

# **Phase Change Materials Market - Global Industry Size, Share, Trends, Opportunity, and Forecast, Segmented By Product (Paraffin, Salt Hydrates, Eutectics, Non-Paraffin, Others), By Application (Building and Construction, Heating Ventilation and Air Conditioning (HVAC) Systems, Energy Storage Management, Commercial Refrigeration, Cold Chain and Packaging, Textiles, Others), By Region and Competition, 2019-2029F**

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## **Abstracts**

Global Phase Change Materials Market was valued at USD 1.47 billion in 2023 and is anticipated to project steady growth in the forecast period with a CAGR of 4.23% through 2029. The primary drivers of the global phase change materials market stem from an increasing emphasis on energy efficiency and sustainability. PCMs play a pivotal role in curbing energy consumption and carbon emissions by enhancing the thermal performance of buildings, appliances, and industrial processes. By absorbing excess heat during peak periods and releasing it when temperatures drop, PCMs contribute to maintaining comfortable indoor environments and reducing reliance on mechanical heating and cooling systems, leading to substantial energy savings and environmental advantages.

The construction sector significantly propels the growth of the global phase change materials market. PCMs are increasingly integrated into building materials like insulation, wallboards, and roofing materials to elevate thermal comfort and energy efficiency in residential, commercial, and industrial structures. By regulating indoor temperatures and curbing heat transfer through walls and roofs, PCMs contribute

decreased energy expenses, heightened occupant comfort, and the promotion of sustainable building practices.

Also, the electronics and automotive industries are key contributors to the demand for phase change materials in thermal management applications. With the ongoing miniaturization and heightened power density of electronic devices and components, efficient thermal management is imperative to prevent overheating and ensure reliable performance. PCMs offer a compact and efficient solution for thermal management in electronic devices, such as smartphones, laptops, and electric vehicles, by absorbing and dissipating excess heat during operation. The escalating adoption of renewable energy sources like solar and wind power fuels demand for phase change materials in thermal energy storage applications. PCMs are utilized to store and release thermal energy in solar thermal systems, concentrating solar power plants, and solar water heaters, enabling efficient and dependable energy storage for electricity generation and heating purposes.

## Key Market Drivers

### Growth in Construction Industry

The primary factors propelling the demand for PCMs in the construction industry is the growing emphasis on energy-efficient building designs and green building standards. With increasing awareness of the environmental impact of buildings, architects, developers, and builders are seeking innovative solutions to enhance energy performance and reduce operational costs. PCMs offer a viable solution by optimizing thermal management, minimizing heating and cooling loads, and maintaining comfortable indoor temperatures year-round, aligning with the principles of sustainable building design.

Also, stringent energy efficiency regulations and building codes are driving the adoption of PCMs in construction projects worldwide. Many countries and regions have implemented stringent energy performance standards and sustainability certifications, such as LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method), which incentivize the use of energy-efficient building materials and technologies like PCMs. Compliance with these regulations and certifications requires the integration of PCMs into building envelopes, insulation systems, and HVAC (heating, ventilation, and air conditioning) systems to improve thermal performance and reduce energy consumption.

The increasing demand for green and smart buildings is driving the integration of PCMs into building materials and systems. PCMs are incorporated into insulation, wallboards, roofing materials, and HVAC systems to enhance thermal comfort, reduce energy costs, and achieve sustainability goals. Additionally, the rise of smart building technologies and energy management systems enables real-time monitoring and control of PCM-based thermal storage systems, optimizing energy usage and maximizing efficiency in building operations.

### Surge in Technological Advancements

Technological advancements have led to the development of advanced PCM formulations with tailored phase transition temperatures, improved thermal properties, and enhanced durability. These innovative formulations expand the range of applications for phase change materials and offer solutions optimized for specific temperature ranges and operating conditions.

Nanoencapsulation and microencapsulation technologies are revolutionizing the delivery and performance of phase change materials. These advanced encapsulation techniques enable the incorporation of PCM into a wide range of materials, including fabrics, building materials, and electronics, while maintaining their integrity and enhancing their thermal properties.

The integration of smart technologies such as sensors, actuators, and control systems is transforming PCM systems into intelligent solutions for thermal management. Smart PCM systems can dynamically adjust phase change temperatures, optimize energy storage and release, and respond to changing environmental conditions, offering enhanced flexibility and efficiency in various applications.

Technological advancements are driving the integration of phase change materials into building materials such as concrete, insulation, and roofing materials. PCM-enhanced building materials offer superior thermal performance, reduce energy consumption for heating and cooling, and contribute to sustainable building designs that prioritize energy efficiency and occupant comfort.

### Key Market Challenges

#### Disruptions in Supply Chain

The COVID-19 pandemic has exacerbated disruptions in the PCM supply chain, causing supply shortages, production delays, and logistical challenges. The pandemic-induced lockdowns, travel restrictions, and labor shortages have disrupted manufacturing operations, raw material sourcing, and transportation networks, leading to supply chain bottlenecks and disruptions. As a result, manufacturers and end-users of PCMs have faced challenges in sourcing raw materials, fulfilling orders, and meeting project deadlines.

PCMs are manufactured using a variety of raw materials, including paraffins, fatty acids, bio-based materials, and inorganic salts. Disruptions in the supply chain for these raw materials, such as shortages, price volatility, and supply constraints, can impact PCM production and availability. Fluctuations in raw material prices and availability can affect production costs, profit margins, and pricing strategies for PCM manufacturers, influencing market dynamics and competitiveness.

The transportation and logistics sector plays a crucial role in the PCM supply chain, facilitating the movement of raw materials, intermediate products, and finished goods across regions and countries. However, disruptions in transportation networks, port closures, customs delays, and freight capacity constraints can impede the timely delivery of PCM products to customers. Logistical challenges and transportation delays increase lead times, affect inventory management, and disrupt supply chain operations, posing challenges for PCM manufacturers and end-users.

## Key Market Trends

### Expansion of Cold Chain Logistics

The growing demand for temperature-sensitive products, including perishable food items, vaccines, biologics, and specialty chemicals, is driving the need for reliable cold chain logistics solutions. PCM-based technologies offer an effective means of maintaining the required temperature range throughout the supply chain, ensuring product quality and compliance with regulatory standards.

The food and beverage industry is experiencing a heightened focus on food safety, quality, and shelf-life extension. PCM solutions play a critical role in preserving the freshness, nutritional value, and sensory attributes of perishable foods by preventing temperature fluctuations during storage and transportation.

The pharmaceutical industry relies heavily on cold chain logistics to maintain the

efficacy and stability of temperature-sensitive drugs and vaccines. PCM-based thermal packaging solutions are increasingly adopted to ensure the integrity of pharmaceutical products during transit, especially in regions with challenging environmental conditions.

PCM technologies are gaining traction due to their environmental benefits, including energy efficiency and reduced carbon footprint. PCM-based cold chain solutions offer a sustainable alternative to traditional refrigeration systems, leading to lower energy consumption and greenhouse gas emissions.

Ongoing advancements in PCM formulations, packaging designs, and application methods are driving innovation in the market. Manufacturers are developing new PCM products with enhanced thermal properties, improved durability, and compatibility with various packaging materials, thereby expanding their applicability in cold chain logistics.

## Segmental Insights

### Product Insights

Based on the category of product, the paraffin segment emerged as the dominant player in the global market for phase change materials in 2023. Paraffin exhibits excellent thermal stability over a wide temperature range, making it suitable for various applications requiring precise temperature control. Its stable phase change characteristics ensure reliable thermal energy storage and release, contributing to its dominance in the PCM market.

Paraffin-based PCMs have a high latent heat storage capacity, meaning they can absorb and release large amounts of thermal energy during phase transitions. This high heat storage capacity makes paraffin an efficient and effective material for storing thermal energy in applications such as building insulation, HVAC systems, and solar thermal energy storage.

Paraffin is a relatively low-cost material compared to other PCM options, making it a cost-effective choice for various applications. Its affordability makes it an attractive option for large-scale deployment in commercial and industrial projects, driving its dominance in the PCM market.

## Regional Insights

Europe emerged as the dominant region in the Global Phase Change Materials Market in 2023, holding the largest market share in terms of value. Europe has been at the forefront of implementing stringent building energy efficiency regulations and standards to reduce energy consumption and carbon emissions in the construction sector. PCMs are widely used in building materials such as insulation, wallboards, and roofing systems to improve thermal comfort and energy efficiency in buildings. The strong emphasis on energy-efficient building design and construction has driven the demand for PCMs in Europe, making it a dominant market for PCM applications in the construction industry.

European governments have implemented supportive policies, incentives, and funding programs to promote the adoption of renewable energy technologies and energy-efficient solutions, including PCMs. Programs such as the European Union's Horizon 2020 initiative, the Energy Efficiency Directive, and national building codes incentivize the use of PCM-enhanced building materials and energy storage systems in residential, commercial, and institutional buildings. These policies create a favorable regulatory environment and drive market growth for PCMs in Europe.

Europe boasts a robust research and development infrastructure with leading academic institutions, research centers, and industry collaborations focused on PCM technologies. European research initiatives such as the European Technology Platform on Renewable Heating and Cooling (RHC-Platform) and the European Energy Research Alliance (EERA) support collaborative research, innovation, and knowledge exchange in the field of PCMs. The region's strong R&D capabilities drive technological advancements, product innovation, and market leadership in PCM applications across various sectors.

### Key Market Players

Henkel AG & Co. KGaA

Honeywell International.Inc.

Croda International Plc

PureTemp LLC

Laird Limited

Rubitherm Technologies GmbH

PCM Products Ltd

Climator Sweden AB

Shin-Etsu Chemicals Co., Ltd.

Dongguan Gu%li%Heng plastic technology co., LTD

### Report Scope:

In this report, the Global Phase Change Materials Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

#### Phase Change Materials Market, By Product:

Paraffin

Salt Hydrates

Eutectics

Non-Paraffin

Others

#### Phase Change Materials Market, By Application:

Building and Construction

Heating Ventilation and Air Conditioning (HVAC) Systems

Energy Storage Management

Commercial Refrigeration



Cold Chain and Packaging

Textiles

Others

Phase Change Materials Market, By Region:

North America

United States

Canada

Mexico

Europe

France

United Kingdom

Italy

Germany

Spain

Asia Pacific

China

India

Japan

Australia

South Korea



South America

Brazil

Argentina

Colombia

Middle East & Africa

South Africa

Saudi Arabia

UAE

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Phase Change Materials Market.

Available Customizations:

Global Phase Change Materials Market report with the given market data, TechSci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

Detailed analysis and profiling of additional market players (up to five).

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