

Global Dual-Use Phase Change Material (PCM) for Thermal Management Market Growth 2026-2032

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Abstracts

The global Dual-Use Phase Change Material (PCM) for Thermal Management market size is predicted to grow from US\$ 763 million in 2025 to US\$ 5267 million in 2032; it is expected to grow at a CAGR of 32.0% from 2026 to 2032.

Dual-Use Phase Change Material (PCM) for Thermal Management refers to PCM technologies, products or solutions that are applicable both to military equipment thermal management (e.g., missile-borne phased-array radar TR modules, high-power electronic warfare systems, infrared stealth, naval/armored platforms, individual soldier thermal protection) requiring high reliability, high power density, and harsh environment adaptability, and to civilian high-value applications (EV/ESS thermal runaway prevention, AI server PUE optimization, cold-chain logistics, building energy efficiency, smart wearables, automotive thermal comfort seats), enabling synergy in technology and supply chain. It features passive thermal management, buffering transient thermal shocks and stabilizing temperature. It excludes common thermal insulation materials and active cooling systems, and covers organic, inorganic, and composite PCMs (microencapsulated, porous scaffold, thermally enhanced, structure-thermal-stealth integrated).

Dual-use phase change materials (PCM) for thermal management epitomize the same technology, different markets paradigm. In military applications, missile-borne phased-array radar TR modules, high-power electronic warfare systems, and hypersonic vehicles demand PCM that can absorb hundreds of watts per square centimeter within milliseconds to seconds while surviving extreme mechanical stress. This creates extremely high technological barriers, unit prices ranging from tens of thousands to hundreds of thousands of dollars, and gross margins often exceeding 50%. In civilian markets, battery thermal runaway prevention, AI data center peak

shaving, and cold chain logistics require PCM to shift from 'high reliability' to 'high cost-effectiveness', with gross margins typically 20-35%, but market size grows exponentially. Pricing: commodity organic paraffin PCM sells for USD 2-5/kg, micro-encapsulated PCM USD 10-30/kg, while military-grade composite cold plates or packaged modules can cost USD 500-2,000/unit. Margins reflect this tiering: Yangtze Optical Electronic (688143), KULR, and ACT maintain 45-65% gross margins; Outlast, leveraging patent licensing and brand, enjoys 40-50%; civilian leaders such as Nabai Chuan and Hangzhou Ruhr achieve 25-35%; low-end building PCM has become a red ocean with margins below 15%. Downstream: military electronics (missiles, radars, EW) account for ~25% of the dual-use PCM market by value (highest unit value), battery thermal runaway protection ~30% (fastest growth, CAGR >35%), cold chain logistics ~20%, data centers & AI servers ~10%, building energy efficiency & smart textiles ~10%, aerospace ~5%. Incremental demand is driven by: (1) China's military electronics upgrade - active phased-array radars and missile-borne TR modules are shifting from 'optional' to 'mandatory' for PCM cold plates; (2) EV penetration exceeding 50% and new safety standards for grid-scale storage driving battery PCM module growth >35% annually; (3) mandatory PUE

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