



**"CHANGING PHASES,
CHANGING FUTURES:
PHASE CHANGE MATERIALS
IN THE FIGHT AGAINST AIR
POLLUTION"**



LIQUID TO SOLID (& back)



INTRODUCTION

Air pollution poses a significant threat to public health and the environment worldwide. With increasing urbanization and industrialization, finding effective solutions to combat air pollution has become imperative. In this presentation, we explore an innovative approach utilizing **phase change materials (PCMs)** to mitigate air pollution and create cleaner environments.



INTRO TO PHASE CHANGE MATERIAL

Phase change materials are substances capable of storing and releasing large amounts of energy during phase transitions, such as from solid to liquid or liquid to gas, and vice versa. Organic materials used as phase change material tend to be polymers with long-chain molecules composed primarily of carbon and hydrogen.

Properties of Phase Change Materials:

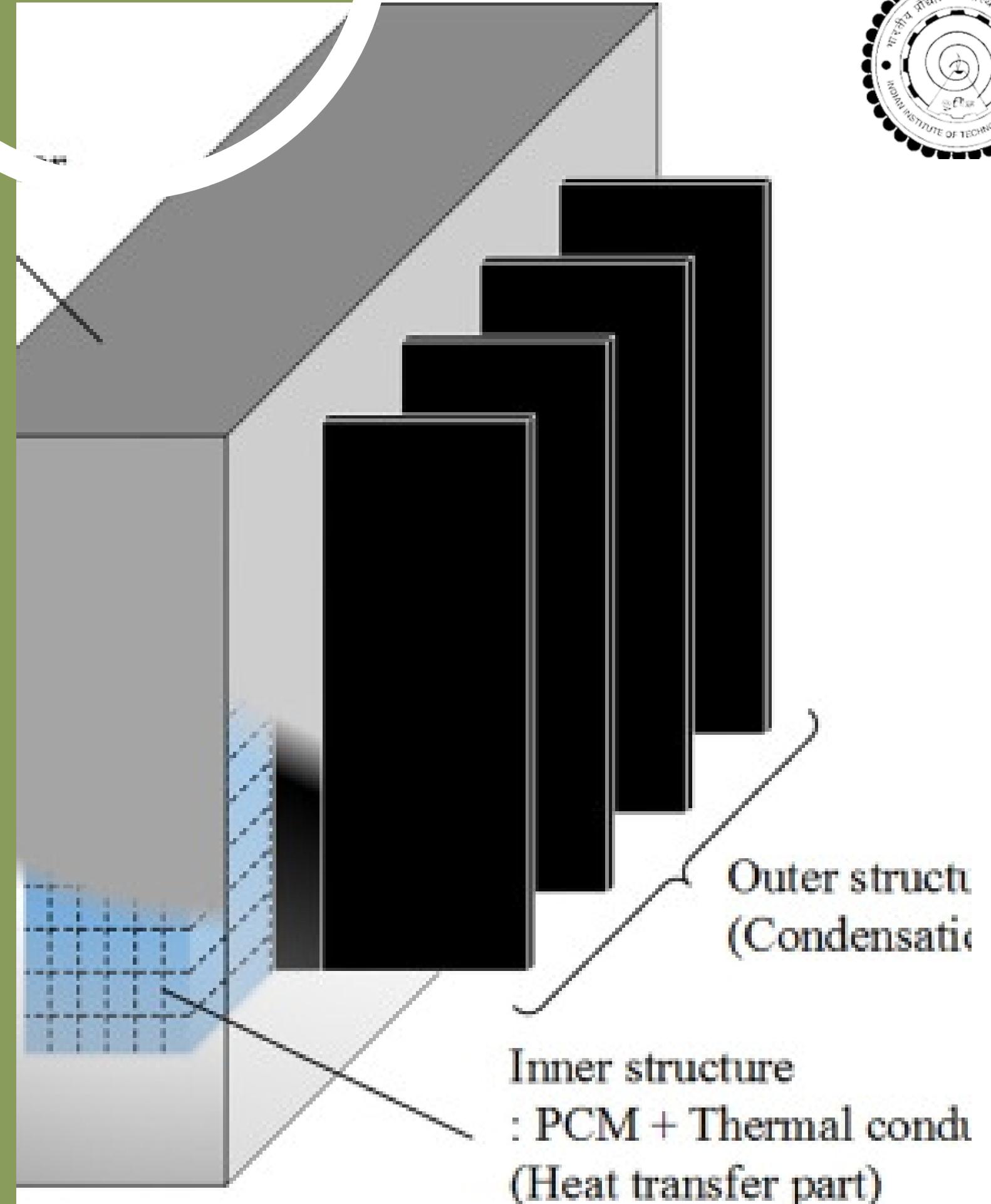
- **Melting point and freezing point:** Determine the temperature range at which the phase transition occurs.
- **Latent heat of fusion:** Identify the amount of heat absorbed or released during the phase transition.
- **Thermal conductivity:** Assess how efficiently heat is transferred through the material.
- **Stability and durability:** Evaluate the material's ability to withstand repeated phase transitions and environmental conditions.



HOW THEY REDUCE AIR POLLUTION

Thermal Energy Storage:

Many air pollution control processes, such as thermal oxidizers and catalytic converters, generate heat as they operate. PCMs can act as thermal energy storage mediums, absorbing excess heat produced during these processes. By stabilizing temperatures, PCMs can enhance the efficiency and effectiveness of air pollution control technologies, leading to better pollutant removal and lower energy consumption.





Energy efficient

Energy Storage and Efficiency: By incorporating phase change materials into building materials like walls, roofs, and windows, it's possible to regulate indoor temperatures more effectively. This reduces the reliance on heating and cooling systems powered by fossil fuels, thus lowering greenhouse gas emissions associated with energy consumption.

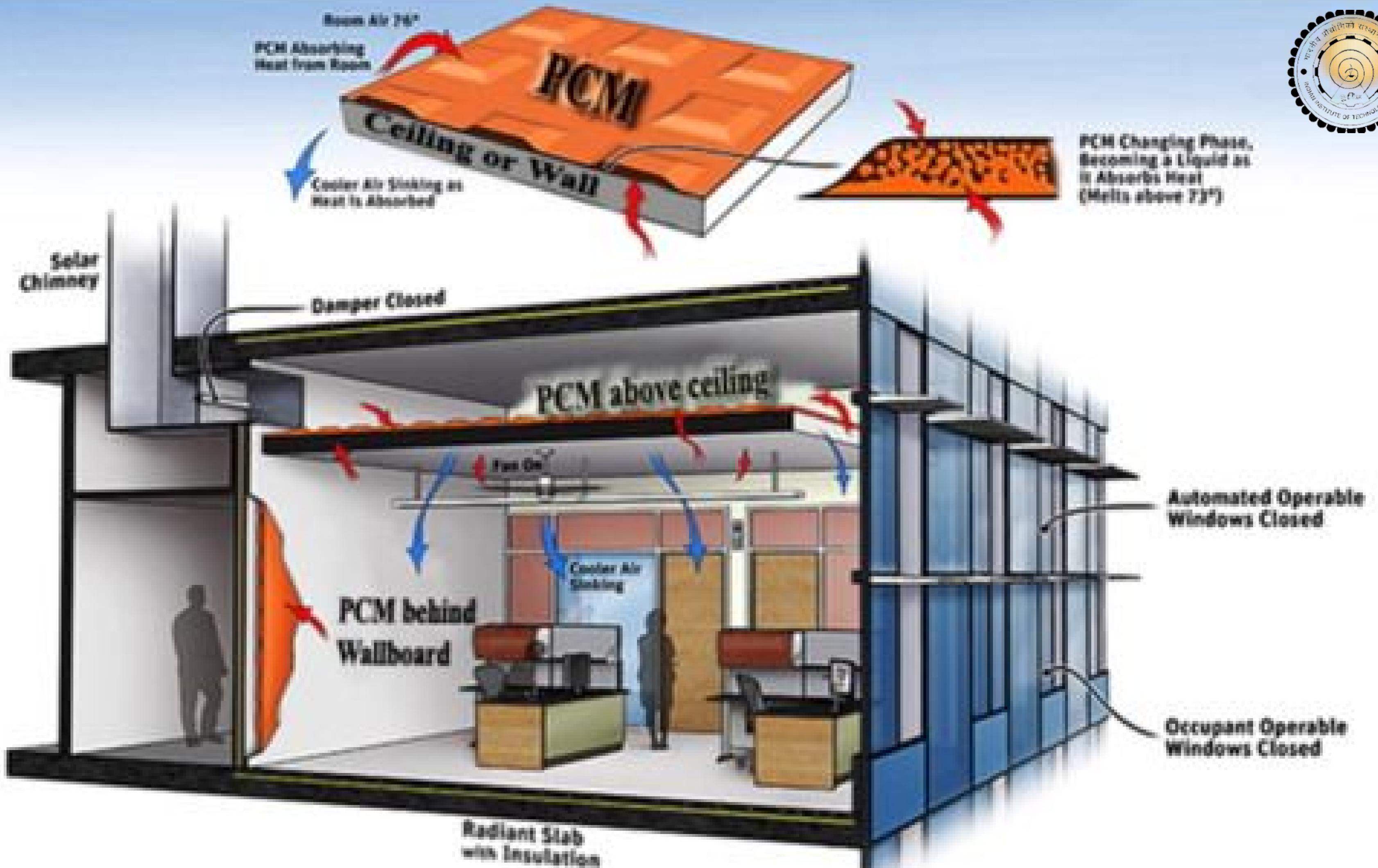
In Vehicles

Vehicle Emission Reduction: PCM-based heat storage systems can be implemented in vehicles to capture and store waste heat from engines or exhaust systems. This captured heat can then be utilized to improve fuel efficiency or power auxiliary systems, thereby reducing overall emissions.



OTHER USES

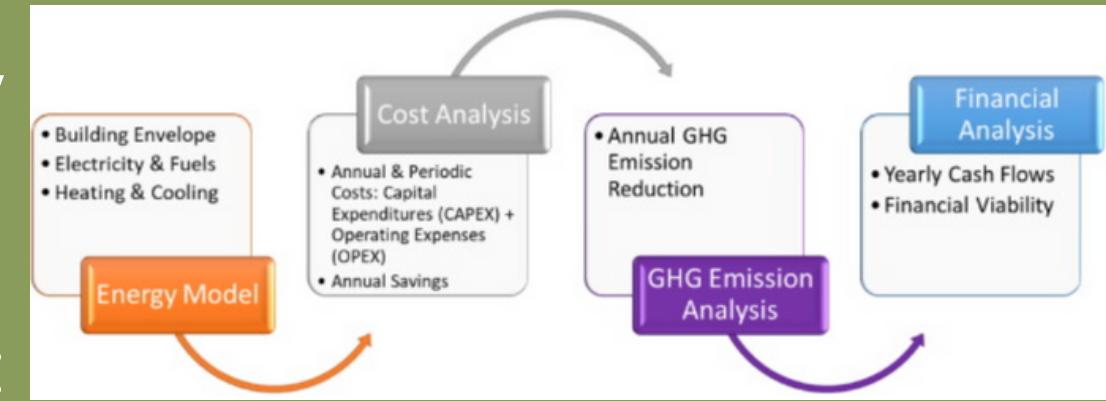
- 1. Air Quality Control in Indoor Environments:** PCM-based ventilation systems can help regulate indoor air quality by capturing and neutralizing pollutants. By controlling temperature and humidity levels effectively, PCM systems can also inhibit the growth of mold and bacteria, further improving indoor air quality.
- 2. Carbon Capture and Storage:** Some phase change materials have the ability to absorb and store carbon dioxide (CO₂) from the atmosphere or flue gases. These materials can be utilized in carbon capture and storage (CCS) technologies to mitigate greenhouse gas emissions from industrial processes and power plants.
- 3. Waste Heat Recovery:** PCMs can be employed in waste heat recovery systems to capture and reuse heat generated by various industrial processes. This not only improves energy efficiency but also reduces the need for additional energy inputs, thereby lowering overall emissions.





Economic Viability and Feasibility

Consideration of cost implications and economic viability of PCM solutions:



1. Energy Efficiency: PCM technologies can enhance energy efficiency in heating, cooling, and air pollution control processes, resulting in cost savings over time.
2. Long-Term Savings: While PCMs may require initial investments, their ability to reduce energy consumption and improve system performance can lead to long-term economic benefits.
3. Lifecycle Analysis: Conducting a lifecycle analysis can assess the overall economic and environmental impacts of PCM technologies, considering costs and benefits throughout their entire lifespan.
4. Market Demand: With increasing awareness of air pollution issues and regulatory incentives for pollution control, there is growing market demand for innovative solutions like PCMs.
5. Cost-Benefit Analysis: Quantifying the environmental benefits and avoided costs associated with air pollution reduction can demonstrate the economic value of PCM solutions.

FEASIBILITY

1. Technical Feasibility:

- Assess if PCM technologies align with project goals and are compatible with existing infrastructure.

2. Economic Feasibility:

- Evaluate upfront costs versus long-term savings and potential revenue streams.

3. Environmental Feasibility:

- Consider PCM's impact on air quality improvement and overall sustainability.

4. Market Feasibility:

- Analyze market demand, competition, and regulatory support for PCM solutions.

5. Social Feasibility:

- Address societal concerns and assess community acceptance of PCM implementation.



Real-world and environmental impacts of implementing phase change materials

Air Quality Improvement:
PCM technologies have the potential to reduce emissions of pollutants such as sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and particulate matter (PM), thereby improving local and regional air quality.

Health Benefits:

By reducing air pollution levels, PCM solutions can mitigate adverse health effects associated with poor air quality, such as respiratory diseases, cardiovascular problems, and premature mortality, leading to improved public health outcomes.

Climate Change Mitigation:

By lowering energy demand and reducing emissions of greenhouse gases and other air pollutants, PCM technologies contribute to mitigating climate change and promoting sustainable development.



"PHASE CHANGE MATERIALS OFFER A TRANSFORMATIVE SOLUTION TO COMBAT AIR POLLUTION, TURNING CHALLENGES INTO OPPORTUNITIES AND PAVING THE WAY FOR A CLEANER, HEALTHIER FUTURE."