

The Global Market for Thermal Energy Storage 2024-2035

<https://marketpublishers.com/r/GE7CF428ED62EN.html>

Date: April 2024

Pages: 270

Price: US\$ 1,250.00 (Single User License)

ID: GE7CF428ED62EN

Abstracts

Thermal energy storage (TES) is a rapidly growing sector within the broader energy storage industry, offering unique solutions for managing and optimizing energy supply and demand. TES technologies enable the capture, storage, and release of thermal energy, allowing for more efficient and sustainable energy utilization across various applications. As the world transitions towards cleaner energy sources and seeks to reduce greenhouse gas emissions, TES is poised to play a crucial role in decarbonizing power generation, industrial processes, and building energy systems.

TES technologies leverage the principles of thermodynamics to store energy in the form of heat or cold, using a variety of materials and systems. The three main categories of TES technologies are sensible heat storage, latent heat storage, and thermochemical energy storage. Sensible heat storage, the most mature and widely adopted TES technology, utilizes materials such as molten salts, concrete, and solid materials to store thermal energy through temperature changes. Latent heat storage employs phase change materials (PCMs) that absorb or release heat during phase transitions, offering higher energy densities and more stable storage temperatures. Thermochemical energy storage, an emerging technology, harnesses reversible chemical reactions to store and release thermal energy, providing the highest energy densities and long-term storage capabilities.

The TES market encompasses a diverse range of applications, including concentrated solar power (CSP), industrial process heat, district heating and cooling, residential and commercial buildings, and long-duration energy storage. In the power sector, TES enables the integration of renewable energy sources, such as solar thermal and geothermal, by providing a means to store and dispatch energy when needed. Industrial manufacturing processes can benefit from TES by recovering and reusing waste heat,

improving energy efficiency, and reducing fuel consumption. District heating and cooling networks leverage TES to optimize supply and demand, while residential and commercial buildings can utilize TES for space heating, cooling, and domestic hot water production. Additionally, TES is emerging as a promising solution for long-duration energy storage, complementing batteries and other storage technologies in grid-scale applications.

The global TES market is driven by several factors, including the increasing adoption of renewable energy, the need for energy efficiency and cost savings, and supportive government policies and regulations. The decarbonization of the power and industrial sectors, coupled with the integration of intermittent renewable energy sources, is creating a growing demand for TES solutions. Energy efficiency measures, such as peak shaving, load shifting, and waste heat recovery, are further driving the adoption of TES across various end-use sectors. Moreover, government initiatives, renewable energy mandates, and emissions trading schemes are providing incentives and support for TES projects worldwide.

As the TES market continues to evolve, several key trends and opportunities are emerging. Advancements in materials science are leading to the development of novel TES materials with improved performance, durability, and cost-effectiveness. Innovations in system design, such as modular and scalable TES solutions, are enabling easier integration and deployment across diverse applications. Furthermore, the increasing focus on long-duration energy storage is opening up new market segments for TES technologies, particularly in grid-scale applications and the integration of renewable energy sources.

This report provides a comprehensive analysis of the global TES market, covering the period from 2024 to 2045. It offers insights into the current market landscape, technology trends, key applications, and regional developments. The report includes market size and growth projections, segmented by technology, application, and region, along with a detailed value chain analysis and competitive landscape assessment. Additionally, it features in-depth profiles of leading TES companies, highlighting their product offerings, strategic initiatives, and market positioning. With its extensive coverage and strategic insights, this report serves as an invaluable resource for stakeholders across the TES value chain, including technology providers, project developers, utilities, industrial end-users, investors, and policymakers.

Contents include:

Comprehensive overview of TES technologies, including sensible heat storage, latent heat storage, and thermochemical energy storage

In-depth analysis of TES applications, such as concentrated solar power, industrial process heat, district heating and cooling, residential and commercial buildings, and long-duration energy storage

Market size and growth projections for the global TES market, segmented by technology, application, and region, from 2024 to 2045

Detailed value chain analysis, identifying key players and their roles in the TES market

Competitive landscape assessment, featuring profiles of leading TES companies and their product offerings, strategic initiatives, and market positioning. Companies profiled include 1414 Degrees, Alumina Energy, Antora, Bedrock Energy, Build to Zero, Cartesian, Echogen, Electrified Thermal Solutions, EnergyNest, Fourth Power, Harvest Thermal, Heliogen, Highview Power, Hyme Energy, Kraftblock, Kyoto Group, Lumenion, MGA Thermal, Polar Night Energy, Rondo Energy, and Sunamp.

Discussion of key market drivers, opportunities, and challenges, including the decarbonization of the power and industrial sectors, integration of renewable energy sources, and supportive government policies and regulations

Analysis of regional TES markets, including North America, Europe, Asia-Pacific, and the Rest of the World, highlighting key projects, installations, and market trends

Identification of emerging trends and opportunities in the TES market, such as advancements in materials science, modular and scalable system designs, and the growing focus on long-duration energy storage

Strategic insights and recommendations for stakeholders across the TES value chain, including technology providers, project developers, utilities, industrial end-users, investors, and policymakers

The Global Market for Thermal Energy Storage (TES) 2024-2045 is an essential

resource for anyone seeking to understand the current state and future potential of the TES market. With its comprehensive coverage, in-depth analysis, and strategic insights, this report provides a solid foundation for making informed decisions and developing effective strategies in the dynamic and rapidly evolving TES industry.

Contents

1 RESEARCH METHODOLOGY

2 REPORT SCOPE

3 EXECUTIVE SUMMARY

- 3.1 Current market size and growth potential
- 3.2 Major market drivers and barriers
- 3.3 Emerging trends and opportunities
- 3.4 Key technology conclusions
 - 3.4.1 TES technologies and their applications
 - 3.4.2 Technology readiness levels and commercialization status
 - 3.4.3 Future technology development and innovation roadmap
- 3.5 Thermal energy storage value chain and key players
- 3.6 Thermal energy storage market size and growth projections
 - 3.6.1 Global market size and forecast
 - 3.6.2 Market segmentation by technology, application, and region
 - 3.6.3 Regional initiatives

4 INTRODUCTION

- 4.1 Overview of thermal energy storage technologies
 - 4.1.1 Historical development and milestones
 - 4.1.2 Comparison with other energy storage technologies
 - 4.1.3 Benefits and challenges of TES deployment
- 4.2 Working principles of thermal energy storage systems
 - 4.2.1 Charging and discharging processes
 - 4.2.2 Heat transfer and storage mechanisms
 - 4.2.3 System components and configurations
- 4.3 Thermal energy storage classification and applications
 - 4.3.1 Sensible
 - 4.3.2 Latent
 - 4.3.3 Thermochemical storage
 - 4.3.4 Mechanical-thermal
 - 4.3.5 Low, medium, and high-temperature applications
 - 4.3.6 Centralized and distributed storage systems

5 MARKET DRIVERS AND OPPORTUNITIES

- 5.1 Decarbonization of power and industrial sectors
 - 5.1.1 Renewable energy integration and intermittency management
 - 5.1.2 Emissions reduction targets and carbon pricing
 - 5.1.3 Energy efficiency and process optimization
- 5.2 Integration of renewable energy sources
 - 5.2.1 Solar thermal and concentrated solar power
 - 5.2.2 Wind energy and power-to-heat solutions
 - 5.2.3 Geothermal energy and waste heat recovery
- 5.3 Energy efficiency and cost savings
 - 5.3.1 Peak shaving and load shifting
 - 5.3.2 Demand response and energy arbitrage
 - 5.3.3 Reduced fuel consumption and operating costs
- 5.4 Grid stability and resilience
 - 5.4.1 Frequency regulation and ancillary services
 - 5.4.2 Transmission and distribution infrastructure deferral
 - 5.4.3 Microgrid and off-grid applications
- 5.5 Policy support and emissions trading schemes
 - 5.5.1 Renewable energy mandates and incentives
 - 5.5.2 Carbon markets and emissions trading schemes
 - 5.5.3 Building codes and energy efficiency standards
- 5.6 Regional initiatives and funding programs

6 THERMAL ENERGY STORAGE APPLICATIONS

- 6.1 Concentrated solar power (CSP)
 - 6.1.1 Parabolic trough and power tower systems
 - 6.1.2 Molten salt and other storage media
 - 6.1.3 Hybridization with fossil fuel and biomass
 - 6.1.4 SWOT analysis
- 6.2 Industrial process heat
 - 6.2.1 Overview of industrial heat demand by temperature and operation
 - 6.2.1.1 Low-temperature processes (400°C)
 - 6.2.2 TES applications for specific industrial processes
 - 6.2.2.1 Food and beverage processing
 - 6.2.2.2 Pulp and paper manufacturing
 - 6.2.2.3 Chemical and petrochemical industries
 - 6.2.2.4 Metallurgy and mining

- 6.2.2.5 Cement and ceramic production
- 6.2.3 SWOT analysis
- 6.3 District heating and cooling
 - 6.3.1 Combined heat and power (CHP) systems
 - 6.3.2 Waste heat recovery and utilization
 - 6.3.3 Seasonal storage and load balancing
 - 6.3.4 SWOT analysis
- 6.4 Residential and commercial buildings
 - 6.4.1 Space heating and cooling
 - 6.4.2 Water heating and thermal comfort
 - 6.4.3 Integration with solar thermal and heat pump systems
 - 6.4.4 SWOT analysis
- 6.5 Long-duration energy storage
 - 6.5.1 Electro-thermal energy storage systems
 - 6.5.2 Pumped thermal electricity storage (PTES)
 - 6.5.3 Compressed air energy storage (CAES) with TES
 - 6.5.4 SWOT analysis
- 6.6 Chemical looping and hydrogen production
 - 6.6.1 Chemical looping combustion (CLC) and reforming (CLR)
 - 6.6.2 Hydrogen production and storage
 - 6.6.3 Integration with carbon capture and utilization (CCU)
- 6.7 Cold chain and refrigeration
 - 6.7.1 Food and pharmaceutical storage and transport
 - 6.7.2 Industrial refrigeration and process cooling
 - 6.7.3 Air conditioning and space cooling
 - 6.7.4 SWOT analysis

7 TECHNOLOGIES AND MATERIALS

- 7.1 Sensible heat storage
 - 7.1.1 Molten salts
 - 7.1.1.1 Nitrate salts and eutectics
 - 7.1.1.2 Chloride and carbonate salts
 - 7.1.1.3 Salt selection criteria and properties
 - 7.1.2 Concrete and solid materials
 - 7.1.2.1 High-temperature concrete and ceramics
 - 7.1.2.2 Natural and recycled materials (rock, sand, bricks)
 - 7.1.2.3 Compatibility with heat transfer fluids
- 7.2 Latent heat storage (phase change materials)

- 7.2.1 Organic PCMs (paraffins, fatty acids)
 - 7.2.1.1 Paraffin wax
 - 7.2.1.2 Non-Paraffins (fatty acids, esters, alcohols)
 - 7.2.1.3 Bio-based phase change materials
- 7.2.2 Inorganic PCMs (salt hydrates, metallics)
 - 7.2.2.1 Salt hydrates
 - 7.2.2.2 Metal and metal alloy PCMs (High-temperature)
- 7.2.3 Encapsulation and heat exchanger design
 - 7.2.3.1 Benefits
 - 7.2.3.2 Macroencapsulation
 - 7.2.3.3 Micro/nanoencapsulation
 - 7.2.3.4 Shape Stabilized PCMs
 - 7.2.3.5 Commercial Encapsulation Technologies
 - 7.2.3.6 Self-Assembly Encapsulation
- 7.2.4 Eutectic PCMs
 - 7.2.4.1 Eutectic Mixtures
 - 7.2.4.2 Examples of Eutectic Inorganic PCMs
 - 7.2.4.3 Benefits
 - 7.2.4.4 Applications
 - 7.2.4.5 Advantages and disadvantages of eutectics
 - 7.2.4.6 Recent developments
- 7.3 Thermochemical energy storage
 - 7.3.1 Adsorption and absorption
 - 7.3.1.1 Zeolites and silica gels
 - 7.3.1.2 Metal-organic frameworks (MOFs)
 - 7.3.1.3 Salt hydrates and ammoniates
 - 7.3.2 Chemical reaction energy storage
 - 7.3.2.1 Metal oxide redox reactions
 - 7.3.2.2 Carbonation and calcination cycles
 - 7.3.2.3 Catalytic reactions and reforming
- 7.4 Electro-thermal energy storage
 - 7.4.1 Joule heating and resistive heating
 - 7.4.2 Induction heating and electromagnetic systems
 - 7.4.3 Heat pumps and refrigeration cycles
- 7.5 Comparison of TES technologies: advantages and disadvantages
 - 7.5.1 Energy density and storage capacity
 - 7.5.2 Efficiency and round-trip
 - 7.5.3 Cost and economic viability
 - 7.5.4 Operational flexibility and response time

- 7.5.5 Environmental impact and safety considerations
- 7.6 Technology readiness levels and commercial maturity
 - 7.6.1 Research and development (TRL 1-3)
 - 7.6.2 Prototype and pilot-scale demonstration (TRL 4-6)
 - 7.6.3 Commercial-scale deployment (TRL 7-9)

8 MARKET ANALYSIS

- 8.1 Market Size
 - 8.1.1 By technology type
 - 8.1.2 By application and end-use sector
 - 8.1.3 By region
- 8.2 Price and Cost Analysis
- 8.3 Value Chain
- 8.4 Project case studies and deployment examples
 - 8.4.1 Utility-scale TES projects
 - 8.4.2 Industrial TES applications
 - 8.4.3 District heating and cooling networks
 - 8.4.4 Residential and commercial building projects
- 8.5 Competitive Landscape
- 8.6 Customer Segmentation
- 8.7 Risks and Opportunities

9 THERMAL ENERGY STORAGE PROJECTS AND INSTALLATIONS

- 9.1 Global overview of TES projects and installations
 - 9.1.1 Number and capacity of operational projects
 - 9.1.2 Planned and under-construction projects
- 9.2 Regional breakdown of TES projects
 - 9.2.1 North America
 - 9.2.2 Europe
 - 9.2.3 Asia-Pacific
 - 9.2.4 Rest of the World
- 9.3 TES projects by application and industry
 - 9.3.1 Power generation and utilities
 - 9.3.2 Industrial manufacturing and process heat
 - 9.3.3 District heating and cooling
 - 9.3.4 Buildings and construction
 - 9.3.5 Transportation and mobility

10 COMPANY PROFILES 190 (80 COMPANY PROFILES)

11 REFERENCES

List Of Tables

LIST OF TABLES

Table 1. Market drivers and barriers in thermal energy storage.

Table 2. TES technologies and applications.

Table 3. Thermal energy storage revenues, by technology (Billions USD) 2020-2035.

Table 4. Thermal energy storage revenues, by applications and end-use sector (Billions USD) 2020-2035.

Table 5. Thermal energy storage revenues, by region (Billions USD) 2020-2035.

Table 6. Regional initiatives in Thermal energy storage.

Table 7. Historical development and milestones of TES technologies.

Table 8. Comparison of TES with other energy storage technologies.

Table 9. Benefits and challenges of TES deployment.

Table 10. Concentrated solar power and thermal energy storage plants.

Table 11. TES applications for decarbonizing industrial process heating.

Table 12. TES for industrial and non-CSP applications.

Table 13. Operating temperatures and time ranges for TES technologies.

Table 14. Concrete and solid materials in TES.

Table 15. Advantages and disadvantages of paraffin wax PCMs.

Table 16. Advantages and disadvantages of non-paraffins.

Table 17. Advantages and disadvantages of Bio-based phase change materials.

Table 18. Advantages and disadvantages of salt hydrates

Table 19. Advantages and disadvantages of low melting point metals.

Table 20. Advantages and disadvantages of eutectics.

Table 21. Comparative properties of TES technologies.

Table 22. Thermal energy storage revenues, by technology (Billions USD) 2020-2035.

Table 23. Thermal energy storage revenues, by applications and end-use sector (Billions USD) 2020-2035.

Table 24. Thermal energy storage revenues, by region (Billions USD) 2020-2035.

Table 25. TES price and cost analysis.

Table 26. Thermal energy storage value chain.

Table 27. Market players in Sensible and Latent Heat TES.

Table 28. Market players in Electro-thermal Energy Storage.

Table 29. Market players in Thermochemical Energy Storage

Table 30. Operational TES projects.

Table 31. Planned and under-construction TES projects.

Table 32. Caldera battery system.

Table 33. CrodaTherm Range.

List Of Figures

LIST OF FIGURES

- Figure 1. Components of the energy transition strategy.
- Figure 2. Technology readiness levels and commercialization status for thermal energy storage.
- Figure 3. Thermal energy storage (RES) roadmap.
- Figure 4. Thermal energy storage value chain and key players.
- Figure 5. Thermal energy storage revenues, by technology (Billions USD) 2020-2035.
- Figure 6. Thermal energy storage revenues, by applications and end-use sector (Billions USD) 2020-2035.
- Figure 7. Thermal energy storage revenues, by region (Billions USD) 2020-2035.
- Figure 8. Thermal energy storage technology working principle.
- Figure 9. SWOT analysis: TES concentrated solar power.
- Figure 10. SWOT analysis: TES for industrial process heat.
- Figure 11. SWOT analysis: district heating and cooling.
- Figure 12. SWOT analysis: TES for residential and commercial buildings.
- Figure 13. SWOT analysis: LDES.
- Figure 14. CaL process scheme.
- Figure 15. SWOT analysis: TES for cold chain and refrigeration.
- Figure 16. Thermal energy storage materials.
- Figure 17. Direct molten-salt storage system.
- Figure 18. Indirect molten-salt storage system.
- Figure 19. Molten-salt TES capacity installed globally (gigawatt hour).
- Figure 20. Schematic of PCM in storage tank linked to solar collector.
- Figure 21. UniQ line of thermal batteries.
- Figure 22. Thermochemical storage methods and materials.
- Figure 23. TES technologies by commercial readiness levels (CRL).
- Figure 24. Thermal energy storage revenues, by technology (Billions USD) 2020-2035.
- Figure 25. Thermal energy storage revenues, by applications and end-use sector (Billions USD) 2020-2035.
- Figure 26. Thermal energy storage revenues, by region (Billions USD) 2020-2035.
- Figure 27. Thermal energy storage installations, by technology (GWh) 2020-2035.
- Figure 28. Thermal energy storage installations, by markets (GWh) 2020-2035.
- Figure 29. Thermal energy storage installations, by region (GWh) 2020-2035.
- Figure 30. Thermal energy storage installations, by technology (GWh) 2020-2035.
- Figure 31. Thermal energy storage installations, by markets (GWh) 2020-2035.
- Figure 32. Ultraguard -70°C Phase Change Material (PCM) being loaded into a Stirling

Ultracold ULT25NEU portable freezer.
Figure 33. HI-FLOW Phase Change Materials.

I would like to order

Product name: The Global Market for Thermal Energy Storage 2024-2035

Product link: <https://marketpublishers.com/r/GE7CF428ED62EN.html>

Price: US\$ 1,250.00 (Single User License / Electronic Delivery)

If you want to order Corporate License or Hard Copy, please, contact our Customer Service:

info@marketpublishers.com

Payment

To pay by Credit Card (Visa, MasterCard, American Express, PayPal), please, click button on product page <https://marketpublishers.com/r/GE7CF428ED62EN.html>

To pay by Wire Transfer, please, fill in your contact details in the form below:

First name:
Last name:
Email:
Company:
Address:
City:
Zip code:
Country:
Tel:
Fax:
Your message:

****All fields are required**

Customer signature _____

Please, note that by ordering from marketpublishers.com you are agreeing to our Terms & Conditions at <https://marketpublishers.com/docs/terms.html>

To place an order via fax simply print this form, fill in the information below and fax the completed form to +44 20 7900 3970