

# PRODUCT APPLICATION NOTES

## SPACE HEATING

# PCM Based Space Heating

PLUSS has designed a PCM integrated room heating system which is capable of providing thermal comfort in high altitude areas where temperature during night falls to as low as  $-20^{\circ}\text{C}$ . The system works for 24 hours by maintaining the room temperature in the range of  $15\text{-}30^{\circ}\text{C}$  throughout the day and night.

## What is the need?

Today's tech savvy world is completely dependent on fossil fuels.

- Comfort travelling to luxury offices; transportation of agriculture produce to mouth-watering food products, all of us are dependent on non-renewable fossil fuels.
- Thermal comfort in Cold Regions: There are finite numbers of systems in northern India for passive solar heating and solar water heaters but fail to provide thermal comfort and hot water during non-sunshine hours.
- 52% of total pollutants are suspended in atmosphere as a result of burning wood and kerosene to keep bodies warm in cold weather conditions.
- Electricity demand has risen by 43% from 2010 to 2014 because of centrally air conditioned luxury hotel, malls and offices. All these factors count to total global warming we all are facing today.

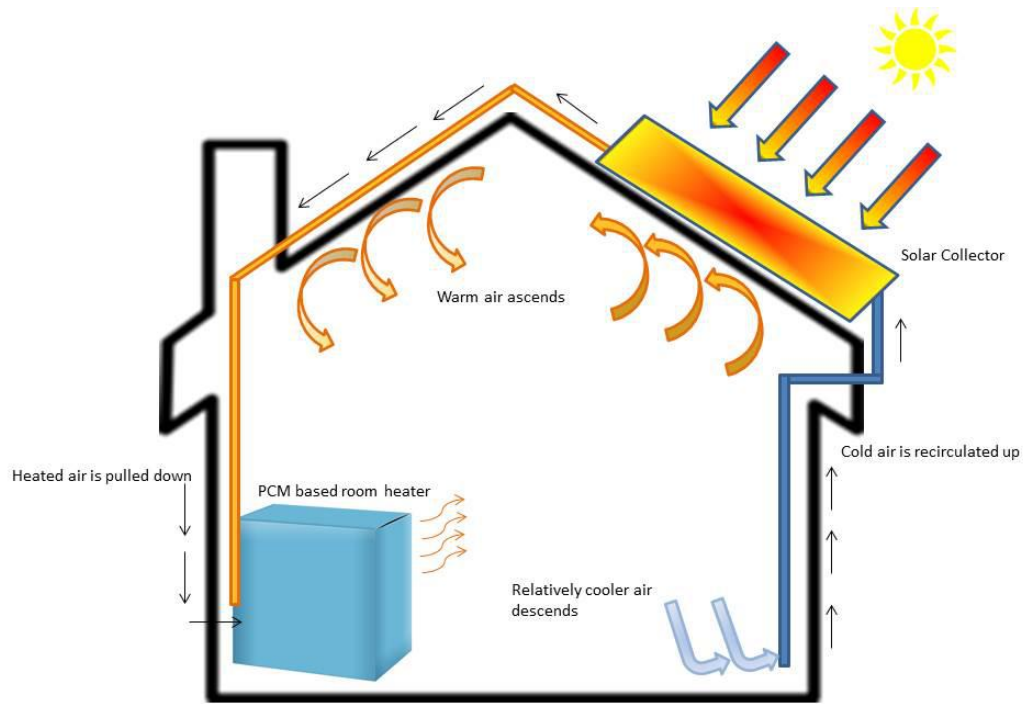
While it is inevitable to stop the growing use of technology and hence the growing energy demand, it is certainly possible to substitute to cleaner energy sources and gradually phase out the use of fossil fuels.

PCM technology makes this substitution possible in energy guzzling applications related to heating ventilation and air conditioning. Whether it is refrigeration requirement for mobility, buildings or processes; PCMs enable efficient usage of energy by thermal storage.

## How it works?

1. During daytime, excess heat pulled by duct fan from the solar collector, allows PCM to melt.
2. Residual heat in the air controls the temperature in the room.
3. During off-sunshine hours, air passage is diverted to allow the air circulation within the room. This prevents heat losses from the room to the ambient by blocking the entrance of outside cold air.
4. Heat collected in the PCM controls the temperature inside the room by preventing temperature drop up to  $15^{\circ}\text{C}$  until 7a.m. in the morning.
5. Overall system provides thermal comfort for 24 hours within the human-comfort temperature range of  $15\text{-}25^{\circ}\text{C}$  even when the ambient is  $-20^{\circ}\text{C}$ .

It is an effective way to fill in the gaps of energy supply and demand by utilizing renewable energy source like solar energy, heat storage (thermal energy storage or TES) and passive heating technologies.



Schematic representation for working of PCM based space heating process.

## Components:-

This system has three components:

1. **Evacuated tube collector (ETC)** based solar air collector: Evacuated tubes act as solar collector. Radiations collected from solar collector heats up the tube which then heats up the air in contact with it.
2. **Duct fan:** Suction created by duct fan pulls the hot air from the solar air collector and pushes to the heat exchanger with PCM.
3. **PCM heat exchanger:** PCM heat exchanger is a crucial part of the whole system. Design of heat exchanger is such that the hot air pushed through the duct fans, comes in direct contact with PCM encapsulated in HDPE panels.

⇒ The unique layout of PCM within the heat exchanger allows easy charging and discharging of PCM with small openings at the top that allows air to spread evenly in the room thereby heating up the space.

*\*Please note that all the above components are the core components for a PCM based space heating system. Apart from these, there are additional components like the room dimension and insulation wall thickness play major roles in determining the heat exchanger sizing and thereby the performance of the entire system.*

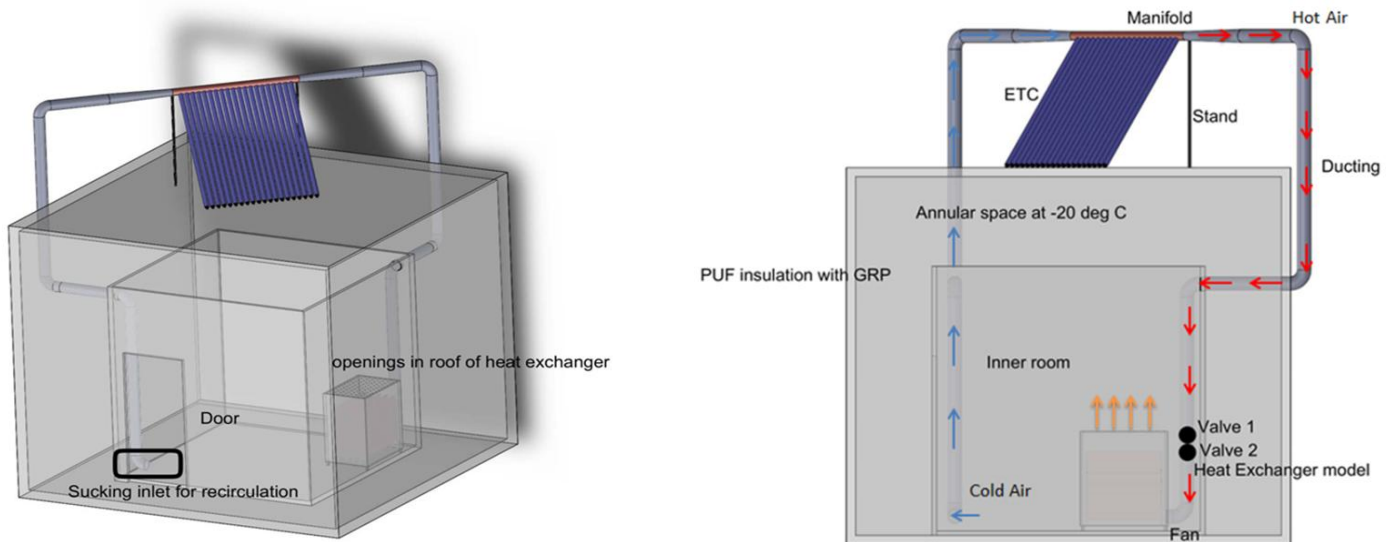
Project 1: PCM based Space Heating at Bawal, Haryana - 2018.

◆ Specifications:

S.No.	Parameters	Specifications
1.	Total amount of PCM	95 kg
2.	Room Size	3m x 3m x 3m
3.	Room-wall thickness (PUF insulation)	60mm
4.	Target Temperature inside the room	15° - 20°C
5.	Constant ambient temperature	-20°C

Detailed specifications of the involved components

◆ Photographs:

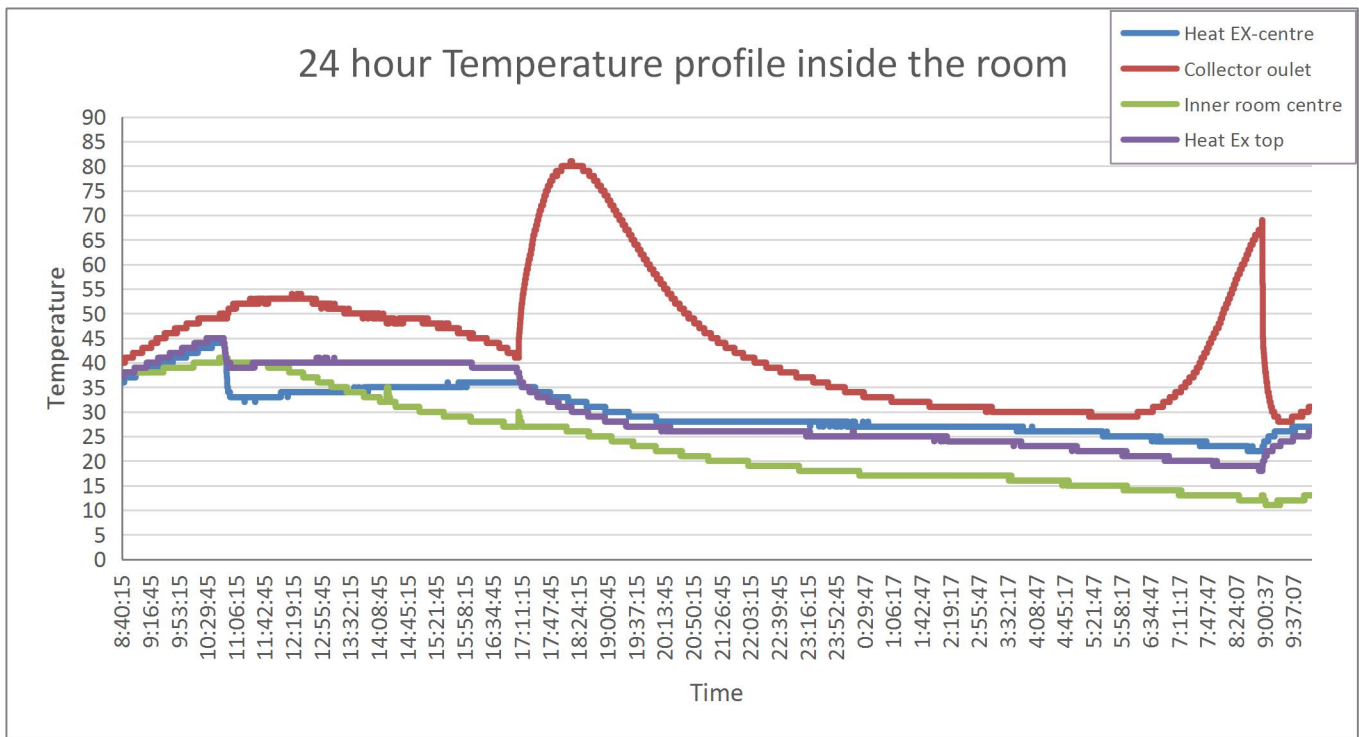


3D View



Actual view of the Space Heating at PLUSS premises, Bawal, Haryana

◆ Temperature profile:



Actual test results of temperature inside the room when ambient is -20°C

**Project 2: PCM based Space Heating at IIT Mandi, Himachal Pradesh : 2019**

◆ **Specifications:**

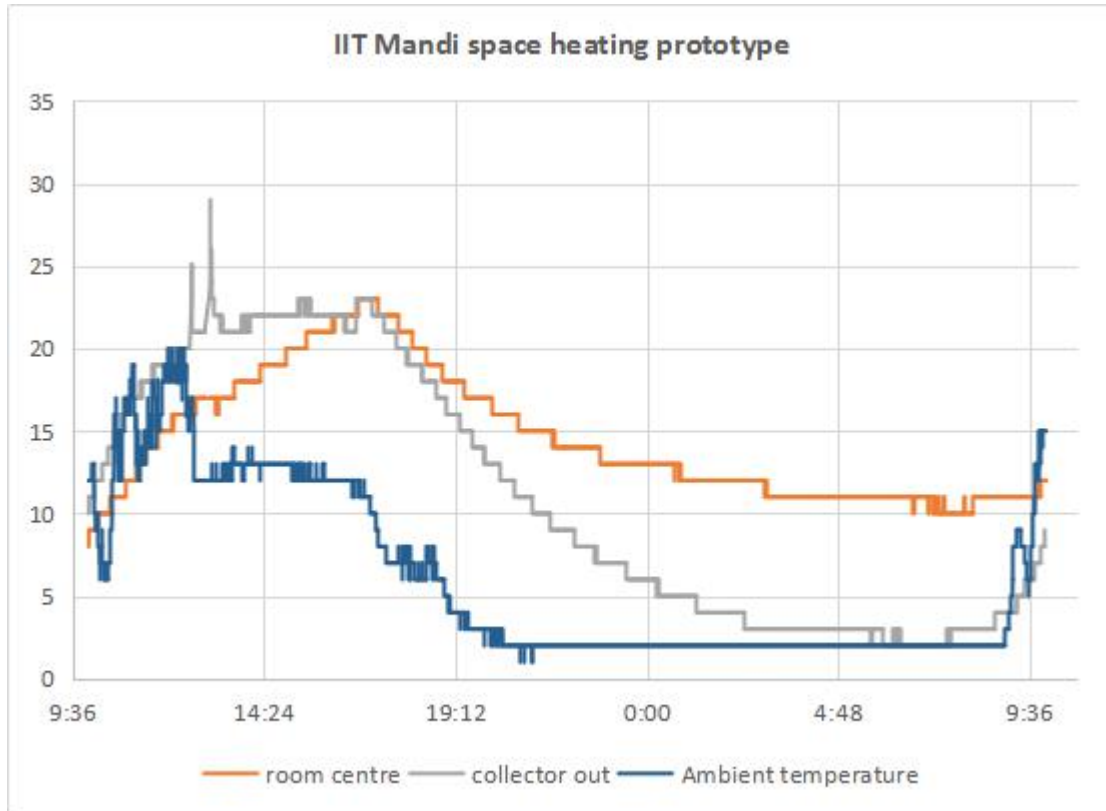
S.No.	Parameters	Specifications
1.	Total amount of PCM	110 kg
2.	Room Size	3m x 3m x 3m
3.	Room-wall thickness (PUF insulation)	60mm
4.	Target Temperature inside the room	15° - 20°C
5.	Constant ambient temperature	-4 to 0°C

◆ **Photographs:**



Actual view of the Space Heating at IIT Mandi, Himachal Pradesh

◆ Temperature profile:



Actual test results of temperature inside the room when ambient is 0 to 2°C

## Advantages over conventional space heaters

1. Operational during non-sun hours: Integrating a PCM enables the solar space heater to provide warm air even when there is no sun.
2. Low operational or running cost: As solar energy is free and in abundance, there is almost no or very low operational cost.
3. Efficient: Good solar collectors can convert approximately 80% of the falling radiation into useful energy.
4. Space-efficient: Generally solar photovoltaics are placed above the roof of the room; hence only the PCM or TES bank is kept inside the room.
5. Environment-friendly: There is no element of non-renewable fuel and hence no chance of emitting CO<sub>2</sub> emissions.
6. Payback period is within 2 years, after which it will be a complete saving.

Such a room heating system may have high installation costs initially, but for a long term, it is a better investment due to its small payback time-period.

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