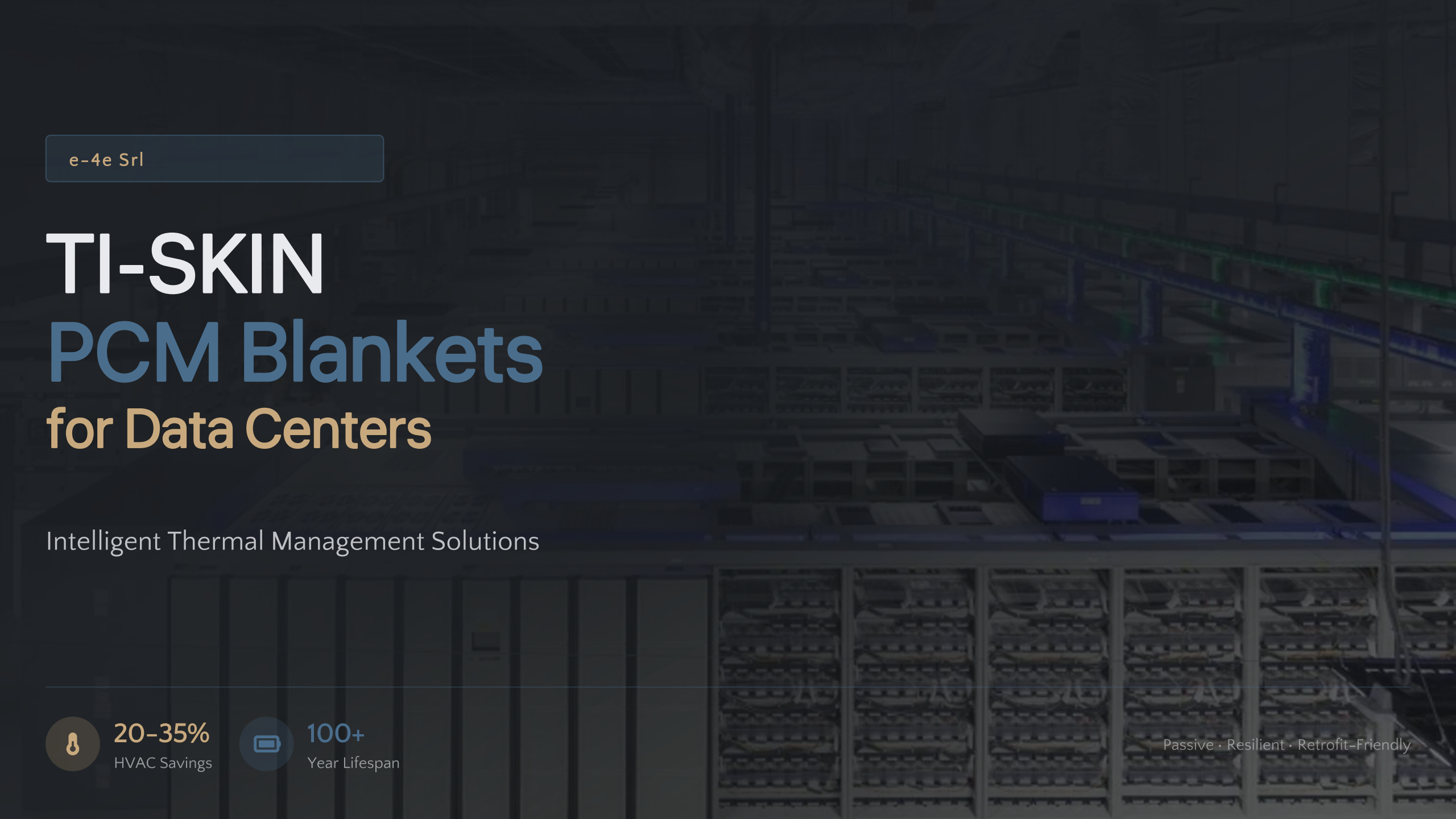


e-4e Srl

TI-SKIN
PCM Blankets
for Data Centers

Intelligent Thermal Management Solutions

20–35%
HVAC Savings

100+
Year Lifespan

Passive · Resilient · Retrofit-Friendly

The Challenge

Data Center Energy Consumption

Cooling Dominates Power Usage

Data centers consume massive energy for cooling, often representing 30-50% of total power consumption. This is driven by constant high-density server heat generation that requires continuous thermal management.

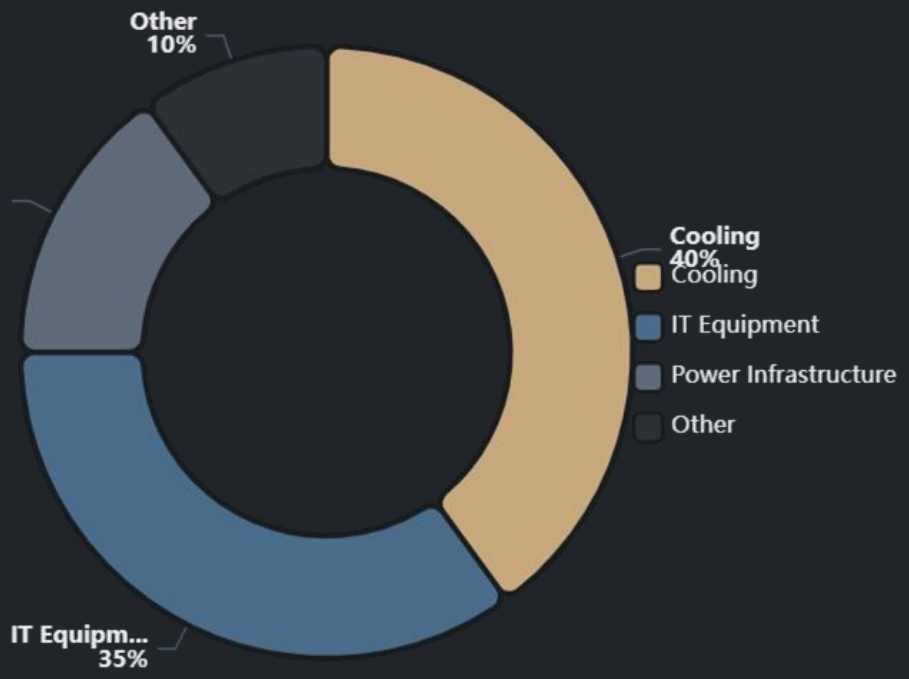
High-Density Heat Challenge

Modern servers generate intense heat loads that traditional cooling systems struggle to manage efficiently. AI workload surges create unpredictable thermal spikes, demanding innovative solutions.

Rising Operational Costs

Peak demand charges and continuous HVAC runtime drive up operational expenses. Equipment wear from constant cycling further increases maintenance costs and reduces system lifespan.

Energy Distribution in Data Centers



30-50%	24/7	High
Cooling Energy	Operation	Heat Density

The Solution

What Are TI-SKIN PCM Blankets?

Revolutionary Thermal Management Technology

TI-SKIN PCM blankets are flexible, quilted radiant-barrier sheets filled with phase-change materials (PCMs) that actively capture, store, and release heat at specific temperatures.

Active vs. Passive

Unlike traditional insulation that only slows heat flow, TI-SKIN intercepts and downgrades peak temperature to its phase change temperature through active thermal storage.

Key Differentiator

Heat Absorption

Can absorb up to 1135 Kj/ per square meter during phase transition (melting to gel-like state) without temperature increase.

Thermal Capacity

Energy Release

Releases stored energy as temperatures drop, refreezing to solid state and creating a passive thermal buffer that stabilizes indoor conditions.

Cyclic Operation

- Retrofit-Friendly
- Zero-Energy
- Maintenance-Free
- 20-35% Savings

Technology Deep Dive

How PCM Technology Works

1 Solid State

At lower temperatures, PCM remains in solid crystalline form, ready to absorb heat energy when temperatures rise.

Below phase change temp

2 Phase Transition

As heat is absorbed, PCM melts to gel-like state, storing up to 1135 Kj/sq .m without temperature increase.

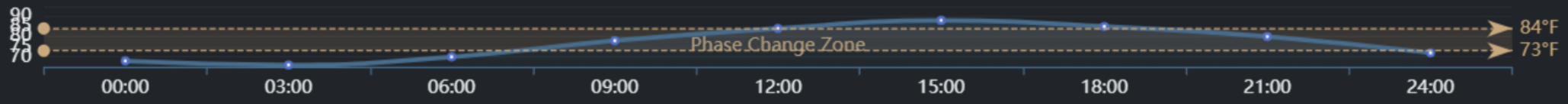
At phase change temp (73-84°F)

3 Energy Release

When temperatures drop, stored energy is released as heat, refreezing PCM back to solid state for next cycle.

Below phase change temp

Phase Change Temperature Profile



1135	23-29°C	∞	100+
Kj/sq mt Capacity	Phase Change Range	Unlimited Cycles	Year Lifespan

Application 1 · Highest Impact

Above Suspended Ceilings & Return-Air Plenums

Highest-Impact, Easiest Retrofit

Lay blankets directly on top of ceiling tiles or in the plenum space. This creates a large-area thermal sponge that intercepts rising hot return air before it reaches CRAC/CRAH units or chillers.

Energy Benefits

- ✓ **Buffers short-term heat spikes** (e.g., AI workload surges)
- ✓ **Delays compressor calls** and reduces cycling
- ✓ **Enables load shifting**—absorbing during peaks, releasing overnight

Why It Works

- ✓ Data halls have **accessible dropped ceilings**
- ✓ **Installation is fast** with minimal disruption
- ✓ Commercial settings show **15–20% HVAC runtime reduction**

15–20%	Fast	Minimal
HVAC Runtime Cut	Installation	Disruption

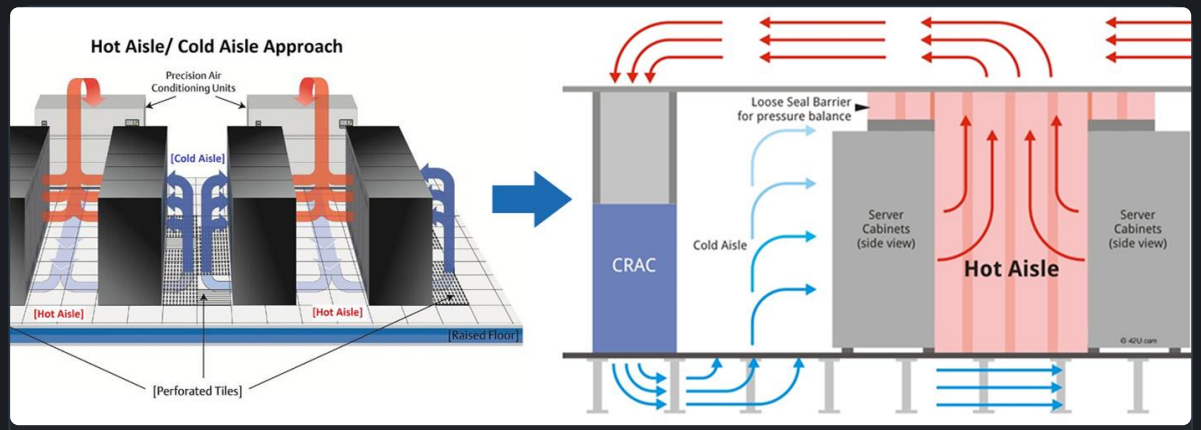
Ceiling Plenum Deployment

The diagram illustrates how hot air rises from server racks into the ceiling plenum space. PCM blankets installed above the ceiling tiles act as a thermal buffer, absorbing excess heat before it reaches the CRAC units.

Hot Air Flow Cold Air Flow

Application 2 · Source Control

Hot-Aisle Containment Systems



Hot-Aisle/Cold-Aisle Architecture

Server racks are arranged in alternating hot and cold aisles. Cold air flows through perforated tiles to cool servers, while hot exhaust air is contained and directed back to CRAC units. PCM blankets enhance this containment strategy.

- Cold Aisle
- Hot Aisle

Heat Absorption at the Source

Line hot-aisle enclosures or apply to containment structures. The blankets absorb server exhaust heat passively at the source, preventing it from overloading the room or cooling coils.

Energy Benefits

- ✓ Lowers temperature delta cooling system must overcome
- ✓ Enables higher supply-air set-points (within ASHRAE guidelines)
- ✓ Reduces fan/chiller power consumption

Bonus Benefits

- ✓ Improves temperature uniformity across data hall
- ✓ Provides short-term thermal inertia during outages
- ✓ Critical with UPS/battery systems

Strategic Advantage
Source-level heat management maximizes efficiency

ASHRAE
Compliant

Application 3 · Building Envelope

Perimeter Walls & Exterior Envelopes

Building Shell Thermal Protection

Apply to interior faces of exterior walls or above roof insulation. This application requires climate-tuned PCM formulation to match local temperature profiles.

Solar & Ambient Heat Gain Blocking

Blocks solar/ambient heat gain, which is secondary to IT load but still meaningful in warmer climates. Reduces baseline cooling demand on the building shell.

Climate Tuning

Critical requirement: PCM formulation must be tuned to local climate conditions. Different regions require different phase change temperatures for optimal performance.

Custom formulation available

Energy Benefits

- Reduces baseline cooling demand
- Complements IT load management
- Most effective in warmer climates

Ideal Applications

- Warmer climate regions
- High solar exposure buildings
- Overall facility efficiency focus

Interior Walls

Roof/Attic

Climate-Tuned

Baseline Reduction

Application 4 · Hybrid Integration

Support Areas & Hybrid Integration

Complementary Thermal Management

PCM blankets can be deployed in **support areas and integrated with existing systems** for maximum cooling efficiency and redundancy.

Support Area Applications

Battery Rooms
Localized thermal buffering for UPS battery systems

UPS Spaces
Temperature stabilization for critical power infrastructure

Near Air Handlers
Strategic placement for enhanced thermal management

Hybrid Integration Options

Existing Containment
Works alongside hot/cold aisle containment systems

Free-Cooling Economizers
Complements air-side and water-side economizers

Liquid-Cooling Loops
Integrates with direct-to-chip and immersion cooling

Localized buffering provides targeted thermal protection where it's needed most

Maximum effect achieved through strategic hybrid deployment

Battery Rooms

UPS Spaces

Air Handlers

Value Proposition

Key Advantages for Energy-Demand Reduction

Peak Shaving & Demand-Charge Avoidance

Stores heat during **high-load periods** instead of immediately engaging chillers. This reduces peak demand charges and shifts energy consumption to off-peak hours.

$ Significant cost savings on electricity bills

Lower Runtime & Cycling

Extends HVAC equipment life with **15–20% less runtime** reported in similar systems. Reduced cycling minimizes wear and tear on compressors and fans.

Reduced maintenance costs and longer equipment life

Passive & Resilient Operation

No power, no moving parts, with >100-year lifespan and unlimited cycles. Helps during outages by slowing temperature rise, providing critical thermal inertia.

∞ Unlimited charge/discharge cycles

Retrofit Simplicity

Lightweight, pliable, Class A fire-rated (ASTM E-84), non-toxic, and mold-resistant—ideal for live data centers with minimal disruption.

Fast installation in operational facilities

Peak	15–20%	100+	Easy
Shaving	Less Runtime	Year Lifespan	Retrofit

Implementation Guide

Practical Considerations for Best Results

PCM Temperature Tuning

Critical factor: Specify a melt point **2–5°C above** your target supply-air temperature.

Recommended Range	23–29°C
Custom formulations available for specific requirements	

Coverage Requirements

Deployment strategy: Cover **50–100% of ceiling area** (or targeted zones) depending on heat density.

Recommended Coverage	50–100%
Modeling with building data is recommended for optimization	

System Compatibility

Works **alongside (doesn't replace)** containment, raised-floor designs, or advanced cooling systems.

- ✓ Verify airflow patterns
- ✓ Ensure fire code compliance
- ✓ Check warranty impacts

Quantified Impact

Real-world analogs show **25–35% HVAC power reduction** and major peak-demand cuts.

- ✓ Depends on climate conditions
- ✓ Varies with PUE baseline
- ✓ Based on load profile

SYNOPSIS

The most effective strategy is **ceiling-plenum deployment in data halls**—it leverages the blankets' large surface area, easy install, and proven commercial performance to deliver the biggest passive cooling buffer with the least disruption.

Results & ROI

Proven Performance & Return on Investment

15–20%

HVAC Runtime Reduction

Achieved in commercial and telecom settings with similar thermal management applications

20–35%

HVAC Energy Savings

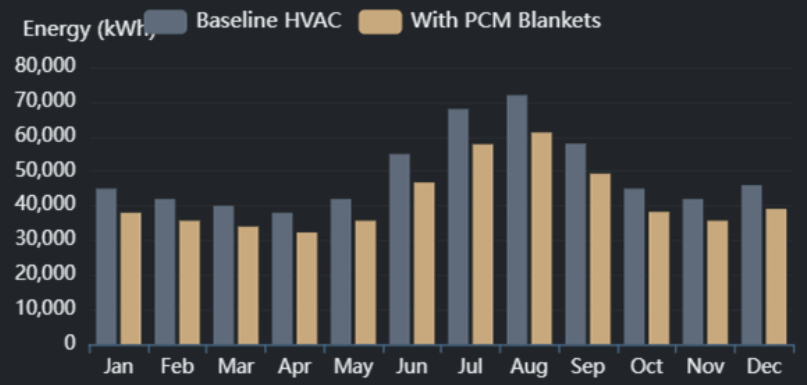
Potential savings based on building/commercial deployments and data-center analogs

25–35%

HVAC Power Reduction

Real-world analogs show major peak-demand cuts and significant power savings

Energy Savings Potential



Thermal Battery Effect

The PCM technology acts as a "thermal battery" that directly lowers energy demand while improving resiliency. It absorbs excess heat during peak periods and releases it during off-peak hours.

Improved Resiliency

Provides short-term thermal inertia during brief power or cooling outages, critical for maintaining safe operating temperatures while UPS/battery systems engage.

- Lower OpEx
- Reduced Carbon
- Less Maintenance
- Fast Payback

Transform Your Data Center

Ready to Reduce Your Cooling Costs by 20-35%?

Contact E-4E to learn how TI-SKIN PCM blankets can improve thermal resilience while delivering significant energy savings.

Contact Us

info@ti-skin.it
Aosta Valley - Italy

Proven Results

20-35% HVAC Savings
100+ Year Lifespan

Quality Assured

Class A Fire-Rated
ASTM E-84 Certified

Zero-Energy
Passive Operation

Retrofit-Friendly
Easy Installation

Maintenance-Free
No Moving Parts