



BLUE STAR

Solar Air Conditioning & Industrial Heating Solutions



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Solar Air Conditioning Products & Services

Blue Star designs, installs, integrates and maintains turnkey solutions for complex industrial solar thermal and cooling needs



CURRENT SOLUTIONS

Solar Industrial Air Conditioning
Solar Industrial Hot Water/Steam

FUTURE SOLUTIONS

Solar Industrial Cold Storage & Refrigeration
Radiant Comfort Cooling Systems
Ceramic-based Heat Storage Systems
Residential Hybrid Air Conditioning



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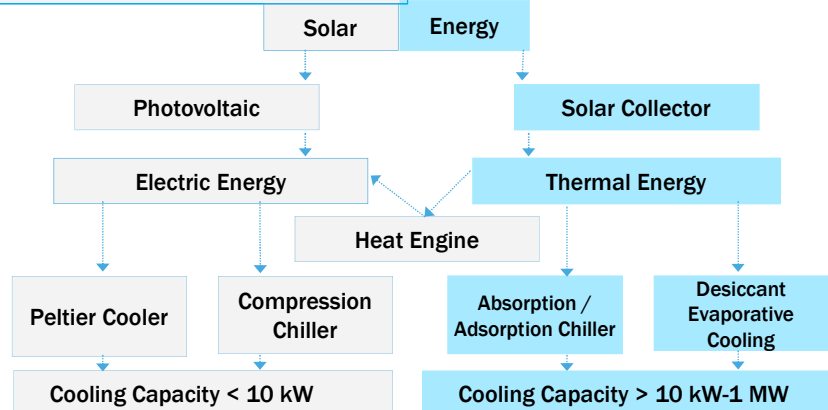
- Solar Air Conditioning Solutions
- Industrial Heating Solutions



Solar Thermal Air Conditioning & Solar Photovoltaic

Solar Photovoltaic (PV) Air Conditioning

Solar Thermal Air Conditioning



Different types of Solar Thermal Collectors

Non-concentrating collector systems

Flat plate collector

- Operational temp: 55 - 60° C
- Efficiency: 20 - 25%
- Not effective in diffused or rainy conditions



Evacuated tube collector

- Operation temperature: 80 - 120° C
- Efficiency: 35 - 45%
- Partially effective collector under diffused and rainy conditions



Concentrating collector systems

Parabolic trough collector

- Operational temp: 100 - 200° C
- Efficiency: 55% (at 200° C)
- Not effective in diffused or rainy conditions



Linear Fresnel collector

- Operation temp: > 200° C
- Efficiency: 50 - 55%
- Not effective under diffused and rainy conditions



Compact Linear Fresnel Solar Mirror System

Dish collector

- Operation temp: > 250° C
- Efficiency: 50 - 60%
- Not effective under diffused and rainy conditions



Efficient Solar Collectors

Blue Star uses two types of efficient solar thermal collectors:

1. Evacuated tubes (ETC) with Compound Parabolic Reflector (CPC) Patented Design producing water @ 98 deg C .
2. Thermal Vacuum based collectors producing water @ 200 deg C

▪ Both solar collectors used by Blue Star can produce enough hot water to run the air conditioning chiller for 340 days in a year in India

▪ 2 times more efficient than other collectors



Evacuated tubes (ETC) with Compound Parabolic Reflector (CPC) patented design

- Used to produce solar hot water up to 98*celsius for:
 - Solar air conditioning for small & medium capacity requirement of up to 500 TR & where roof space is not a constraint
 - Medium temperature requirement of process hot water
- A highly reflecting, weather-proof CPC increases efficiency
- Special mirror geometry ensures both direct and diffused sunlight falls on absorber
- No south adjustment mounting area or tracking required
- Can be mounted with very little inclination



Solar Collectors offered by Blue Star



In order to increase the efficiency of the evacuated tubes, a highly reflecting, weather-proof CPC-reflector (Compound Parabolic Concentrator) is placed behind the evacuated tubes.

•The special mirror geometry ensures that even at unfavourable irradiation angles direct and diffuse sunlight falls onto the absorber.





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Solar Air Conditioning Advantage

- State-of-the-art technology using thermal energy
- Taps heat from the sun using sophisticated solar heat collectors
- Solar energy used to generate chilled water for air conditioning
- Power-hungry compressors replaced by simple pumps
- Saves as much as 85 percent on power costs in the process
- Most suited for use with Vapour Absorption and Adsorption Chillers



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Benefits of Solar Air Conditioning

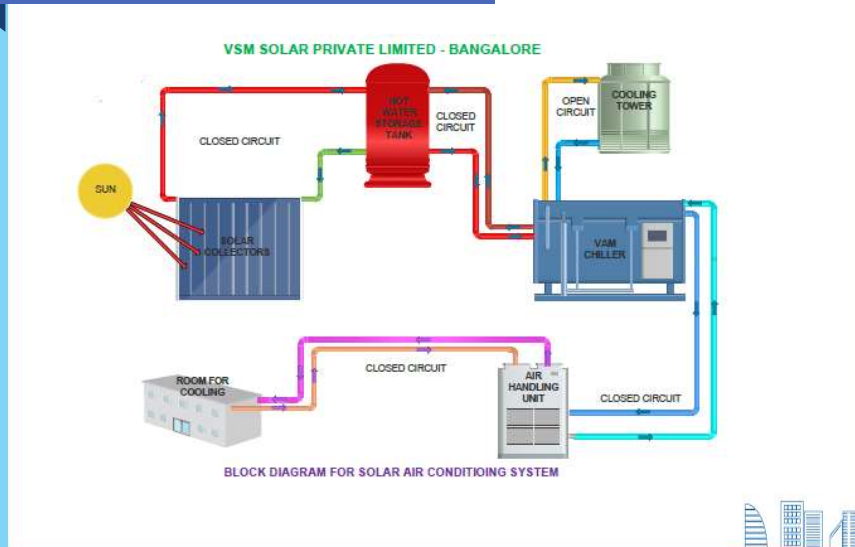
- Substantial power saving over conventional systems: The enormous power ensures the equipment pays back for itself in three years.
- Blue Star's solar air conditioning systems have a working lifespan of 20 years as opposed to less than 10 of conventional air conditioning systems. The savings accumulate to a phenomenal sum over the entire life of the plant.
- Green building certification: Green building audits award high scores to systems that use renewable energy and increase energy-efficiency. Blue Star's solar air conditioning systems are therefore the ideal choice in buildings that are aiming for Platinum or Gold Green Building certification.
- Subsidy benefits: Government offers 25% subsidy on capital investment into solar air conditioning. Additionally, soft loans are arranged at low interest rates for another 50% of the cost of such equipment.





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Solar Air Conditioning System



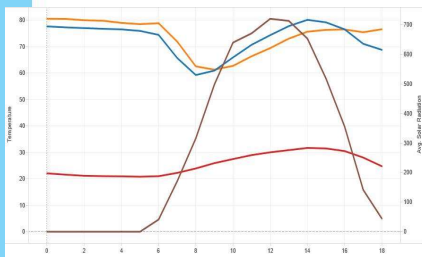
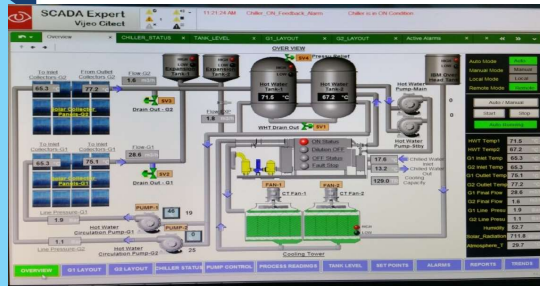
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Efficient and Customised Absorption Chillers



- The technology uses state-of-the-art Absorption Chillers with unique auto-purging and safety features to avoid crystallisation & longer life span (25 years)
- Through a unique design and integration services, we have the flexibility to integrate alternate customer preferred chillers.

Solar Thermal Air Conditioning - Monitoring Systems



- End-to-end remote monitoring platform for our systems enabling the real-time measurement of performance
- Trend graphs and reports, help predict problems before they occur and drive continuous improvement
- Performance levels and metrics backed by ongoing maintenance contracts that ensure customers system runs optimally over many years

Alternatives for cooling during non- sunshine hours

Following options can be alternatives during non-sunshine hours.

- Existing electrical chiller is used as back up.
- Provide back up electrical chillers.
- Provide electrical heaters in the hot water storage tank to heat the water and run the absorption chiller for cooling.
- Provide thermal storage system for storing hot and chilled water to run the absorption chiller for cooling.



Solar Thermal vs Solar Photovoltaic (PV)

A solar thermal system is much more efficient as compared to a solar PV power generation system:

- Hot climate which is detrimental to the efficiency of a PV system helps in improving the output of a solar thermal system
- PV system occupies around three times more space as compared to an equivalent solar thermal system
- Solar thermal system also ensures higher power savings over PV system. Savings on power ensures that the equipment pays back for itself in just one and a half years
- Solar thermal system absorbs heat energy unlike solar PV which uses sunlight, ensuring the system functions around the year and not only during months when sunlight is available.



Solar Thermal vs Conventional– Pay back period is < 4 years

DELHI - SOLAR AIR CONDITIONING 250 TR TYPICAL						
Pay back years	3	Years	4	months		
Saving over the life cycle of 20 years	1,400.7	Rs. Lakhs				
SOLAR AIR CONDITIONING (Rs in Lacs)						
Year	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
CAPEX for setting up the system - Refer sheet "Capex"	-848.28					
Government (MNRE) Subsidy - Refer sheet "Capex"		180.79				
Tax saving-40% Depreciation-considered-Refer sheet "Capex"		104.85	62.91	37.75	22.65	13.59
Saving in the Cost of Conventional Chiller	75.00					
Saving in reduction of electrical systems	150.00					
Savings/ (Incremental cost) on account of CAPEX	-623.28	285.64	62.91	37.75	22.65	13.59
Payment for the soft loan-Interest		-31.88	31.88	26.57	21.25	15.94
Payment for the Bridge loan-Interest		-21.70				
Interest cost @10% on the investment		-62.33	28.56	6.29	3.77	2.26
Net Saving/(Incremental Cost) on account of CAPEX	-623.28	169.74	123.35	70.60	47.67	31.79
Savings/ (Incremental) OPEX: (Refer sheet "Opex")						
Electricity Savings		84.10	84.10	84.10	84.10	84.10
Savings through Maintenance		1.58	1.58	1.58	1.58	1.58
Savings/ (Incremental cost) on account of OPEX		85.68	85.68	85.68	85.68	85.68
Interest cost on saving		-8.57	-8.57	-8.57	-8.57	-8.57
Net Savings/ (Incremental cost) on account of OPEX		77.11	77.11	77.11	77.11	77.11
Payback and Savings	-623.28	-376.44	-175.98	-28.27	96.52	205.42

Advantages of Solar Air Conditioning vs Conventional Air Conditioning



		Conventional Air Conditioning System	Rating	Solar Air Conditioning System	Rating	Advantages of Solar Air Conditioning
Opex and Saving	Power source	Uses vapour compression chiller that uses electrical energy as the power source		Uses vapour absorption system that uses solar heated water as the power source	✓	Results in 85 - 90% saving in the consumption of electrical energy
	Maintenance	High due to the vapour compressor		Low as there are no moving parts but for a few pumps	✓	Results in lower maintenance costs
Eco Friendliness	Refrigerant	Uses refrigerants that are not so eco friendly ODP/ GWP	✓	Uses water as refrigerant, which is the most neutral medium ever	✓	No ozone layer depletion
Capex and Recurring cost	Initial Investment	Low		High	✓	Due to high saving in electrical power consumption, the pay back period is less than 5 years over the life of 20 years
	Life	Life of compression chillers around 8 to 10 years only - requires replacement		Life of around 20 years		

Advantages of Steam Generation through Solar Thermal



- High-temperature water & steam generated while using the technology is of great utility in various industries, including automobile, textile, dairy, solar cooking, and healthcare.
- Hot water generated can be used extensively in baths, kitchens, laboratories, raw material treatment plants & production lines.
- Solar thermal steam system consist of arrays of evacuated tube collectors, connected in a row, to generate thermal heat & store it in the form of hot water up to 200*celsius in a pressurised hot water tank of suitable capacity.
- Hot water at 180 - 200*celsius remains liquid at pressures above 15 bar. Pressurising is executed & maintained by an expansion vessel connected to a HWT.
- A suitable high pressure pump circulates water from the HWT to the array of collectors. The pump is a variable discharge pump to ensure, increased amounts of hot water gets circulated when the solar irradiation is more.



Industrial Heating Solutions - Solar thermal steam generation

- Steam generated through solar thermal air conditioning is highly efficient as compared to solar PV technology where Solar energy is converted to electricity & then to heat energy, reducing the efficiency as compared to the solar thermal heating where there is a direct conversion.
- In an urban setting wherein there are huge space constraints, solar thermal collectors are apt since they occupy lesser space as compared to solar PV cells.
- Solar thermal pays back for itself in around 3 years, extremely low as compared to the other fuels used in industrial heating solutions.



Thermal Vacuum based collectors heating water @ 200 deg C

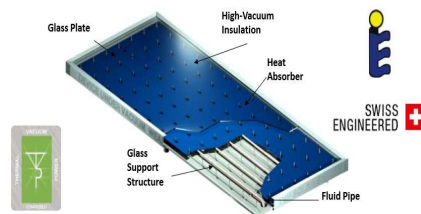
▪Used to produce hot water up to 200*celsius at high pressures of 16 - 20 bar, for:

- Solar air conditioning of higher capacities of 500 TR (1750kW cooling)
- Steam requirement in industrial processes
- Solar desalination processes
- Solar cooking
- Solar cold storage

▪Combines high-vacuum insulation and planar layout in solar thermal panel

▪Collects both direct and diffused light

▪High performance at competitive cost





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Select List of Installations

- IBM , manyata tech park , Bangalore – 225 TR
- Guj State Electricity Corp , Gandhinaga – 150 TR
- Swiss Embassy , New Delhi – 60 TR
- INTEL Bangalore
- IISc Bangalore
- APL Global School , Chennai
- L&T Mumbai
- VSM Solar Bangalore
- Rajgiri Hospital , Cochin



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Summary

**Blue Star brings you
Solar Air Conditioning & Industrial Heating
with state-of-the-art and proven technology resulting in**

- Enormous power saving (~85 percent)
- Very long plant life (> 20 years)
- Low pay back time (~3 years)

