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Thermal Energy Storage Market-Global Industry Size, Share, Trends, Opportunity, and Forecast, 2018-2028F By Technology (Sensible Heat Storage, Latent Heat Storage and Thermochemical Storage), By Storage Material (Water, Molten Salts, Phase Change Materials and Others), By Application (Power Generation, District Heating & Cooling and Process Heating & Cooling), By End User (Utilities, Commercial, Industrial and Residential), By Region, Competition

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Abstracts

TThe global thermal energy storage market was valued at USD 18.89 billion in 2022 and is projected to reach USD 49.72 billion by 2028, exhibiting a CAGR of 9.18% during the forecast period from 2021 to 2030. Thermal energy storage refers to the storage of energy by utilizing various materials that store and release energy based on temperature fluctuations. This technology finds its applications in heat pumps, power plants, and waste management systems. By leveraging thermal energy storage systems, energy demand during peak hours can be reduced, resulting in lower carbon dioxide emissions and decreased energy consumption for end consumers. Thermal energy storage is extensively used in thermal power plants and solar power plants to ensure a steady power supply, even during nighttime, and to harness heat in process industries. Furthermore, the increasing adoption of renewable power generation and the growing demand for HVAC thermal energy storage systems present other compelling factors. Additionally, the rising concern over greenhouse gas emissions and escalating fuel prices is anticipated to further stimulate the demand for advanced thermal energy storage systems.

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Key Market Drivers:

Demand for energy storage to supplement the ever-increasing generation of solar energy.

The decarbonization of the energy sector and the reduction of carbon emissions to combat global climate change are crucial objectives for governments, energy authorities, and utilities worldwide. According to IRENA, the accelerated deployment of renewable energy, coupled with electrification and improved energy efficiency of the electric grid, can deliver more than 90% of the necessary carbon dioxide (CO2) emission reductions by 2050, in line with the Paris Climate targets. In 2019, the global renewable energy installed capacity increased by 176 GW, representing a growth rate of 7.4% compared to 2018. The hydropower sector witnessed a recovery, contributing to the overall generation growth. Solar generation surpassed bioenergy in 2018, becoming the third-largest source of renewable electricity generation. Solar and wind generation saw significant increases of 28% and 11% respectively. Together, these two sources accounted for 73% of renewable energy growth since 2014. Solar energy experienced a remarkable average annual growth rate of 49% globally, driven by strong federal policy mechanisms, such as the Investment Tax Credit for solar power, and rising demand for clean energy across major economies in North America, Europe, and the Asia Pacific region.

In China, renewable energy sources contributed to 26.7% of the country's total power generation in 2018, with hydro, wind, PV, and biomass making significant contributions. China has set ambitious solar targets, aiming to reach at least 210 GW, and potentially up to 270 GW, by 2020. The Government of India has also set a target of installing 175 GW of renewable energy capacity by 2022, including wind, bio power, solar, and small hydropower. Spain has raised its renewable energy target to 74% by 2030 and plans to add 157 GW of renewable energy capacity. Concentrating Solar Power (CSP) generation increased by an estimated 34% in 2019 and is expected to continue growing. Continuous policy support for CSP projects across various regions, including the Middle East and Africa, Asia Pacific, and North America, will contribute to this growth.

Thermal energy storage plays a vital role in CSP plants, enabling the storage of solar heat for electricity production during periods without sunlight. This ensures uninterrupted operations and offers advantages such as increased reliability, improved overall efficiency, reduced costs, and lower carbon dioxide emissions. The integration of thermal energy storage in CSP plants is expected to drive market growth.

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Rising demand for energy:

The demand for electricity, driven by growing commercialization and heightened usage during peak hours, alongside the need for heating and cooling applications in smart infrastructure, is fueling market growth. Supportive government policies in developed and developing nations for renewable energy technologies further contribute to this expansion. Many countries worldwide are investing in renewables, stimulating market growth across diverse economies. Investments in solar and wind power are not only creating jobs but also reducing emissions and fostering innovation. One of the primary goals of numerous governments is to curtail carbon emissions in the energy sector, thus mitigating global climate change. This objective has led to improved energy efficiency in electric grids, resulting in reduced carbon dioxide emissions. For instance, the Government of India aims to install 175 gigawatts of renewable energy capacity by 2022, encompassing wind, biopower, solar, and hydropower sources. Similarly, the Spanish government plans to add 157 gigawatts of renewable energy capacity by 2030. The utilization of thermal energy storage offers enhanced reliability, reduced investment costs, increased overall efficiency, and lower operational expenses. Furthermore, the rapid growth of decentralized renewable energy technologies will act as a driving force for the market.

Key Market Challenges:

High initial set-up costs vary with technology.

The cost of thermal energy storage technologies varies depending on the application, size, and thermal insulation technology. Phase change material (PCM) and thermochemical storage-based systems generally have higher costs compared to the storage capacity they provide. Storage systems typically account for around 30% to 40% of the total system cost. Ongoing research in energy storage technologies aims to reduce upfront capital requirements, making thermal energy storage more competitive in the near future.

Sensible heat storage offers a storage capacity ranging from 10 kWh/t to 50 kWh/t, with storage efficiencies between 50% and 90%, depending on the specific heat of the storage medium and thermal insulation technologies. PCMs can provide higher storage capacity and efficiencies in the range of 75% to 90%. In most cases, storage is based on solid or liquid phase change, with energy densities around 100 kWh/m3 (e.g., ice). Thermal chemical storage (TCS) systems can achieve storage capacities of up to 250

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kWh/t, with operating temperatures exceeding 300°C and efficiencies ranging from 75% to nearly 100%.

The cost of a complete sensible heat storage system ranges between Euros 0.1/kWh and 10/kWh (USD 0.11/kWh and 10.7/kWh), depending on the size, application, and thermal insulation technology. Costs for PCM and TCS systems are generally higher. These systems involve significant expenses associated with the heat (and mass) transfer technology required to achieve sufficient charging or discharging power. Costs for latent heat storage systems using PCMs range from Euros 10/kWh to 50/kWh (USD 10.7/kWh to 53.5/kWh), while TCS costs are estimated to range from Euros 8/kWh to 100/kWh (USD 8.56/kWh to 107/kWh). The economic feasibility of thermal energy storage heavily depends on the application and operational requirements, including the number and frequency of storage cycles.

High prices of TES systems may restrain industry growth.

The significant capital investment required for constructing TES systems has been a major constraint on market expansion. However, the technology has become more competitive due to improvements and standardization in the manufacturing process, as well as the increasing demand for advanced storage materials. Furthermore, the positive perspective on carbon emissions reduction and the development of CSP plants is expected to drive market growth in the coming years.

Key Market Trends

Shift towards renewable energy generation is a trend.

Numerous countries worldwide are transitioning towards renewable energy generation and embracing thermal energy storage to achieve carbon reduction goals. Furthermore, governments, associations, and universities are actively investing in research and development to develop innovative thermal storage mediums with minimal or zero environmental impact. In this context, the advent of cutting-edge technologies such as smart sensors, IoT, and AI is anticipated to significantly enhance the efficiency of thermal energy storage.

Segmental Insights.

Application Insights:

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The power generation segment is projected to experience significant growth during the forecast period. The increasing demand for reliable and cost-effective power supply in off-grid and remote areas will drive this segment. Furthermore, the implementation of various government initiatives aimed at promoting electricity generation from solar power plants will further enhance the growth of the power generation segment. Under the feed-in tariff scheme, renewable power generation suppliers receive retail electricity prices for each unit generated and can sell any excess power back to the grid.

Storage Material Insights:

Molten salt technology is anticipated to experience substantial growth during the forecast period. The growth of this segment can be attributed to its high technological efficiency, as well as its application in various solar energy projects. Molten salt is utilized for storing the heat collected through solar troughs and solar towers. This heat, harnessed through this technology, is then converted into superheated steam to power steam turbines.

Regional Insights:

Europe accounted for the largest share of revenue and is projected to maintain its lead throughout the forecast period. The region is characterized by a significant number of thermal energy storage systems used for various applications such as space heating, water heating, district heating and cooling, and power generation. Spain emerges as the key contributor to the regional market growth due to its numerous operational TES projects and the presence of major players like Abengoa Solar. The governments of Europe have developed a model known as the European model, which efficiently stores and distributes energy based on population density in specific regions. Notably, the federal government of Germany heavily invests in advanced research for electrical energy storage, particularly in relation to its use in residential solar panels.

Key Market Players

BrightSource Energy Inc.

Aalborg CSP AS

Abengoa SA

Baltimore Aircoil Company

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Burns & McDonnell

SaltX Technology Holding AB

Terrafore Technologies LLC

Trane Technologies PLC

SR Energy

Vantaa Energy

Report Scope:

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

Global Thermal Energy Storage Market, By Technology:

Sensible Heat Storage

Latent Heat Storage

Thermochemical Storage

Global Thermal Energy Storage Market, By Storage Material:

Water

Molten Salts

Phase Change Materials

Others

Global Thermal Energy Storage Market, By Application:

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Power generation

District Heating & Cooling

Process Heating & Cooling

Global Thermal Energy Storage Market, By End User:

Utilities

Commercial

Industrial

Residential

Global Thermal Energy Storage Market, By Region:

North America

Europe

South America

Middle East & Africa

Asia Pacific

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Thermal Energy Storage Market.

Available Customizations:

Global Thermal Energy Storage Market report with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following

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customization options are available for the report:

Company Information

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

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