
INDUSTRY OVERVIEW

The information and statistics set out in this section and other sections of this document were extracted from the Frost & Sullivan Report prepared by Frost & Sullivan, which was commissioned by us, and from various official government publications and other publicly available publications. We engaged Frost & Sullivan to prepare the Frost & Sullivan Report, an independent industry report, in connection with the [REDACTED]. We believe that the sources of this information are appropriate sources for such information and have taken reasonable care in extracting and reproducing such information. We have no reason to believe that such information is false or misleading or that any fact has been omitted that would render such information false or misleading. The information from official government sources has not been independently verified by us, the Sole Sponsor, the [REDACTED], the [REDACTED] or any other party involved in the [REDACTED] and no representation is given as to its accuracy.

SOURCE AND RELIABILITY OF INFORMATION

We have commissioned Frost & Sullivan, an Independent Third Party, to conduct a study of China’s heat-generating materials and products market. We agreed to pay Frost & Sullivan a fee of RMB850,000 for the preparation of the Frost & Sullivan Report, and our Directors consider that such fee reflects market rates and are of the view that the payment of the fee does not affect the fairness of conclusions drawn in the Frost & Sullivan Report. Founded in 1961, Frost & Sullivan has over 45 global offices with more than 3,000 industry consultants, market research analysts, technology analysts and economists.

RESEARCH METHODOLOGY

During the preparation of the Frost & Sullivan Report, Frost & Sullivan conducted primary research that involved discussing the status of the industry with industry participants and industry experts, as well as secondary research that involved reviewing company reports, independent research reports and Frost & Sullivan’s own database.

BASIS AND ASSUMPTION

The Frost & Sullivan Report was compiled based on the following assumptions: (i) China’s economy is likely to maintain steady growth in the next decade; (ii) China’s social, economic, and political environment is likely to remain stable from 2026 to 2030 (“**Forecast Period**”); and (iii) market drivers like favourable policies, diversified market demands, development towards high-end and precision, increasing R&D investment and innovation, downstream demand driving industry growth, etc., are likely to further drive the development of China’s heat-generating materials and products industry.

ANALYSIS OF CHINA’S HEAT-GENERATING MATERIALS AND PRODUCTS INDUSTRY

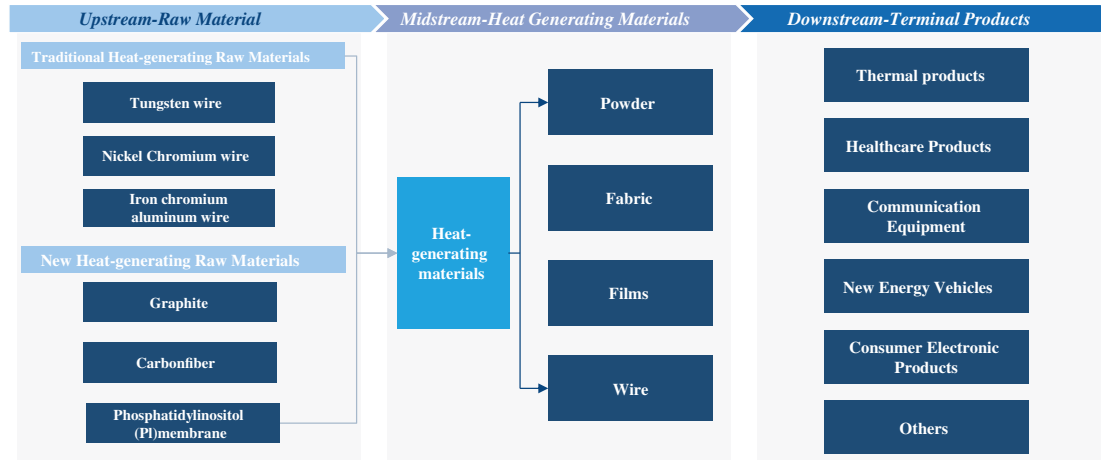
Heat-generating materials refer to materials that can generate heat in some way. These materials are used in a wide range of applications, including heating devices, healthcare, outdoor travel, and other areas. The design and selection of a heat-generating material depends on factors such as the desired rate of heat release, the temperature range, and the environment in which it will be used.

The industrial chain of the heat-generating materials and products industry includes upstream raw materials, midstream heat-generating materials and downstream terminal products. Upstream raw materials mainly include traditional heat-generating raw materials and new heat-generating raw materials. Traditional heat-generating materials are mainly metallic materials; new heat-generating materials are primarily non-metallic, including graphene, carbon fiber and others. Midstream refers to heat-generating materials. Around 90% of new heat-generating materials are graphene-based.

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Downstream applications mainly include thermal products (including warm clothing, bedding products, etc), consumer electronic products, healthcare products, household appliances, communication equipment, new energy vehicles, graphene-integrated thermal products and other sectors.

Industrial Chain of the Heat-generating Materials and Products Industry

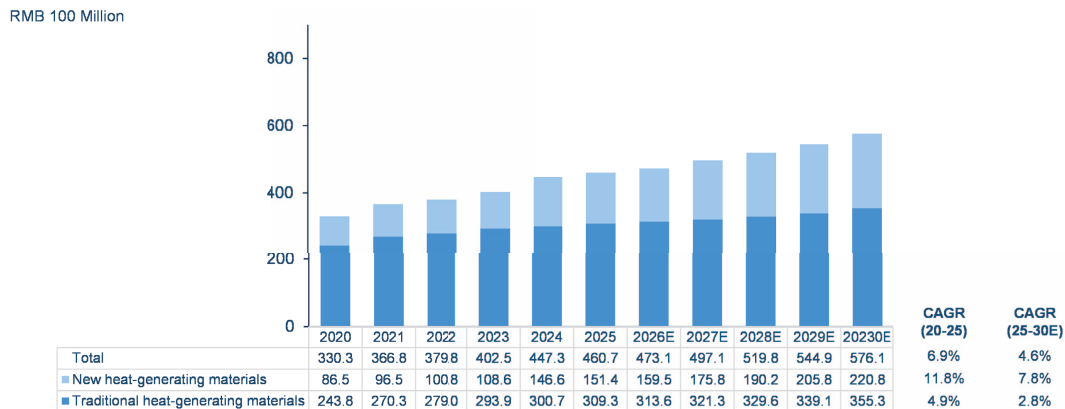


Source: Frost & Sullivan Analysis

MARKET SIZE OF CHINA’S HEAT-GENERATING MATERIALS AND PRODUCTS INDUSTRY

China’s heat-generating materials industry is significantly affected by technological breakthroughs and national policies in the PRC. The market size achieved growth in the past several years, from RMB33.0 billion in 2020 to RMB46.1 billion in 2025, representing a CAGR of 6.9% from 2020 to 2025. China’s heat-generating materials market is expected to further expand over the next few years, reaching RMB57.6 billion in 2030, with a CAGR of 4.6% from 2025 to 2030. In particular, the market size of the new heat-generating materials increased from RMB8.7 billion in 2020 to RMB15.1 billion in 2025, representing a CAGR of 11.8% from 2020 to 2025. China’s new heat-generating materials market is expected to further expand over the next few years, reaching RMB22.1 billion in 2030, with a CAGR of 7.8% from 2025 to 2030.

Heat-generating materials, Breakdown by type of materials, China, 2020 – 2030E



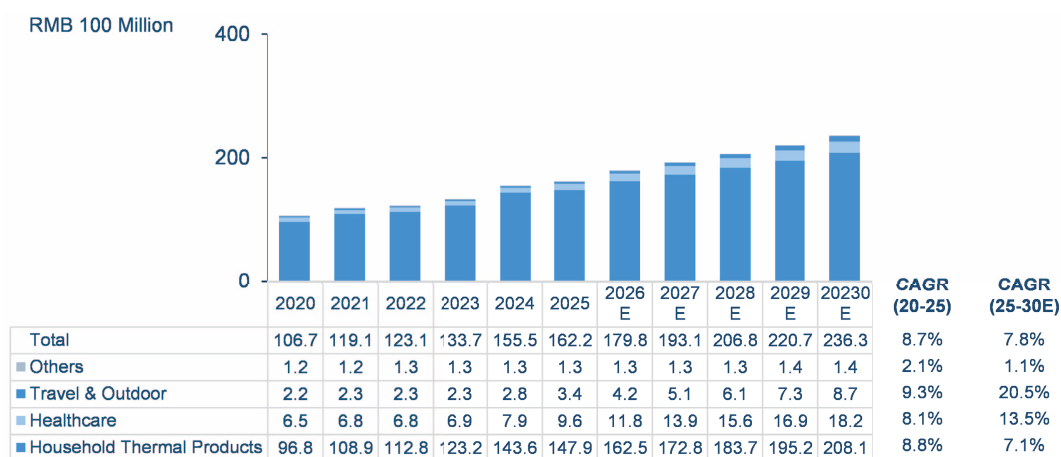
Source: China Composites Industry Association (CCIA), Frost & Sullivan Analysis

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New heat-generating products mainly refer to products that used new heat-generating materials such as graphene to achieve high efficiency, safety, energy saving and multi-functional heating devices. The market size of China’s new heat-generating products market increased from RMB10.7 billion in 2020 to RMB16.2 billion in 2025, representing a CAGR of 8.7% from 2020 to 2025. China’s new heat-generating products market is expected to further develop over the next few years, reaching RMB23.6 billion in 2030, with a CAGR of 7.8% from 2025 to 2030. Household thermal products are one of the largest downstream applications which household thermal products include warm clothing, bedding products. The market size of new heat-generating in household thermal products increased from RMB9.7 billion in 2020 to RMB14.8 billion in 2025, representing a CAGR of approximately 8.8% from 2020 to 2025. China’s new heat-generating products market in household thermal products is expected to further develop over the next few years, reaching RMB20.8 billion in 2030, with a CAGR of 7.1% from 2025 to 2030. After the ice and snow economy and the Winter Olympics, the demand for products such as heat-generating clothes and home heat-generating products is gradually increasing as consumers’ awareness and understanding of graphene products deepens. This drives the future growth of the new heat-generating products market. The market size of new heat-generating materials in healthcare increased from RMB0.7 billion in 2020 to RMB1.0 billion in 2025, representing a CAGR of approximately 8.1% from 2020 to 2025. China’s new heat-generating materials market in healthcare is expected to further develop over the next few years, reaching RMB1.8 billion in 2030, with a CAGR of 13.5% from 2025 to 2030. The market for household thermal products is larger than the market for new heat-generating materials because of the added value of selling downstream products.

In new heat-generating products market, the market size of smart thermal clothing, personal relaxing products and travel and outdoor products are RMB0.4 billion, RMB0.2 billion and RMB0.3 billion in 2025, respectively.

New Heat-generating Products, Breakdown by Downstream Applications, China, 2020 – 2030E



Source: CCIA, Frost & Sullivan Analysis

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MARKET DRIVERS OF CHINA’S NEW HEAT-GENERATING MATERIALS AND PRODUCTS INDUSTRY

Favorable Policies and Fiscal Initiatives: The National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT), and other government agencies have introduced a series of policies to encourage the development of new heat-generating materials and products industry. Compared to other regions in China, the northeast region has more companies focusing on R&D in new heat-generating materials and products industry due to its special climatic conditions. Therefore, the government launched a series of financial support policies for northeast region of China, some specific initiatives include: (i) implementing tax reductions, especially for small and micro-enterprises lowering the VAT rate in the manufacturing sector, and reducing the taxes and fees faced by small and micro-enterprises; (ii) providing comprehensive financial subsidies to support advanced industries; and (iii) introducing R&D post-subsidies to encourage science and technology innovation.

Wide Range of Downstream Applications and Strong Market Demand: In home and living sector, intelligent temperature-controlled mattresses and electric carpets using graphene, carbon fibre, and other high-tech materials are highly sought after by consumers. New heat-generating materials is widely used in physical therapy and health care sector, such as hot compresses, far-infrared physical therapy devices, etc. The travelling and outdoor industry also brings development opportunities for new heat-generating materials and products industry. With the popularity of outdoor sports, there is a growing demand for outdoor warming equipment. New heat-generating materials are used in outdoor jacket, hiking shoes, camping tents and sleeping bags to keep these gears warm and comfortable in cold environments. They are easy to carry and provide warmth at critical moments, ensuring a pleasant and safe journey.

Growing Investment in R&D and Technological Breakthroughs: With the rapid development of the graphene industry and the intensification of market competition, enterprises and scientific research institutions have increased their investment in graphene technology research and development. Some companies have also established cooperative relations with universities and research institutes to jointly promote the research and development and application of graphene technology. This cooperation model helps to integrate the resources of all parties and improve the efficiency and quality of R&D.

Rising Environmental Protection Awareness: As environmental protection awareness rises, environmentally friendly heat-generating materials are being highlighted, driving up demand for green, sustainable products. As major new heat-generating material, the graphene heat-generating process does not produce harmful gases or radiation, making it harmless to the human body; Its high stability and durability ensure the long-term safety use of the product. At the same time, graphene material has good corrosion resistance and high-temperature resistance, which can effectively extend the service life of floor heating systems, reduce the frequency of maintenance and replacement.

Growing Ageing Population and Rising Health Awareness: With the ageing population and the improvement in health consciousness, the demand for warmth and health care products is increasing, and the growing demand for medical and health care, warmth and health care, and other industry markets provides positive impact for the development of new heat-generating materials industry, which brings good growth expectations. The public’s demand for health care due to the ageing population and increased health awareness has given rise to new heat-generating products such as graphene heat-generating knee pads, neck pads, eye masks, and other new heat-generating products. In terms of medical treatment, new heat-generating materials also have applications and needs.

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FUTURE TRENDS OF CHINA’S NEW HEAT-GENERATING MATERIALS AND PRODUCTS INDUSTRY

The Ice and Snow Economy Drives the Growth of the New Heat-generating Product Market: A number of central policies to support the development of the ice and snow economy was introduced, ranging from continuous promotion of the popularization and development of ice and snow sports across the country, to stimulating the vitality of ice and snow economy with the high-quality development of ice and snow sports. At the 2022 Beijing Winter Olympics, graphene heating clothing, seats, carpets and other products attracted attention for their excellent thermal performance. Meanwhile, the high voltage graphene-based film technology begins to play a role in military, aerospace and other fields. After the Winter Olympics, the demand for graphene based heating clothing, household products and other products has gradually increased.

The Industrial Transformation and Infrastructure Boom in Northeast China Have Driven the Growth of Demand for Thermal Equipment: The transformation of traditional industries in Northeast China is developing rapidly. As one of the coldest regions in China, the Northeast region often has extremely cold weather with degrees below zero, and outdoor workers exposing to severe cold and strong winds is driving demand for thermal equipment. With the continuous development of the engineering industry, engineering companies are paying more attention to the safety and health of workers, so the demand for thermal equipment such as outdoor jacket and sleeping bag have increased significantly, driving the growth of the sleeping bag industry in Northeast China.

Enterprises Move Towards High-end, One-stop Integrated Manufacturers: The industry’s future development trend is towards high-end, one-stop integrated manufacturers. The one-stop manufacturer can determine the direction of upstream new heat-generating material research and development and manufacturing according to the requirements of new heat-generating products to make their product offerings more diversified and personalized. To a certain extent, they can eliminate the limitations of upstream materials and have more advantages in producing high-end products. In addition, the one-stop comprehensive manufacturing model can provide manufacturers with resource integration, information sharing, helping them develop and enhance their competitiveness in the new heat-generating materials and products market.

Enterprise Manufacturing Becomes More Standardized: As new heat-generating material technology continues to advance, the development of industry standards will inevitably follow. Many companies are enhancing their manufacturing processes through intelligent production technologies. These companies effectively utilize innovations such as the Internet of Things, big data, intelligent production and artificial intelligence to manage and optimize their production processes, leading to improved standardization and uniformity of their products.

Enterprises Meet Diversified Heat-generating Needs: The new heat-generating materials and products enterprises, such as leading floor heat-generating companies, have begun to provide users with a personalized heat-generating experience through continuous R&D and technological innovation to meet the diverse needs of customers. Adopting intelligent sensing technology, it can automatically adjust the heat-generating power according to the indoor temperature and people’s activities to achieve intelligent control, so that users can enjoy just the right warmth without manual adjustment. In the future, intelligent temperature control is expected to become feasible, improving heat-generating efficiency, and save energy.

Enterprises Promote Distributorship Models and Brand Reputation-Building: Going forward, it is expected that the distributorship model will be more and more widely used in the new heat-generating material and product market. Distributors can reduce the capital pressure of new heat-generating materials and products enterprises, help them adapt to market changes, and assist

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enterprises in adjusting their products and market strategies. On the other hand, new heat-generating materials and products companies are more likely to enhance their brand reputation through advertising, the distributorship model can expand sales coverage and increase brand reputation and trust of the product.

Sales Prospect is Broad in the Field of Comfortable Car-Seats: The increasing demand of consumers for driving sense experience has increasingly become prominent for car seat comfort in car sales. In order to improve the comfort of car seats, many car seats are now equipped with heating functions. The heating element of the traditional heating pad uses resistance wires, facing problems of uneven heating, slow heating rate, and high energy consumption. Compared with the traditional resistance wire heating pad, the graphene heating pad has a faster heating rate, less energy consumption and better thermal uniformity, and has broad market sales prospects.

ENTRY BARRIERS ANALYSIS OF CHINA’S HEAT-GENERATING MATERIALS AND PRODUCTS INDUSTRY

Technical Barrier: (i) R&D of high thermal conductivity materials: With the increasing integration and power of electronic equipment, the requirements for thermal conductivity materials are becoming more demanding, and the research and development of high thermal conductivity materials has become a key technical bottleneck in the industry. Enterprises need to invest a lot of resources in R&D to improve the thermal conductivity and stability of these materials; and (ii) Sustainability of technological innovation: With the continuous progress of science and technology, the research and development and application of new thermal conductive materials will be more extensive. Enterprises need to maintain the continuity of technological innovation to cope with the continuous changes in market demand and the rapid iteration of technology.

Market access barriers: (i) High requirements for downstream production enterprises: Downstream production enterprises of heating materials, such as leading enterprises in consumer electronics, communications, automobiles and other fields, have high requirements for suppliers’ product quality, capital status, production capacity, and R&D capabilities. New entrants need to meet these requirements in order to enter the market; and (ii) Establishment of supplier system: Downstream production enterprises often establish a stable supplier system, which will not be easily replaced once established. New entrants need to spend a lot of time and effort to build their own supplier system.

Capital Barrier: (i) R&D investment: The heat-generating materials and products industry is a technology-intensive industry, and enterprises need to invest a lot of money in technology R&D and product innovation. This poses a big challenge for companies with limited financial resources; and (ii) Equipment purchase and production line construction: The production of high-performance thermal conductive materials requires advanced production equipment and production lines, and the purchase of such equipment and the construction of production lines require a large amount of capital investment.

Policy and regulatory barriers: (i) The impact of environmental protection regulations: With rising environmental awareness and the strengthening of environmental protection regulations, enterprises need to increase investment in environmental protection facilities to ensure that environmental protection standards are met in the production process. This poses a big challenge for some enterprises with inadequate environmental protection facilities; and (ii) Compliance with safety production regulations: The thermal conductive materials industry involves some hazardous chemicals and dangerous working environments such as high temperature and high pressure, and enterprises need to strictly abide by safety production regulations to ensure safety in the production process.

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CHALLENGE ANALYSIS OF CHINA’S HEAT-GENERATING MATERIALS AND PRODUCTS INDUSTRY

Increasing Labor Cost: Labor force is an important factor in the heat-generating materials and products industry. As the economy develops, labor costs in China have been rising in recent years. The average annual salary of employees in China increased from RMB79.9 thousand in 2020 to RMB107.4 thousand in 2025, with CAGRs of 6.1%, respectively. This increase in labor costs poses significant operational risks for industry participants, as higher expenses erode profit margins, the competitiveness of the industry will be reduced, hence the sustainability of businesses will be challenged, particularly for smaller companies with limited resources.

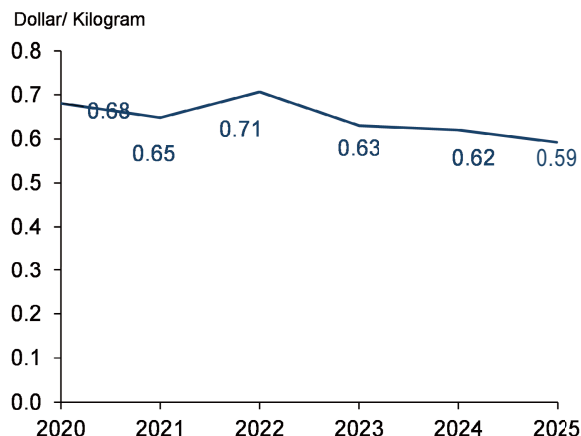
COST ANALYSIS OF CHINA’S HEAT-GENERATING MATERIALS AND PRODUCTS INDUSTRY

The charts below show the trend of the import and export prices of graphene raw materials from 2020 to 2025. Import prices are on a downward trend between 2020 and 2025, with the highest point reached \$0.71/kg in 2022. Changes in import prices can cause cost fluctuations for new heat-generating materials and products. On the other hand, export prices are also on a downward trend, with the highest point at \$1.57/kg in 2022.

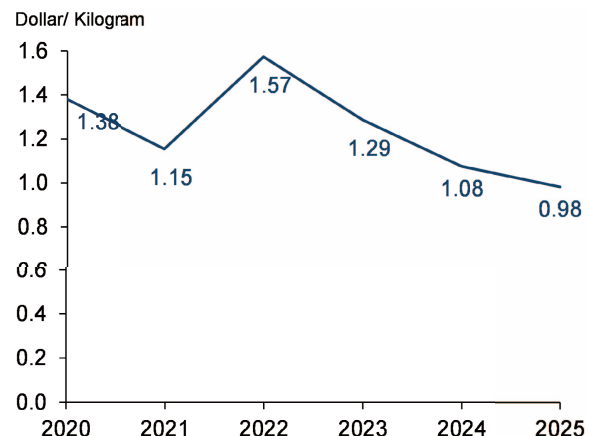
At present, graphene raw materials are experiencing price fluctuations. Since 2020, the global economic growth has slowed down, there has been an overall overcapacity of the graphite, and the price of graphite has fallen. In 2020, the demand for electric vehicles rose rapidly, leading to a sharp increase in the demand for power batteries, and high-purity graphite raw materials, resulting in a rise in graphite prices.

The overall characteristics of the global graphite trade is relatively concentrated in export and relatively deconcentrated in import. The world’s major graphite exporters are China, Madagascar, Mozambique, Germany and Brazil. The demand side of graphite trade is more dispersed, and no country occupies a large share of trade. The main importing countries are South Korea, Japan, Germany, India and United States. Meanwhile, TPU film is also recognized as major raw material of China’s heat-generating materials and products industry. TPU film prices remained relatively stable during 2020 and 2025, with minor fluctuations influenced by several factors. The slight decrease was primarily attributed to improved production efficiencies among major manufacturers and increased market competition in the Asia-Pacific region. Additionally, the stability of oil prices, a key raw material in TPU production, may have also influenced TPU film price consistency. While demand from the automotive and electronics sectors continued to grow, expanded production capacity from key suppliers helped balance the market, preventing significant price volatility. In the future, TPU film prices will stabilize and rise as costs fall and demand resilience supports them.

Graphene Raw Material Import Price, 2020–2025



Graphene Raw Material Export Price, 2020–2025



Source: National Bureau of Statistics of China, National Energy Administration, Frost & Sullivan Analysis

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COMPETITIVE LANDSCAPE ANALYSIS

The process of making new heat-generating materials, such as graphene is complex and requires extremely high purity. Traditional heat-generating materials, such as wires, require only basic metallurgical processes, makes traditional heat-generating materials producers difficult to enter the new heat-generating materials market. As such, it is reasonable analyse the competitive landscape of the new heat-generating materials industry separately from that of the traditional heat-generating materials industry.

In 2025, the total revenue generated from enterprises of new heat-generating materials in China reached RMB15,140 million, with the top five market participants accounting for approximately 0.7% market share. With approximately RMB23 million revenue of new heat-generating materials, the Group accounted for around 0.2% of market share in 2025 and ranked 2nd in China’s new heat-generating materials market by 2025.

In 2025, there are over 50 thousand participants in new heat-generating materials and products industry in China.

Ranking of Top 5 Companies in China’s New Heat-generating Materials Industry in 2025 by Revenue

Ranking	Enterprise	Revenue during the year ended 2025 (100 Million RMB)	Market share during the year ended 2025 (%)
1	Company A	0.33	0.2%
2	The Group	0.23	0.2%
3	Company B	0.21	0.1%
4	Company C	0.17	0.1%
5	Company D	0.12	0.1%
	Top 5	1.06	0.7%
	Others	150.34	99.3%
	Total	151.40	

Source: Expert Interviews, annual reports, Frost & Sullivan

In 2025, the total revenue of new heat-generating products produced in China reached RMB16,220 million, with the top five market participants accounting for approximately 1.7%. With approximately RMB96 million in revenue from new heat-generating products, the Group accounted for around 0.6% of the market share in 2025 and ranked 1st in China’s new heat-generating products market by 2025.

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Ranking of Top 5 Companies in China’s New Heat-generating Products Industry in 2025 by Revenue

Ranking	Enterprise	Revenue during the year ended 2025 (100 Million RMB)	Market share during the year ended 2025 (%)
1	The Group	0.96	0.6%
2	Company E	0.80	0.5%
3	Company F	0.41	0.3%
4	Company C	0.35	0.2%
5	Company B	0.21	0.1%
	Top 5	2.73	1.7%
	Others	159.47	98.3%
	Total	162.20	

Source: Expert Interviews, annual reports, Frost & Sullivan

Notes:

- (1) Company A: Established in 2011, this private company is headquartered in Jiangsu Province, China. The company specializes in the R&D, production, and sales of carbon nanotube materials (including electronic protective materials, insulating materials, and consumables), along with supporting equipment and components. It serves the advanced materials and electronics industries through technological innovation and integrated solutions.
- (2) Company B: Established in 2015, this company is a private company headquartered in Shenzhen, Guangdong, China. The company focuses on the application research and development and production of graphene heating technology, and the industry involves consumer goods such as maintenance and protective gear, clothing and home textiles, beauty, and energy rooms; Graphene heating, graphene modified anticorrosive coatings and other industrial applications.
- (3) Company C: Established in 2018, this company is a private company headquartered in Jinhua, Zhejiang Province, China. The company is a high-tech enterprise dedicated to the industrial application of graphene, integrating R&D, production, sales, installation, and service.
- (4) Company D: Established in 2012, this company is a private company headquartered in Foshan, Guangdong, China. The company developed and mastered core technologies for electric heating films, and produce commercial, agricultural, and residential electric heating equipment such as graphene electric heating film floor heating systems and electric space heaters.
- (5) Company E: Established in 2018, this company is a private company headquartered in Beijing, China. The company’s business scope includes technical services, technology transfer, technology development, technology promotion, technical consultation; enterprise management consulting; construction project management; sales of plastic products, electronic products, chemical products, etc.
- (6) Company F: Established in 2013, this company is a private company headquartered in Shenzhen, Guangdong, China. The company developed a full range of graphene-based heating materials, including low-temperature, medium-temperature, and high-temperature heating materials. Its business scope includes: R&D and sales of electric heating film, far-infrared film, and related application products.