

The Global Market for Solid-State Coolers 2024-2034

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Abstracts

Effective thermal management is critical across many industries dealing with high heat loads including electronics, automotive, aerospace, power generation, and directed energy systems. Conventional cooling technologies like vapor compression are reaching their limits for hotter systems and demanding environments.

Solid-state cooling offers transformative solutions by harnessing properties of materials and nanoscale structures to pump and transfer heat. Solid-state cooling refers to refrigeration technologies that utilize solid state materials and devices to provide cooling without traditional vapor compression or coolant cycles. Solid-state coolers leverage unique properties of materials like semiconductors, ceramics, alloys and nanostructures combined with phenomena such as quantum tunneling, thermoelectric effects, photonics, and magnetism to enable cooling below ambient temperatures.

Promising solid-state cooling technologies include:

Thermoelectric coolers using semiconductors to electromagnetically pump heat.

Thermotunneling coolers that leverage nanoscale gaps and quantum tunneling to transfer heat.

Optical refrigerators which use laser light to induce cooling through anti-Stokes fluorescence.

Refrigerators that utilize light emitting diodes (LEDs) as the cold side of a thermoelectric cooler.

Thermoacoustic refrigeration harnessing high intensity sound waves in gases to produce cooling without fluids or gases.

Magnetic refrigeration utilizing magnetocaloric materials and magnetic field cycling.

Passive technologies like heat pipes and advanced heat exchangers provide complementary high performance heat spreading and heat transfer solutions.

Some of the key focus areas covered in the report include:

In-depth technical analysis of cooling approaches:

ThermoelectricCoolers

Thermophotonic (TPX) Coolers

Thermotunneling Coolers

Acoustic/thermoacoustic Cooling

Magnetic Cooling

Photonic Cooling

Optical refrigerators

Thermoelastic Cooling

Electrocaloric Cooling

Thermionic Cooling

Barocaloric Cooling

Thermal Diodes.

Working principles, designs, materials used

Fabrication processes and manufacturing approaches

Performance metrics like cooling capacity, efficiency, operating temperatures

Current technical challenges and limitations

Recent research trends and developments

Applications and End-Use Sectors covered include:

Electronics cooling

Microprocessors, power electronics, LEDs

Consumer devices, data centers, avionics

Optoelectronics

Lasers, detectors, IR cameras

Automotive sector

Seat climate control, battery thermal management

Sensors, LIDAR, infotainment systems

Aerospace

Avionics Cooling, Cryogenic Systems

Satellite Thermal Control, Laser cooling, Thermal Protection Systems

Medical

Food and beverage cooling

Gas liquification, cryogenics

Emerging application areas

Current market size estimates and forecasts to 2034

Adoption trends across application segments

Regional analysis: North America, Asia Pacific, Europe, RoW

Industry landscape:

Key players

SWOT analysis

Market value chain.

Growth opportunities and strategic recommendations

Challenges: technical, commercial, regulatory

Profiles of 24 product developers. Companies profiled include Barocal Ltd., Ferrotec, Frore Systems, Komatsu, Laird Thermal Systems, and Phononic Inc.

Some of the key questions addressed in the report include:

What are the major solid state cooling technologies and what are their principles of operation?

What are the performance metrics like efficiency, cooling capacity and operating temperatures?

What are the current application areas and adoption trends for solid state coolers?

What are the benefits of solid state cooling versus traditional vapor compression systems?

What are the major challenges and limitations of solid state cooling technologies?

Which solid state cooling technologies show the most promise for future adoption?

What are the projected market sizes for solid state cooling over the next 5-10 years?

Who are the key players developing solid state cooling devices?

What are emerging application areas which can benefit from solid state cooling?

What are the strategic recommendations for companies in the solid state cooling ecosystem?

The Global Market for Solid-State Cooling 2024-2034 serves as a comprehensive guide for stakeholders interested in understanding various solid-state cooling approaches, their capabilities, applications across industries, and market outlook. The report aims to provide guidance on leveraging solid state cooling to engineers, researchers, investors, and corporate strategists.

Contents

1 RESEARCH METHODOLOGY

2 INTRODUCTION

- 2.1 Overview of solid-state cooling technology
- 2.2 Existing and emerging solid-state cooling technologies
 - 2.2.1 Active Coolers
 - 2.2.2 Passive Coolers
- 2.3 Benefits over conventional cooling
- 2.4 Cost comparison of conventional and solid-state cooling technologies
- 2.5 Technology roadmap

3 SOLID-STATE COOLING TECHNOLOGIES

- 3.1 Thermoelectric Coolers
 - 3.1.1 Working Principles and Design
 - 3.1.2 Performance Metrics
 - 3.1.3 Applications
 - 3.1.4 Recent Materials and Technology Developments
 - 3.1.5 Challenges and Limitations
- 3.2 Thermoacoustic Coolers
 - 3.2.1 Working Principles and Design
 - 3.2.2 Performance Metrics
 - 3.2.3 Applications
 - 3.2.4 Recent Materials and Technology Developments
 - 3.2.5 Challenges and Limitations
- 3.3 Thermotunneling Coolers
 - 3.3.1 Working Principles and Designs
 - 3.3.1.1 Nanoscale Gap Cooling Principle
 - 3.3.2 Fabrication and Manufacturing
 - 3.3.3 Performance Metrics
 - 3.3.4 Applications
 - 3.3.5 Recent Materials and Technology Developments
 - 3.3.6 Challenges and Limitations
- 3.4 Thermophotonic (TPX) Coolers
 - 3.4.1 Working Principles and Designs

- 3.4.2 Performance Metrics
- 3.4.3 Applications
- 3.4.4 Recent Materials and Technology Developments
- 3.4.5 Challenges and Limitations
- 3.5 Magnetic Cooling
 - 3.5.1 Working Principles and Designs
 - 3.5.2 Performance Metrics
 - 3.5.3 Applications
 - 3.5.4 Recent Materials and Technology Developments
 - 3.5.5 Challenges and Limitations
- 3.6 Optical Refrigerators
 - 3.6.1 Laser-Driven Optical Heat Pumps
 - 3.6.2 Optical Cooling Materials
 - 3.6.3 System Design
 - 3.6.4 Performance Metrics
 - 3.6.5 Applications
 - 3.6.6 Recent Materials and Technology Developments
 - 3.6.7 Challenges and Limitations
- 3.7 Thermoelastic Cooling
 - 3.7.1 Working Principles and Designs
 - 3.7.1.1 Shape memory alloys (SMA)
 - 3.7.2 Performance Metrics
 - 3.7.3 Applications
 - 3.7.4 Recent Materials and Technology Developments
 - 3.7.5 Challenges and Limitations
- 3.8 Electrocaloric Cooling
 - 3.8.1 Working Principles and Designs
 - 3.8.2 Performance Metrics
 - 3.8.3 Applications
 - 3.8.4 Recent Materials and Technology Developments
 - 3.8.5 Challenges and Limitations
- 3.9 Thermionic cooling
 - 3.9.1 Working Principles and Designs
 - 3.9.2 Performance Metrics
 - 3.9.3 Recent Materials and Technology Developments
 - 3.9.4 Applications
 - 3.9.5 Challenges and Limitations
- 3.10 Barocaloric cooling technology
 - 3.10.1 Working Principles and Designs

- 3.10.2 Performance Metrics
- 3.10.3 Recent Materials and Technology Developments
- 3.10.4 Applications
- 3.10.5 Challenges and Limitations
- 3.11 Thermal Diodes
 - 3.11.1 Working Principles and Designs
 - 3.11.2 Applications
 - 3.11.3 Challenges and Limitations

4 MARKET ANALYSIS

- 4.1 Market drivers and trends
- 4.2 Market challenges
- 4.3 Value chain
- 4.4 Competitive Landscape
 - 4.4.1 Key players
 - 4.4.2 SWOT analysis
- 4.5 Global market revenues 2018-2034
- 4.6 By market
- 4.7 By region
 - 4.7.1 North America
 - 4.7.2 Europe
 - 4.7.3 Asia Pacific
 - 4.7.4 Rest of World
- 4.8 Electronics
 - 4.8.1 Market drivers
 - 4.8.2 Applications
 - 4.8.3 Market Size and Growth
- 4.9 Optoelectronics
 - 4.9.1 Market drivers
 - 4.9.2 Applications
 - 4.9.3 Market Size and Growth
- 4.10 Automotive
 - 4.10.1 Market drivers
 - 4.10.2 Applications
 - 4.10.3 Market Size and Growth
- 4.11 Aerospace
 - 4.11.1 Market drivers
 - 4.11.2 Applications

4.11.3 Market Size and Growth

4.12 Medical

4.12.1 Market drivers

4.12.2 Applications

4.12.3 Market Size and Growth

4.13 Food/beverage cooling

4.13.1 Market drivers

4.13.2 Applications

4.13.3 Market Size and Growth

5 COMPANY PROFILES 103 (24 COMPANY PROFILES)

6 REFERENCES

List Of Tables

LIST OF TABLES

Table 1. Benefits of solid-state cooling technologies compared to conventional refrigeration.

Table 2. Cost comparison of conventional and solid-state cooling technologies.

Table 3. Comparative analysis.

Table 4. Applications and benefits of thermoelectric cooling.

Table 5. Challenges and limitations of thermoelectric cooling technology.

Table 6. Applications and benefits of thermoacoustic cooling.

Table 7. Challenges and limitations of thermoacoustic cooling technology.

Table 8. Applications and benefits of thermotunneling coolers.

Table 9. Challenges with thermotunneling coolers.

Table 10. Key performance metrics for thermophotonic coolers.

Table 11. Applications and benefits of thermophotonic (TPX) cooling.

Table 12. Challenges and limitations of thermophotonic cooling technology.

Table 13. Key performance metrics magnetic cooling.

Table 14. Applications and benefits of magnetic cooling.

Table 15. Challenges and limitations of magnetic cooling technology.

Table 16. Applications and benefits of optical refrigerators.

Table 17. Challenges and limitations of optical refrigeration technology.

Table 18. Key performance metrics for thermoelastic cooling.

Table 19. Applications and benefits of thermoelastic cooling.

Table 20. Challenges and limitations of thermoelastic cooling technology.

Table 21. Key performance metrics for Electrocaloric Cooling.

Table 22. Applications and benefits of electrocaloric cooling.

Table 23. Challenges and limitations of electrocaloric cooling technology.

Table 24. Key performance metrics for thermionic Cooling.

Table 25. Applications and benefits of thermionic cooling.

Table 26. Challenges and limitations of thermionic cooling technology.

Table 27. Key performance metrics for barocaloric cooling.

Table 28. Applications and benefits of barocaloric cooling.

Table 29. Challenges and limitations of barocaloric cooling technology.

Table 30. Applications and benefits of thermal diodes.

Table 31. Challenges and limitations thermal diodes.

Table 32. Market drivers and trends in solid-state cooling.

Table 33. Market challenges in solid-state cooling.

Table 34. Key market players in solid-state cooling.

Table 35. Global market for solid-state coolers 2018-2034, total (millions USD).

Table 36. Global market for solid-state coolers 2018-2034, by market (millions USD).

Table 37. Global market for solid-state coolers 2018-2034, by region (millions USD).

Table 38. Market drivers for solid-state cooling in electronics.

Table 39. Applications of solid-state cooling in electronics.

Table 40. Market drivers for solid-state cooling in optoelectronics.

Table 41. Applications of solid-state cooling in optoelectronics.

Table 42. Market drivers for solid-state cooling in automotive.

Table 43. Applications of solid-state cooling in automotive.

Table 44. Market drivers for solid-state cooling in aerospace.

Table 45. Applications of solid-state cooling in aerospace.

Table 46. Market drivers for solid-state cooling in medical.

Table 47. Applications of solid-state cooling in medical.

Table 48. Market drivers for solid-state cooling in food/beverage cooling.

Table 49. Applications of solid-state cooling in food/beverage cooling.

List Of Figures

LIST OF FIGURES

Figure 1. Solid-state cooling technology roadmap.

Figure 2. Thermoelectric cooler schematic.

Figure 3. Schematic of thermoacoustic cooling system.

Figure 4. Electrocaloric system.

Figure 5. Solid-state cooling market value chain.

Figure 6. SWOT analysis for solid-state cooling market.

Figure 7. Global market for solid-state coolers 2018-2034, total (millions USD).

Figure 8. Global market for solid-state coolers 2018-2034, by market (millions USD).

Figure 9. Global market for solid-state coolers 2018-2034, by region (millions USD).

Figure 10. Global market for solid-state coolers 2018-2034, North America (millions USD).

Figure 11. Global market for solid-state coolers 2018-2034, Europe (millions USD).

Figure 12. Global market for solid-state coolers 2018-2034, Rest of World (millions USD).

Figure 13. AirJet® by Frore Systems

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