free area should therefore be checked before selecting the technology.

Q11. How much money can an industry save by installing CST?

There is no single answer because savings depend on the existing fuel and operating conditions.

A simplified calculation is: *Annual Fuel Cost Saving = Fuel Displaced × Fuel Price*

For example, if a solar thermal system displaces 10,000 litres of furnace oil per year, and furnace oil costs ₹70/litre:

Annual fuel saving = 10,000 × ₹70 = ₹7,00,000/year

Q12. Is CST expensive to install?

CST generally requires a higher initial investment than conventional fuel-based heating equipment. However, as sunlight is free, there is no fuel cost. Therefore, CST should be evaluated based on its life-cycle economics, rather than only the initial cost.

Important financial indicators include:

- Capital cost
- Annual fuel savings
- Operation & maintenance cost
- Payback period
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Cost of useful thermal energy

Q13. How long does it take to recover the investment?

The payback period varies significantly from project to project.

A simple calculation is:

$$\text{Simple Payback Period} = \text{Initial Investment} \div \text{Annual Net Savings}$$

For example:

- Investment = ₹50 lakh
- Annual net saving = ₹10 lakh

Payback = ₹50 lakh ÷ ₹10 lakh = 5 years

Actual project economics should include degradation, maintenance, financing costs, fuel-price escalation and system lifetime.

Q14. Can CST generate steam for industrial processes?

Yes. Steam generation is one of the important industrial applications of CST.

CST can be integrated with steam systems through configurations such as:

- Solar steam generation
- Solar-assisted boiler feedwater heating
- Solar steam generation combined with thermal storage

Q15. Can CST directly replace the existing boiler in an MSME?

Usually, it is better to initially consider CST as a solar heat source integrated with the existing heating system, rather than assuming that it will completely replace the boiler.

Q16. Can CST be used for heating water?

Yes, and this is one of the simplest applications. Solar thermal can heat water for:

- Hotels
- Hospitals
- Hostels
- Canteens
- Food processing
- Dairy
- Laundries
- Cleaning operations
- Industrial washing

Solar hot-water systems can be particularly attractive where there is a large and regular hot-water demand during daytime.

Q17. Can CST be used for drying agricultural or industrial products?

Yes. Solar thermal systems can provide controlled hot air for drying applications.

Potential products include:

- Fruits
- Vegetables
- Spices
- Herbs
- Grains
- Tea
- Food products
- Fish/seafood processing
- Leather
- Timber/wood/plywood
- Jute products
- Industrial materials

Compared with open-air drying, controlled solar drying can offer better temperature control, hygiene, drying time and product quality.

Q18. What maintenance does a CST system require?

CST systems require regular maintenance, although the requirements vary by technology.

Typical activities include:

- Cleaning mirrors/collectors/concentrator
- Checking pumps
- Checking valves and piping
- Inspecting insulation
- Checking heat-transfer fluids
- Checking control systems
- Inspecting structural components
- Monitoring temperatures and pressures

Mirror/collector/concentrator cleaning is particularly important because dust and dirt reduce the amount of sunlight reaching the receiver.

Q19. What safety issues should MSMEs consider when installing and operating CST?

CST systems involve concentrated solar energy and potentially high-temperature fluids and pressures.

Important safety considerations include:

- High-temperature surfaces
- Pressurised systems
- Hot heat-transfer fluids
- Steam hazards
- Pump and piping failures
- Over-temperature conditions
- Over-pressure conditions
- Tracking-system movement
- Electrical hazards
- Working at height
- Fire risks
- Emergency shutdown

The system should include appropriate:

- Pressure-relief devices
- Temperature sensors
- Flow sensors
- Emergency shutdown mechanisms
- Isolation valves
- Control logic
- Safety interlocks
- Appropriate insulation
- Warning signs and restricted-access zones

Operator training is equally important. A technically appropriate CST plant can still perform poorly if plant personnel do not understand its operation and safety systems.

Q20. How do I know whether CST is suitable for my industry?

A simple **CST feasibility assessment** should be carried out before investing. The assessment should examine:

- Heat demand:** How much heat/steam does the facility require?
- Temperature requirement:** What temperature does the process need?
- Existing fuel:** What fuel is currently being used?
- Fuel consumption:** How much fuel is consumed annually?
- Operating hours:** Does the process operate during daylight hours?
- Solar resource:** How much sunlight is available at the site?
- Available area:** Is sufficient shadow-free space available?
- System integration:** Can CST be connected to the existing heating/boiler system?
- Economics:** What is the investment, savings and payback period?
- Backup requirement:** What happens when solar energy is unavailable?

After the collection of the right inputs to these questions, it should be realised “Can CST economically and reliably meet a useful portion of my existing heat demand?”. If yes, CST should be installed.