Global and China's Refrigeration And Air-conditioning Control Component and Automotive Thermal Management System Component Market

Independent Market Study

Confidential for

Zhejiang Sanhua Intelligent Controls Co., Ltd.

Frost & Sullivan

2025

Content

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Definition and Overview

- Refrigeration and air-conditioning control components are integral parts used in air conditioners and other refrigeration facilities for household and commercial application scenarios. They provide essential functions such as controlling heating and cooling processes, regulating refrigerant flow, measuring pressure, among others. The primary components category that fulfill these essential functions include valves, heat exchangers, controllers and pumps.

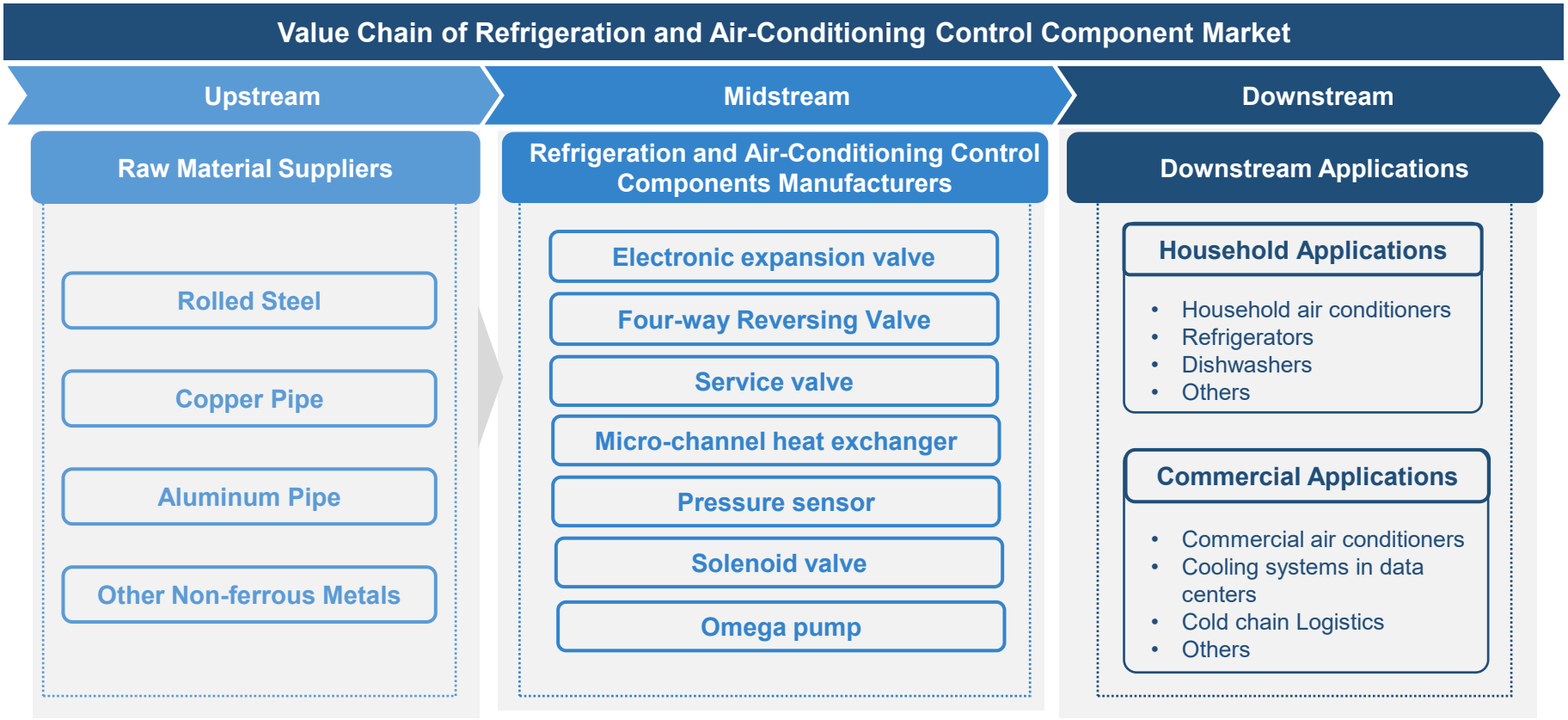
Functions and Applications of Refrigeration and Air-Conditioning Control Components

Category	Component	Function	Main Application
Valves	Electronic Expansion Valve	Regulate refrigerant flow into the evaporator to optimize cooling efficiency	Refrigeration and air conditioning system, refrigerator
	Four-way Reversing Valve (1)	Change the direction of the refrigerant flow to enable the transition between cooling and heating modes	Refrigeration and heating cycle systems
	Solenoid Valve(2)	Electrically controlled to control the flow of refrigerants	Refrigeration units, freezers, air conditioners, heat pumps and coffee machine
	Service Valve(3)	Regulate refrigerant circulates through the system	Split type air conditioners
	Ball Valve(4)	Efficiently control the flow of refrigerant	Refrigeration and air conditioning system
	Assemblies	Connect valves and carry and transport refrigerants	Refrigeration and air conditioning system
	Others	Including electric valve, thermostatic expansion valve, electric switching water valve, water inlet valve for washing machines, gas valve and other valves that regulate the flow of refrigerants and fluid	Refrigeration and air conditioning system and washing machine
Heat Exchangers	Micro-channel Heat Exchanger	Heat exchanger with a channel hydraulic diameter of less than 3mm, which improves the heat exchange capacity of the fluid	Household and commercial air conditioning, refrigeration systems, and washing machine
	Others	Including brazed plate heat exchanger and other heat exchangers that efficiently transfer heat	Refrigeration and air conditioning system
Controllers	Pressure Sensor	Detect pressure and convert it into a signal for precise system regulation	Air conditioning, refrigeration and heat pump systems
	Inverter Controller	Optimize energy performance by intelligently adjusting the operating modes of compressors	Refrigeration and air conditioning system
	Others	Including controller, temperature controller and other controllers that regulate and control the cooling process	Refrigeration and air conditioning system
Pumps	Omega Pump(5)	Pumps housings with integrated, direct or indirect heating of the rinse water, optionally assembled systems including inlet and outlet hoses and integrated thermal safety elements	Dishwashers
	Others	Including drain pump, shielded pump for water and other pumps used for the transportation, circulation and pressure regulation of liquids or gases	Refrigeration and air conditioning system
Others		Including motorized damper, micro-channel condenser, superconductive plate, filter drier and other components used for controlling heating and cooling processes	Household and commercial air conditioning, refrigeration systems, and washing machine

Source: Frost & Sullivan Analysis

Notes:
(1) The scope of four-way reversing valves includes gigaforce four-way reversing valves.
(2) The scope of solenoid valves includes bistable solenoid valves and coffee machine solenoid valves.
(3) The scope of service valves includes bar-stock service valves.
(4) The scope of ball valves includes water ball valves.
(5) The scope of Omega pumps includes Omega BLDC pumps.

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market
Value Chain Analysis



- The value chain of refrigeration and air-conditioning control component market involves upstream raw material suppliers, midstream refrigeration and air-conditioning control component manufacturers and downstream applications. Upstream raw material suppliers primarily produce raw materials that primarily include copper, aluminum and other non-ferrous metals. Midstream refrigeration and air-conditioning control component manufacturers primarily produce a variety of components. Downstream applications primarily include household and commercial applications, among which household applications mainly include household air conditioners, refrigerators and dishwashers, among others, whilst commercial applications mainly include commercial air conditioners, refrigeration systems in cold chain logistics and cooling systems in data centers, among others.

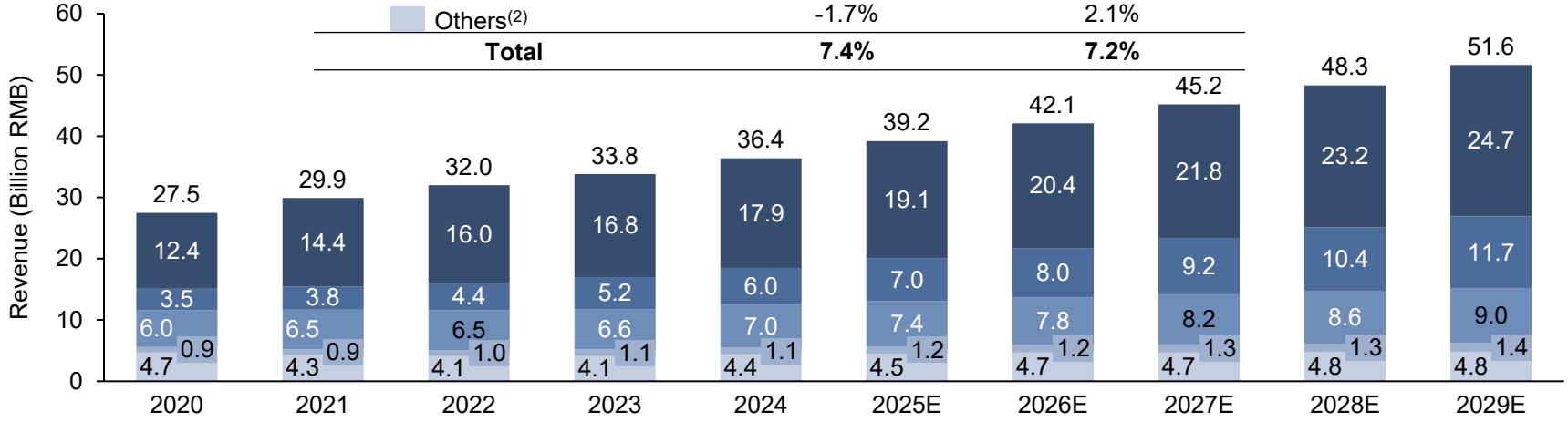
Source: Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Global Market Size of Refrigeration and Air-conditioning Control Components

Revenue of Refrigeration and Air-conditioning Control Components Market By Category (Global), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
Valves	9.7%	6.6%
Heat exchangers	14.8%	14.1%
Controllers	3.9%	5.2%
Pumps(1)	7.0%	4.4%
Others(2)	-1.7%	2.1%
Total	**7.4%**	**7.2%**



- The global market size of refrigeration and air-conditioning control components in terms of revenue increased from RMB27.5 billion in 2020 to RMB36.4 billion in 2024, with a CAGR of 7.4%. With the increasing demand for refrigeration and air-conditioning, the global market size of refrigeration and air-conditioning control components categories in terms of revenue is expected to reach RMB51.6 billion in 2029, representing a CAGR of 7.2% from 2024 to 2029. In terms of revenue in 2024, the global market size of valves, heat exchangers, controllers and pumps accounted for 49.2%, 16.5%, 19.2% and 3.0%, respectively, of the global market size for refrigeration and air-conditioning control components, totaling an aggregate of 87.9%.

Notes:

(1) The revenue of Omega pumps under the pumps category equals the shipment of Omega pumps multiplied by the average selling price, as major manufacturers of Omega pumps include appliance manufacturers who produce Omega pumps to be integrated into their own products and do not generate revenue from sales of Omega pumps. For other pumps under the pumps category, revenue is calculated based on sales volume and average selling price.

(2) Others include approximately ten types of components, such as motorized damper, micro-channel condenser, superconductive plate, filter drier and other components used for controlling heating and cooling processes.

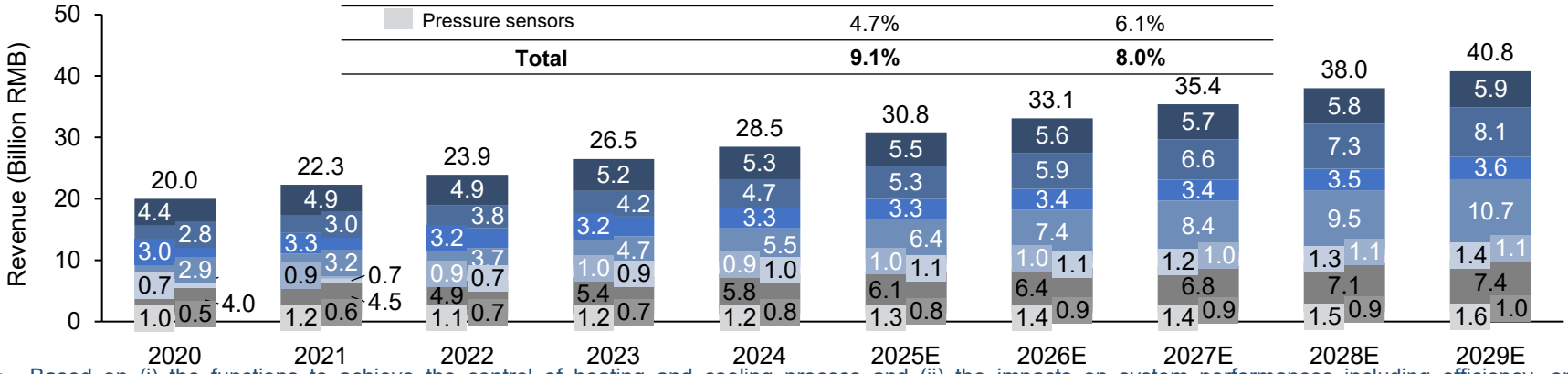
Source: Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Global Market Size of Key Refrigeration and Air-conditioning Control Components

Revenue of Key Refrigeration and Air-conditioning Control Components Market (Global), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
Four-way reversing valves	4.8%	2.2%
Electronic expansion valves	13.6%	11.6%
Service valves	2.4%	1.8%
Micro-channel heat exchangers	16.9%	14.4%
Solenoid valves	6.5%	4.9%
Omega pumps*	9.3%	6.9%
Inverter controllers	9.8%	5.0%
Ball valves	9.9%	4.8%
Pressure sensors	4.7%	6.1%
Total	**9.1%**	**8.0%**



- Based on (i) the functions to achieve the control of heating and cooling process and (ii) the impacts on system performances including efficiency, energy conservation, precise regulation and automatic control, there are certain key refrigeration and air-conditioning control components (the "key components"). Key components primarily include four-way reversing valves, electronic expansion valves, service valves, micro-channel heat exchangers, solenoid valves, Omega pumps, inverter controllers, ball valves and pressure sensors.
- From 2020 to 2024, the global revenue of four-way reversing valves, electronic expansion valves, service valves, micro-channel heat exchangers, solenoid valves, Omega pumps, inverter controllers, ball valves and pressure sensors grew at a CAGR of 4.8%, 13.6%, 2.4%, 16.9%, 6.5%, 9.3%, 9.8%, 9.9% and 4.7%, respectively. The global revenue of four-way reversing valves, electronic expansion valves, service valves, micro-channel heat exchangers, solenoid valves, Omega pumps, inverter controllers, ball valves and pressure sensors is expected to grow at a CAGR of 2.2%, 11.6%, 1.8%, 14.4%, 4.9%, 6.9%, 5.0%, 4.8% and 6.1% from 2024 to 2029, respectively. In terms of revenue in 2024, the global market size of four-way reversing valves, electronic expansion valves, service valves, micro-channel heat exchangers, solenoid valves, Omega pumps, inverter controllers, ball valves and pressure sensors accounted for 14.6%, 12.9%, 9.1%, 15.1%, 2.5%, 2.7%, 15.9%, 2.2% and 3.3%, respectively, of the global market size for refrigeration and air-conditioning control components, totaling an aggregate of 78.3%.

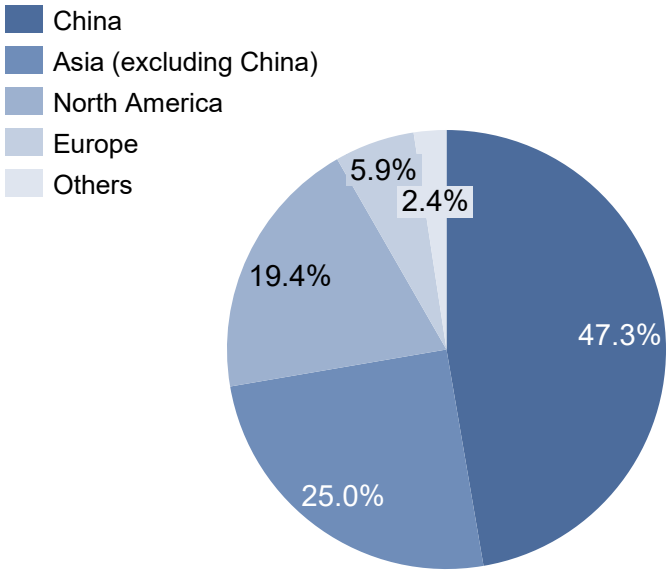
Source: Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Note: The revenue of the global market size of Omega pumps equals the shipment of Omega pumps multiplied by the average selling price, as major manufacturers of Omega pumps include appliance manufacturers who produce Omega pumps to be integrated into their own products and do not generate revenue from sales of Omega pumps.

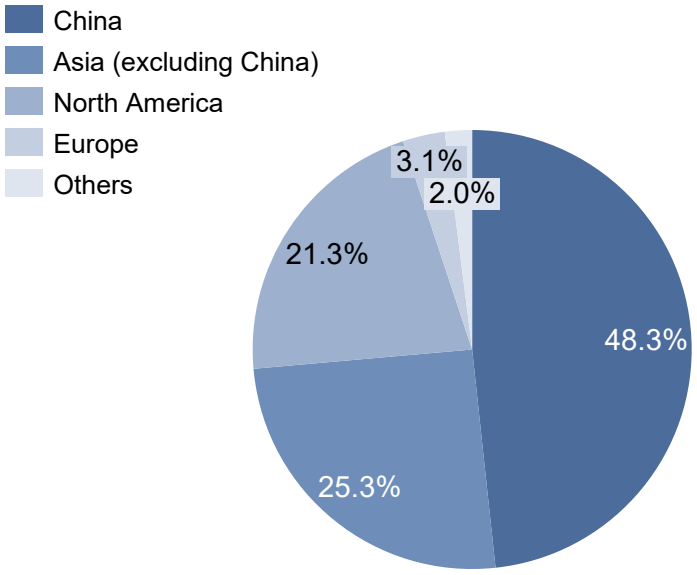
Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Revenue of Key Refrigeration and Air-conditioning Control Components by Region

Revenue of Refrigeration and Air-conditioning Control Component Market (By Region), 2024



Revenue of Refrigeration and Air-conditioning Control Component Market (By Region), 2029E



- China is the largest refrigeration and air-conditioning control component market in the world. In terms of revenue of refrigeration and air-conditioning control components in 2024, China accounted for approximately 47.3% of the global revenue. By 2029, the revenue of refrigeration and air-conditioning control components in China is expected to account for approximately 48.3% of the global revenue.

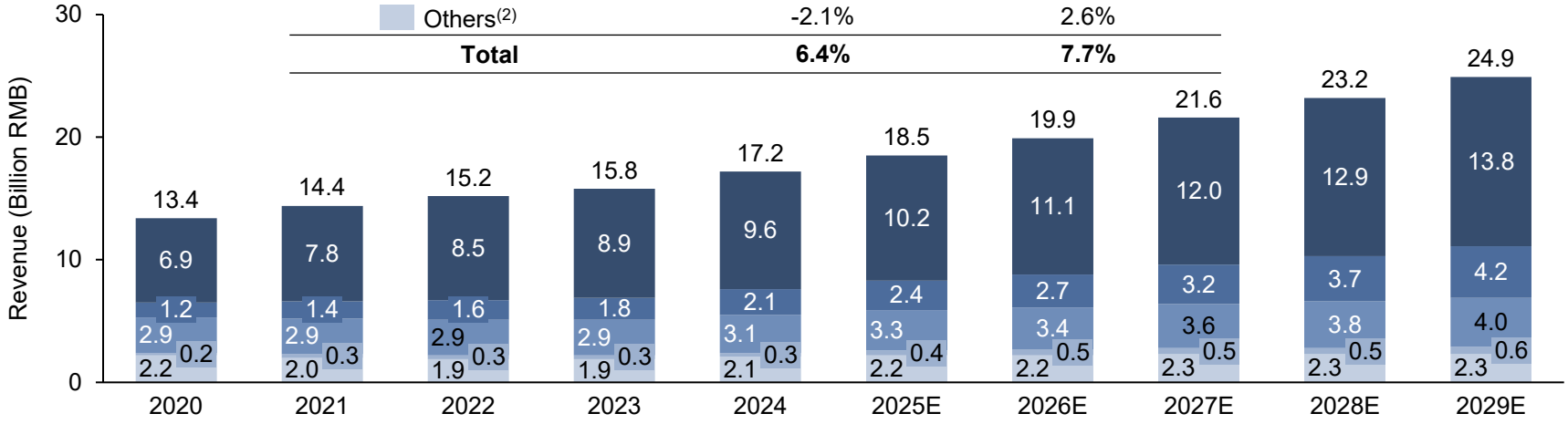
Source: Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Market Size of Refrigeration and Air-conditioning Control Components in China

Revenue of Refrigeration and Air-conditioning Control Components Market By Category (China), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
Valves	8.5%	7.6%
Heat exchangers	13.6%	15.4%
Controllers	1.7%	5.2%
Pumps[1]	15.4%	10.6%
Others[2]	-2.1%	2.6%
Total	**6.4%**	**7.7%**



- The market size of refrigeration and air-conditioning control components in China in terms of revenue increased from RMB13.4 billion in 2020 to RMB17.2 billion in 2024, with a CAGR of 6.4%. With the increasing demand for refrigeration and air-conditioning, the market size of refrigeration and air-conditioning control components categories in China in terms of revenue is expected to reach RMB24.9 billion in 2029, representing a CAGR of 7.7% from 2024 to 2029.

Notes:

(1) The revenue of Omega pumps under the pumps category equals the shipment of Omega pumps multiplied by the average selling price, as major manufacturers of Omega pumps include appliance manufacturers who produce Omega pumps to be integrated into their own products and do not generate revenue from sales of Omega pumps. For other pumps under the pumps category, revenue is calculated based on sales volume and average selling price.

(2) Others include approximately ten types of components, such as motorized damper, micro-channel condenser, superconductive plate, filter drier and other components used for controlling heating and cooling processes.

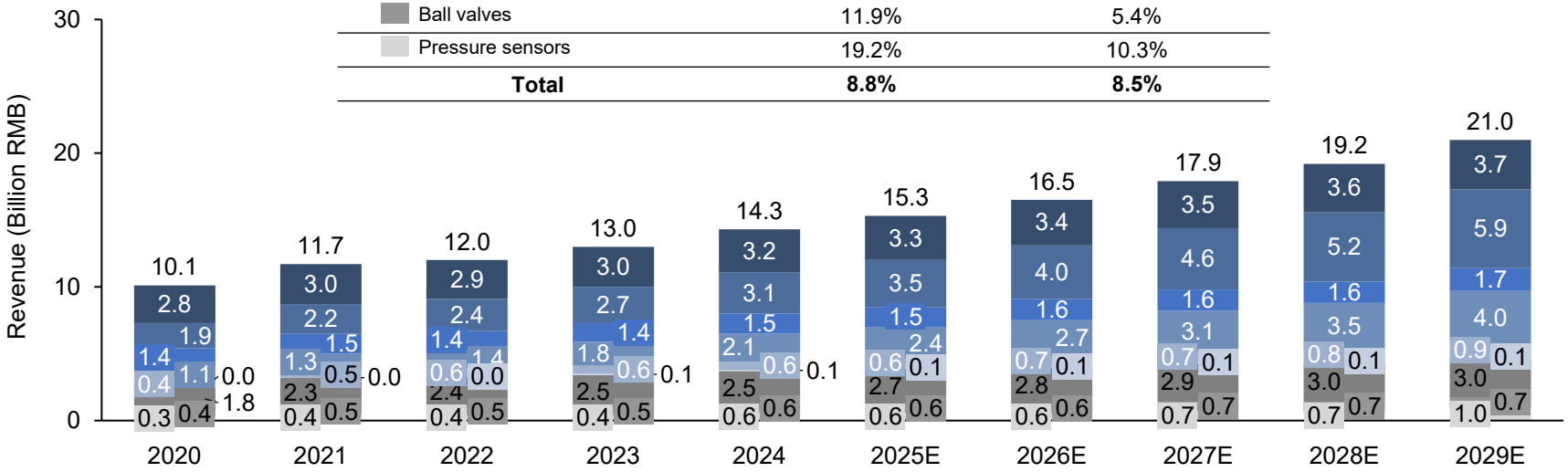
Source: China Refrigeration and Air-Conditioning Industry Association; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Market Size of Key Refrigeration and Air-conditioning Control Components in China

Revenue of Key Refrigeration and Air-conditioning Control Components Market (China), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
Four-way reversing valves	3.4%	2.8%
Electronic expansion valves	13.0%	13.3%
Service valves	1.7%	2.0%
Micro-channel heat exchangers	16.5%	14.3%
Solenoid valves	10.6%	8.0%
Omega pumps*	18.4%	13.2%
Inverter controllers	8.6%	3.7%
Ball valves	11.9%	5.4%
Pressure sensors	19.2%	10.3%
Total	**8.8%**	**8.5%**



- From 2020 to 2024, the revenue of four-way reversing valves, electronic expansion valves, service valves, micro-channel heat exchangers, solenoid valves, Omega pumps, inverter controllers, ball valves and pressure sensors in China grew at a CAGR of 3.4%, 13.0%, 1.7%, 16.5%, 10.6%, 18.4%, 8.6%, 11.9% and 19.2%, respectively. The revenue of four-way reversing valves, electronic expansion valves, service valves, micro-channel heat exchangers, solenoid valves, Omega pumps, inverter controllers, ball valves and pressure sensors in China is expected to grow at a CAGR of 2.8%, 13.3%, 2.0%, 14.3%, 8.0%, 13.2%, 3.7%, 5.4% and 10.3% from 2024 to 2029, respectively.

Source: China Refrigeration and Air-Conditioning Industry Association; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Note: The revenue of the market size of Omega pumps in China equals the shipment of Omega pumps multiplied by the average selling price, as major manufacturers of Omega pumps include appliance manufacturers who produce Omega pumps to be integrated into their own products and do not generate revenue from sales of Omega pumps.

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Market Drivers and Future Opportunities

Drivers	Main Content
Favorable policies promote low energy consumption	• As energy costs continue to rise, consumers are more willing to purchase appliances that can help them save utility costs and reduce their adverse impact on the environment. Meanwhile, governments worldwide have introduced a series of low-carbon and energy-saving policies to accelerate the green transformation of economic development. For instance, the State Council issued the "Action Plan for Energy Conservation and Carbon Reduction from 2024 to 2025" (《2024-2025年節能降碳行動方案》) in 2024, which proposed to strengthen the management of carbon emission intensity, and implement special actions for energy conservation and carbon reduction in different industries. Such supporting policies and growing awareness for energy conservation and carbon reduction drives the increasing demand for refrigeration and air-conditioning control components, such as electronic expansion valves that can improve heat exchange efficiency and reduce energy waste by precisely regulating refrigerant flow, and inverter controllers that can optimize energy performance by intelligently adjusting the operating modes of compressors. In addition, due to the accelerated elimination of refrigerants that cause environmental pollutions, the upgrade and replacement of air conditioners further drives the growth in downstream demand.
Growing requirements for product performance drive product iteration and upgrading	• Consumers are placing greater value on air conditioners of better quality and functionality that contribute to a healthy, comfortable, and eco-friendly home environment, which raises growing requirements for product performance of refrigeration and air-conditioning control components. In response to the growing requirements for product performance, refrigeration and air-conditioning control component manufacturers have been dedicated to conducting product iteration and upgrading. For instance, the technological upgrading in micro-channel heat exchangers such as the innovative design of bending areas can achieve miniaturization of core components and significantly enhance energy efficiency by increasing heat exchange surface area.
Rising living standards and increasing penetration rate of air conditioner	• With increasing consumer purchasing power and living standards, the penetration rate of air conditioners, particularly in emerging markets, continues to rise, further fueling the growth of the global air conditioners market. The global per capita annual net income grew at a CAGR of 4.9% from 2020 to 2024, whilst in emerging markets such as India, the per capita annual net income grew at a CAGR of 6.1% during the same period. Moreover, the penetration rate of air conditioners in some regions stays relatively low, with the average volume of air conditioners per hundred households in China, Americas and Europe reaching approximately 153, 95 and 43 as of December 31, 2024, respectively, while the average volume of air conditioners per hundred households in India reaching only 20 as of December 31, 2024. Therefore, the rising living standards create a greater demand for air conditioners, thereby stimulating demand for refrigeration and air-conditioning control components.
Global warming drives surging demand for air conditioners	• In recent years, due to global warming, extreme weather events, such as prolonged heatwaves, have become increasingly frequent, driving a significant increase in demand for air conditioning. For instance, in Europe, unprecedentedly high temperatures have resulted in the highest recorded average temperatures in summer, which has accelerated the popularization of air conditioners. From 2020 to 2024, the revenue of residential air conditioners in Europe increased from RMB43.5 billion to RMB68.8 billion, with a CAGR of 12.1%. Further, the surging demand for air conditioners in Europe boosted the demand for refrigeration and air-conditioning control components.

Source: Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market

Market Drivers and Future Opportunities

Future Opportunities

Growth in China's exports driven by increasing demand from overseas market	• The demand for refrigeration and air-conditioning control components in overseas markets continues to grow, driven by strict implementation of energy-saving and emission-reduction policies, as well as consumers' preference for high-performance products. China's refrigeration and air-conditioning control component manufacturers leads the global supply and are expanding their brand influence through superior product quality, efficient supply chain management and price advantages, thereby accelerating their global business expansion. Therefore, driven by increasing demand in overseas markets, the exports of refrigeration and air-conditioning control components in China is expected to maintain a stable growth in the future. With the early advantage and global recognition, the global R&D bases, localized production and sales network, the collaboration with many internationally renowned enterprises, and high-quality products and service tailored to local customer needs in overseas markets, our Group can benefit from the increasing demand from overseas market.
Growth prospects from emerging applications	• With the rapid growth of the cold chain logistics industry and data center industry, refrigeration and air-conditioning control components have ushered in broad development opportunities in emerging markets. From 2020 to 2024, the market size of cold chain logistics in China grew at a CAGR of 8.8%, whilst the market size of data center services in China grew at a CAGR of 11.6% during the same period. Emerging downstream applications raise higher requirements for the efficiency and reliability of refrigeration and air-conditioning systems, thereby driving the growth in demand for specialized components tailored for cold chain logistics and data centers. In the future, the growth prospects from emerging applications will further promote the development of the refrigeration and air-conditioning control component market.

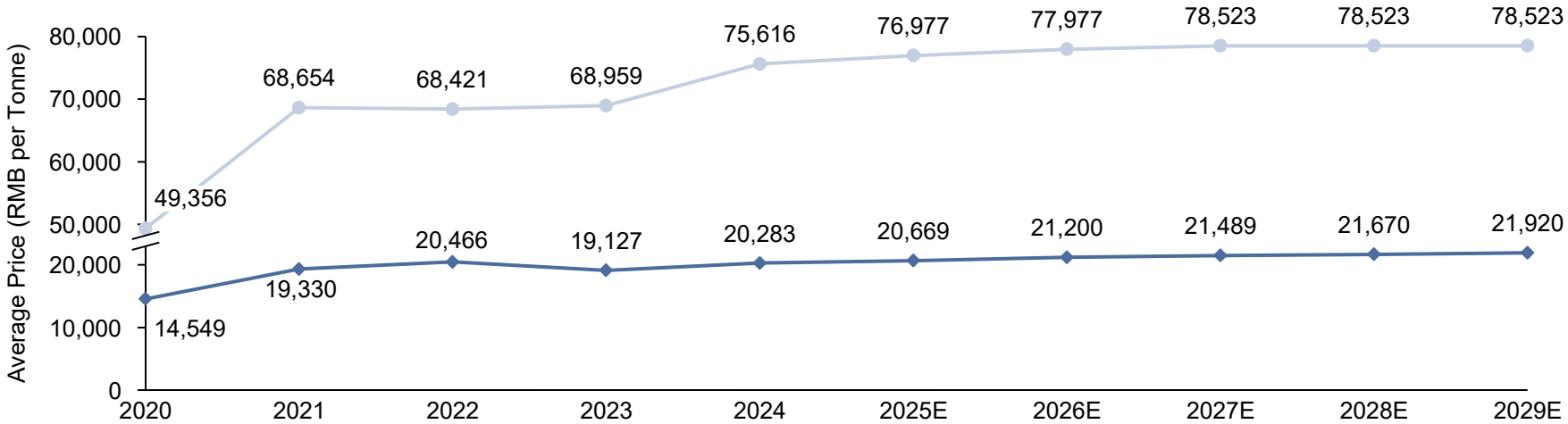
Source: Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Component Market

Average Prices of Major Raw Materials in China

Average Price of Major Raw Materials (China), 2020 – 2029E

Average Price	CAGR (2020-2024)	CAGR (2024-2029E)
Copper	11.3%	0.8%
Aluminum	8.7%	1.6%



- The average prices of copper and aluminum in China are primarily influenced by macro economy, supply and demand dynamics, policy regulations, and average prices in global markets. From 2020 to 2024, the average prices of copper and aluminum in China increased from RMB49,356 per tonne and RMB14,549 per tonne to RMB75,616 per tonne and RMB20,283 per tonne, with a CAGR of 11.3% and 8.7%, respectively. In 2021, the economic recovery in China following the COVID-19 pandemic led to a rapid increase in demand for copper and aluminum. In addition, restrictions on energy and power consumption significantly drove up the prices of these metals in China. In 2023, the demand for aluminum from downstream industries such as real estate and infrastructure construction declined, resulting in a decrease in aluminum prices. However, increased demand from the new energy and power industries boosted copper demand, leading to a rise in copper prices. In 2024, as central banks of major economies commence a rate-cutting cycle, copper prices are expected to rise rapidly due to its financial attributes. By 2029, the average prices of copper and aluminum in China is expected to reach RMB78,523 per tonne and RMB21,920 per tonne, with a CAGR of 0.8% and 1.6% from 2024 to 2029, respectively. The price fluctuations of copper and aluminum bring challenges for manufacturers of refrigeration and air-conditioning control components and automotive thermal management system component. These fluctuations in raw material prices poses a challenge for cost control, requiring companies to optimize procurement strategies and enhance cost management capabilities to mitigate the operational risks resulted from price fluctuations of copper and aluminum. Failure to establish effective cost control and hedging mechanisms to address raw material price fluctuations may result in increased production costs, reduced profits, and forced adjustments in product prices, thereby impacting market competitiveness.

Source: National Development and Reform Commission; IMF; Frost & Sullivan Analysis

- The global refrigeration and air-conditioning control component market is highly concentrated, with approximately 60 refrigeration and air-conditioning control component manufacturers as of December 31, 2024. With the increasingly prominent technical barriers and scale advantages in the refrigeration and air-conditioning control component market, the global market concentration is showing an upward trend. Leading component manufacturers have continuously consolidated their dominant positions through technological improvement, product quality and cost efficiency advantages. In contrast, small component manufacturers may find it difficult to compete with leading manufacturers, due to insufficient technological reserves, limited production scale, and relatively weak supply chain integration capabilities. Our competitors in the global refrigeration and air-conditioning control component market mainly include Dun'an Environment, Saginomiya Seisakusho, Fujikoki and Danfoss, among others.
- In terms of revenue in 2024, the global top three manufacturers of refrigeration and air-conditioning control components accounted for approximately 81.0%, among which our Group ranked first, with a market share of approximately 45.5%.

Main Participants in Global and China's Refrigeration and Air-conditioning Control Component Market

SANHUA
AMPRON Better Sensor Better Life
GANGLI 中山市港利制冷配件有限公司 Gangli Refrigeration Fittings Co., Ltd.
Sensata Technologies
DunAn 盾安环境
Danfoss
EMERSON
SAGInoMIYA
不二製作所
鸿森 HONGSEN
Parker
WANDUN 万盾制冷 WANDUN REFRIGERATION

Source: Frost & Sullivan Analysis

Top Three Providers of Refrigeration and Air-conditioning Control Components in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**16.6**	**45.5%**
2	Company A(1)	Zhejiang Province, China	9.6	26.4%
3	Company B(2)	Japan	3.3	9.1%

- In terms of revenue in 2024, the global top three manufacturers of refrigeration and air-conditioning control components accounted for approximately 81.0%, among which our Group ranked first, with a market share of approximately 45.5%.

Notes:
(1) Company A is a group established in 2001 and listed on the Shenzhen Stock Exchange in 2004, engaging in the provision of refrigeration components, air conditioning equipment and core components of NEV thermal management systems.
(2) Company B is a private group established in 1948, engaging in the provision of refrigeration components, automatic controls, air conditioning and other HVAC equipment.

Source: Annual Reports; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market
Ranking and Market Share

Top Three Providers of Refrigeration and Air-conditioning Valves in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**10.7**	**59.8%**
2	Company A	Zhejiang Province, China	4.0	22.1%
3	Company B	Japan	1.4	7.8%

Top Three Providers of Refrigeration and Air-conditioning Heat Exchangers in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**2.7**	**44.6%**
2	Company C[(1)]	Sweden	1.8	29.1%
3	Company D[(2)]	Denmark	1.2	19.1%

- In terms of revenue in 2024, the global top three manufacturers of valves of refrigeration and air-conditioning control components accounted for approximately 89.7%, among which our Group ranked first, with a market share of approximately 59.8%.
- In terms of revenue in 2024, the global top three manufacturers of heat exchangers of refrigeration and air-conditioning control components accounted for approximately 92.8%, among which our Group ranked first, with a market share of approximately 44.6%.

Notes:
(1) Company C is a group established in 1883 and listed on the Nasdaq Stockholm Exchange in 2002 and the London Stock Exchange in 2010, engaging in the provision of products in the areas of heat transfer, separation and fluid handling.
(2) Company D is a private established in 1933, engaging in the provision of heat exchangers, high pressure pumps and other components for HVAC equipment.

Source: Annual Reports; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market
Ranking and Market Share

Top Three Providers of Refrigeration and Air-conditioning Controllers in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	Company D	Denmark	0.4	12.9%
2	**Our Group**	**Zhejiang Province, China**	**0.9**	**12.5%**
3	Company B	Japan	0.4	7.8%

Top Three Providers of Refrigeration and Air-conditioning Pumps in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**0.6**	**49.2%**
2	Company E[(1)]	Germany	0.3	29.5%
3	Company F[(2)]	Denmark	0.1	8.8%

- In terms of revenue in 2024, the global top three manufacturers of controllers of refrigeration and air-conditioning control components accounted for approximately 31.6%, among which our Group ranked second, with a market share of approximately 12.5%.
- In terms of revenue in 2024, the global top three manufacturers of pumps of refrigeration and air-conditioning control components accounted for approximately 87.5%, among which our Group ranked first, with a market share of approximately 49.2%.

Notes:
(1) Company E is a private group established in 1967, engaging in the provision of dishwashers, refrigerator, freezers, vacuum cleaners, and other home appliances. Company E's revenue of pumps equals shipment of pumps multiplied by average selling price.
(2) Company F is a private group established in 1945, engaging in the provision of high-efficiency, energy-saving pumps and water solutions for domestic homes.

Source: Annual Reports; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market
Ranking and Market Share

Top Three Providers of Electronic Expansion Valves in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**2.4**	**51.4%**
2	Company G[(1)]	Zhejiang Province, China	1.1	22.5%
3	Company A	Zhejiang Province, China	0.6	13.7%

Top Three Providers of Four-way Reversing Valves in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**2.9**	**55.4%**
2	Company A	Zhejiang Province, China	0.9	17.7%
3	Company B	Japan	0.8	14.2%

- In terms of revenue in 2024, the global top three manufacturers of electronic expansion valves accounted for approximately 87.6%, among which our Group ranked first, with a market share of approximately 51.4%.
- In terms of revenue in 2024, the global top three manufacturers of four-way reversing valves accounted for approximately 87.3%, among which our Group ranked first, with a market share of approximately 55.4%.

Note:

(1) Company G is a private group established in 1949, engaging in the provision of in-vehicle air-conditioning systems, space air-conditioners and other various kinds of climatic temperature controlling equipment.

Source: Annual Reports; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market
Ranking and Market Share

Top Three Providers of Solenoid Valves in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	Our Group	Zhejiang Province, China	0.4	47.7%
2	Company B	Japan	0.2	18.0%
3	Company G	Zhejiang Province, China	0.1	9.0%

Top Three Providers of Service Valves in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	Our Group	Zhejiang Province, China	1.3	39.1%
2	Company A	Zhejiang Province, China	1.0	30.0%
3	Company H(1)	Guangdong Province, China	0.3	9.5%

- In terms of revenue in 2024, the global top three manufacturers of solenoid valves accounted for approximately 74.7%, among which our Group ranked first, with a market share of approximately 47.7%.
- In terms of revenue in 2024, the global top three manufacturers of service valves accounted for approximately 78.6%, among which our Group ranked first, with a market share of approximately 39.1%.

Note:
(1) Company H is a private group established in 2007, engaging in the production of refrigeration components, including service valves, four-way reversing valves, electronic expansion valves, among others.

Source: Annual Reports; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market
Ranking and Market Share

Top Three Providers of Micro-channel Heat Exchangers in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	Our Group	Zhejiang Province, China	2.4	43.4%
2	Company D	Denmark	1.0	18.9%
3	Company A	Zhejiang Province, China	0.5	8.4%

Top Three Providers of Omega Pumps(1) in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	Our Group	Zhejiang Province, China	0.5	53.6%
2	Company E	Germany	0.3	37.4%
3	Company I(1)	Guangdong Province, China	0.1	5.6%

- In terms of revenue in 2024, the global top three manufacturers of micro-channel heat exchangers accounted for approximately 70.7%, among which our Group ranked first, with a market share of approximately 43.4%.
- In terms of revenue in 2024, the global top three manufacturers of Omega pumps accounted for approximately 96.6%, among which our Group ranked first, with a market share of approximately 53.6%.

Notes:
(1) The revenue of Omega pumps equals the shipment of pumps multiplied by the average selling price, as major manufacturers of Omega pumps include appliance manufacturers who produce Omega pumps to be integrated into their own products and do not generate revenue from sales of Omega pumps.
(2) Company I is a group established in 2000 and listed on the Shenzhen Stock Exchange in 2013 and the Hong Kong Stock Exchange in 2024, engaging in the provision of a wide range of home appliances, including air conditioners, refrigerators, washing machines and kitchen appliances, among others.

Source: Annual Reports; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Global and China's Refrigeration and Air-conditioning Control Component Market
Ranking and Market Share

Top Three Providers of Pressure Sensors in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	Company B	Japan	0.3	25.3%
2	**Our Group**	**Zhejiang Province, China**	**0.2**	**15.9%**
3	Company J[(1)]	United States	0.2	15.0%

Top Three Providers of Ball Valves in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (Billion RMB)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**0.3**	**32.8%**
2	Company D	Denmark	0.2	28.7%
3	Company A	Zhejiang Province, China	0.1	18.8%

- In terms of revenue in 2024, the global top three manufacturers of pressure sensors accounted for approximately 56.2%, among which our Group ranked second, with a market share of approximately 15.9%.
- In terms of revenue in 2024, the global top three manufacturers of ball valves accounted for approximately 80.3%, among which our Group ranked first, with a market share of approximately 32.8%.
- The global market size of inverter controllers in terms of revenue reached approximately RMB5.8 billion in 2024. The global inverter controller market is concentrated, with approximately 40 market participants as of December 31, 2024. In terms of revenue in 2024, our Group accounted for approximately 10.9% of the global market size of inverter controllers.

Note:
(1) Company J is a group established in 1916 and listed on the New York Stock Exchange in 2010, engaging in the provision of mission-critical sensors, electrical protection components and sensor-rich solutions.

Source: Annual Reports; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Content

Analysis of Automotive Thermal Management System Component Market

Definition and Overview

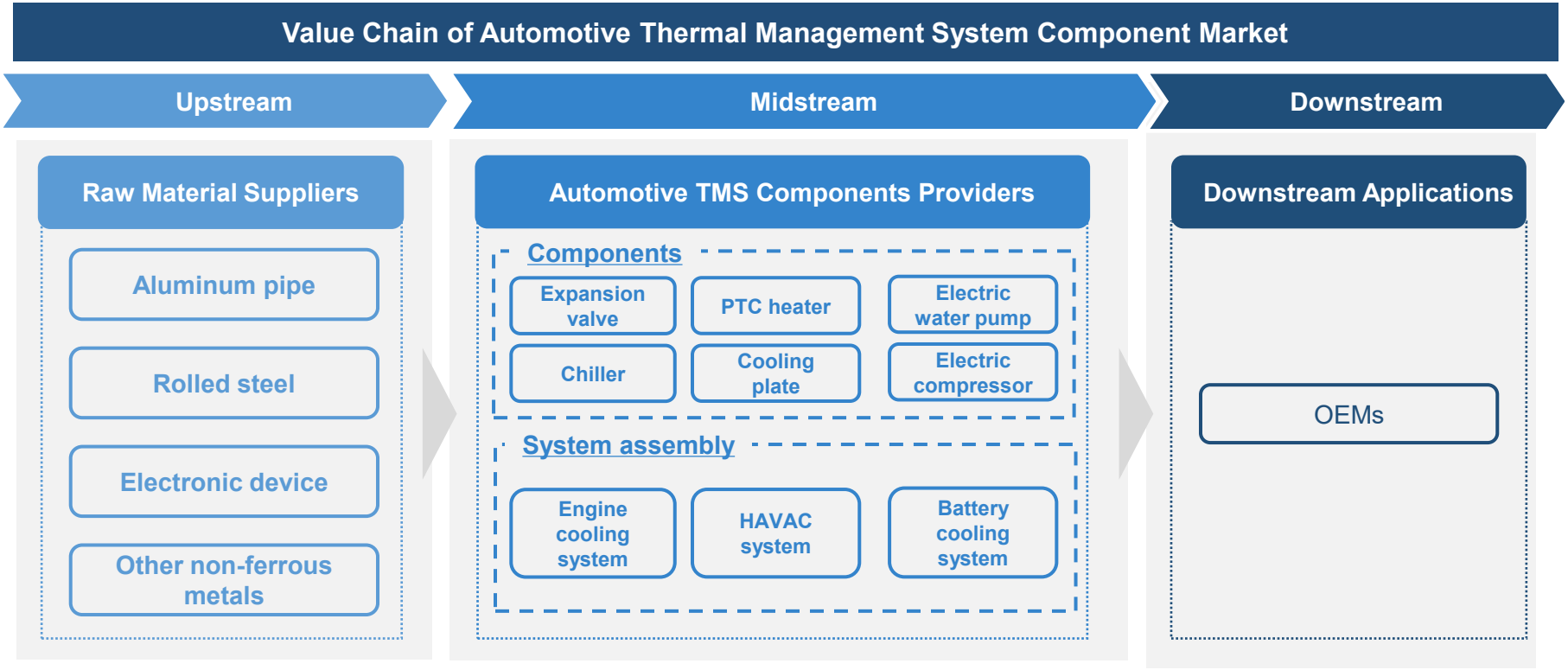
- The automotive thermal management components are a type of core automotive components. The thermal management system is composed of components that monitor and control the operating temperature of various automotive systems, such as the engine and passenger cabin areas, to improve efficiency and prevent damage to the components. Given (i) the functions to achieve the control of cooling and heating process within automotive thermal management systems, and (ii) the impact on system performances such as control accuracy, efficiency and energy conservation, there are four crucial component categories in automotive thermal management system components: (i) integrated modules, (ii) automotive valves, including automotive electronic expansion valves and automotive electronic water valves, (iii) automotive pumps, including electronic and mechanical water pumps and (iv) automotive heat exchangers, including battery coolers and cooling plates.
- Based on automotive types, automotive thermal management system can be divided into thermal management system for ICEVs and thermal management system for NEVs. Thermal management system for ICEVs consists of a powertrain thermal management system and cabinet thermal management system. Thermal management system for NEVs is more complex, including systems for cabinet thermal management, battery thermal management and electrical/control system thermal management, thus it generates more demands and sets higher performance requirements for thermal management system components, including electronic expansion valves, electronic water pumps and electric compressors. The demand for automotive thermal management system components is driven by the transformation in the downstream automotive industry. Considering the transition from ICEVs to NEVs, leading thermal management system component manufacturers are at the forefront of product upgrades, driving the iteration of thermal management system components and further enhancing their application in NEVs.
- With the rapid development of NEV industry, the importance of the NEV thermal management system is becoming increasingly prominent. In particular, electronic expansion valves, which can precisely control the flow of refrigerants, effectively manage the temperatures of cabin areas, batteries and motors of NEVs. Meanwhile, integrated modules optimize space utilization and enhance system efficiency by integrating multiple functions. As key components of thermal management system in NEVs, automotive electronic expansion valves and integrated modules are experiencing a surge in demand

Functions and Applications of Automotive Thermal Management System Components

Category	Components	Functions	Main Applications
Integrated Modules	Integrated Modules	Optimize space utilization and enhance system efficiency by integrating multiple functions	Cabinet thermal management, battery thermal management
Automotive Valves	Electronic Expansion Valve	Effectively facilitate the cooling and heating functions within the thermal management systems of NEVs	Cabinet thermal management
	Others	Including oil valve, electric ball valve, thermostatic expansion valve with shut off electronic water pump and other valves that regulate the flow of liquid or gas.	Cabinet thermal management, electrical/control system thermal management, battery thermal management
Automotive Heat Exchangers	Battery Cooler and Module	Introduce the refrigerant from the air conditioning system, which absorb the heat transferred from the battery cooling circuit in the evaporator and carry the heat away	Battery thermal management
	Others	Including cooling plate, oil cooler, oil cooler module and other heat exchangers that efficiently transfer heat	Cabinet thermal management, electrical/control system thermal management, battery thermal management
Automotive Pumps	Electronic Water Pump	Drive the circulation of coolant, absorbing heat, and transferring it to the outside air through a cooling device	Battery thermal management
	Others	Including electric oil pump and other pumps that used for the transportation, circulation and pressure regulation of liquids	Cabinet thermal management, electrical/control system thermal management, battery thermal management
Others		Including accumulators, compressors and other components used in the automotive thermal management system	Cabinet thermal management, electrical/control system thermal management, battery thermal management

Source: Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Value Chain Analysis



- The value chain of the automotive thermal management system component market primarily involves upstream raw material suppliers, midstream automotive thermal management system components providers and downstream automotive companies. Upstream raw materials primarily include copper, aluminum and other non-ferrous metals. Midstream participants primarily include automotive thermal management system component manufacturers that produce components such as valves, pumps and heat exchangers, and system integrators that are responsible for system assembly and produce integrated modules such as the engine cooling system, HVAC system and battery cooling system. The downstream of automotive thermal management system components is automotive companies.

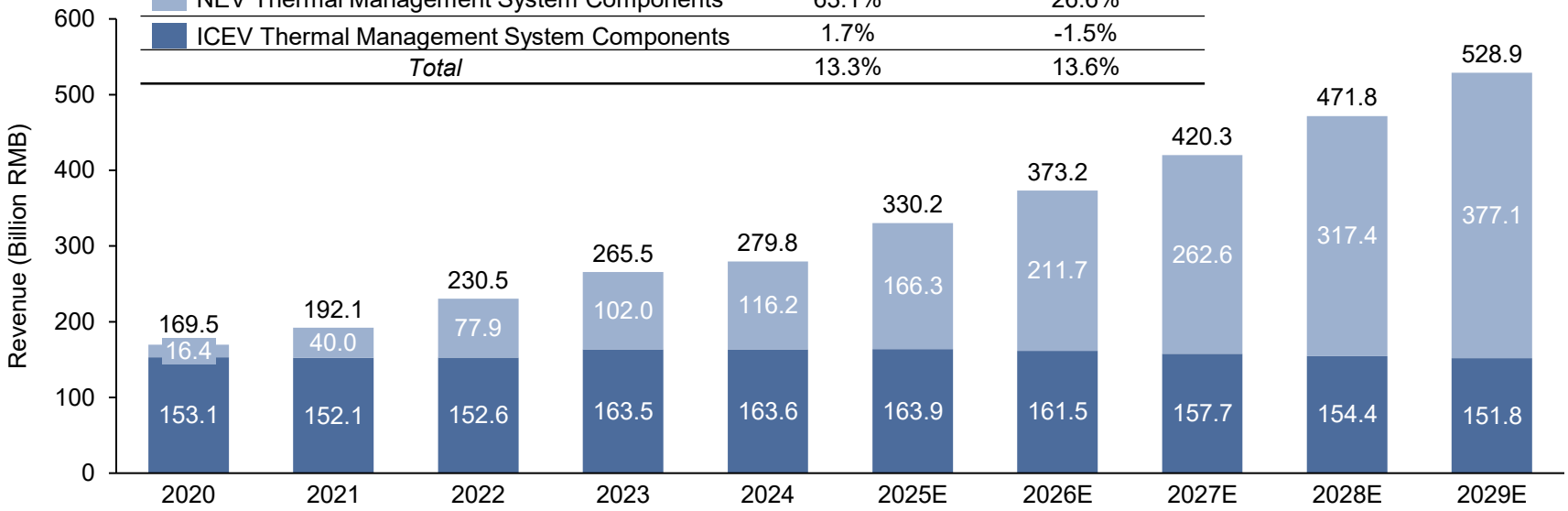
Source: Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Revenue of Global Automotive Thermal Management System Component Market

Revenue of Automotive Thermal Management System Component Market by Automotive Types (Global), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
NEV Thermal Management System Components	63.1%	26.6%
ICEV Thermal Management System Components	1.7%	-1.5%
Total	13.3%	13.6%



- The global market size of automotive thermal management system components in terms of revenue increased from RMB169.5 billion in 2020 to RMB279.8 billion in 2024, with a CAGR of 13.3%. In particular, driven by the rapid development of the NEV industry, the revenue generated by thermal management system components for NEVs increased from RMB16.4 billion in 2020 to RMB116.2 billion in 2024, with a CAGR of 63.1%. By 2029, the global market size of automotive thermal management system components in terms of revenue is expected to reach RMB528.9 billion, with a CAGR of 13.6% from 2024 to 2029. In particular, the revenue generated by thermal management system components for NEVs is expected to reach RMB377.1 billion, with a CAGR of 26.6% from 2024 to 2029. China is the largest market in the global automotive thermal management system component market, with revenue of automotive thermal management system components accounting for approximately 48.4% in 2024.

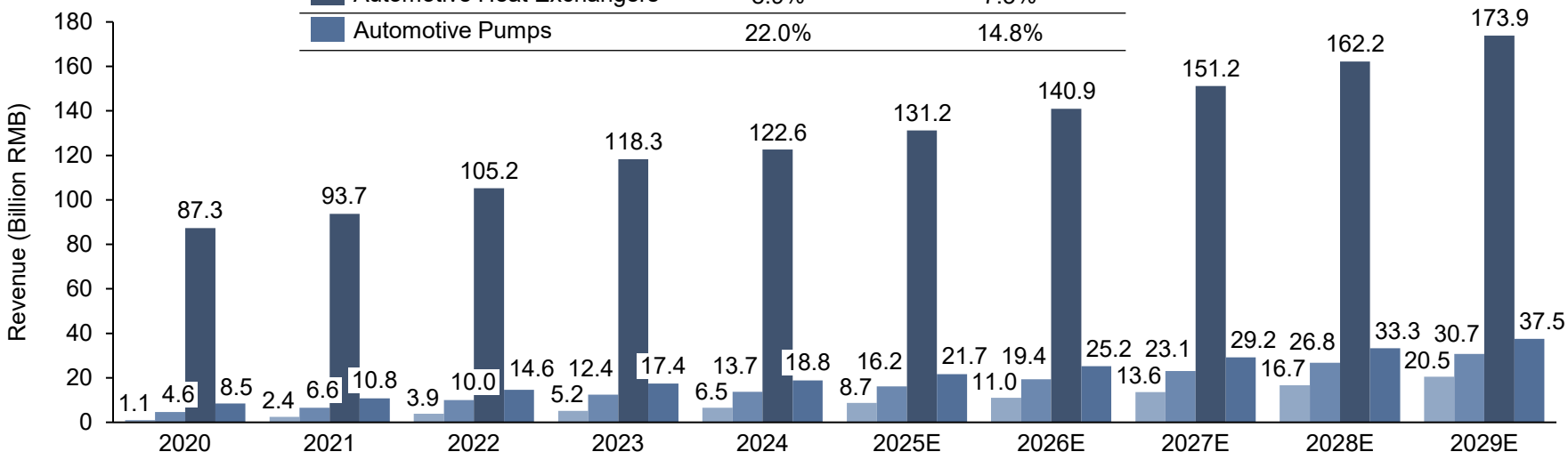
Source: International Organization of Motor Vehicle Manufacturers; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Revenue of Global Crucial Automotive Thermal Management System Component Categories

Revenue of Crucial Automotive Thermal Management System Components Categories (Global), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
Integrated Modules	55.1%	25.9%
Automotive Valves	31.6%	17.6%
Automotive Heat Exchangers	8.9%	7.3%
Automotive Pumps	22.0%	14.8%



- The global market size of each of four crucial categories — integrated modules, automotive valves, automotive heat exchangers and automotive pumps — in terms of revenue reached RMB6.5 billion, RMB13.7 billion, RMB122.6 billion and RMB18.8 billion in 2024, growing at a CAGR of 55.1%, 31.6%, 8.9% and 22.0%, respectively, from 2020 to 2024, and is expected to reach RMB20.5 billion, RMB30.7 billion, RMB173.9 billion and RMB37.5 billion, growing at a CAGR of 25.9%, 17.6%, 7.3% and 14.8% from 2024 to 2029, respectively. In 2024, in terms of revenue, the global market size of integrated modules, automotive valves, automotive heat exchangers and automotive pumps accounted for 2.3%, 4.9%, 43.8% and 6.7%, respectively, of the global market size of automotive thermal management system components, totaling an aggregate of 57.7%.

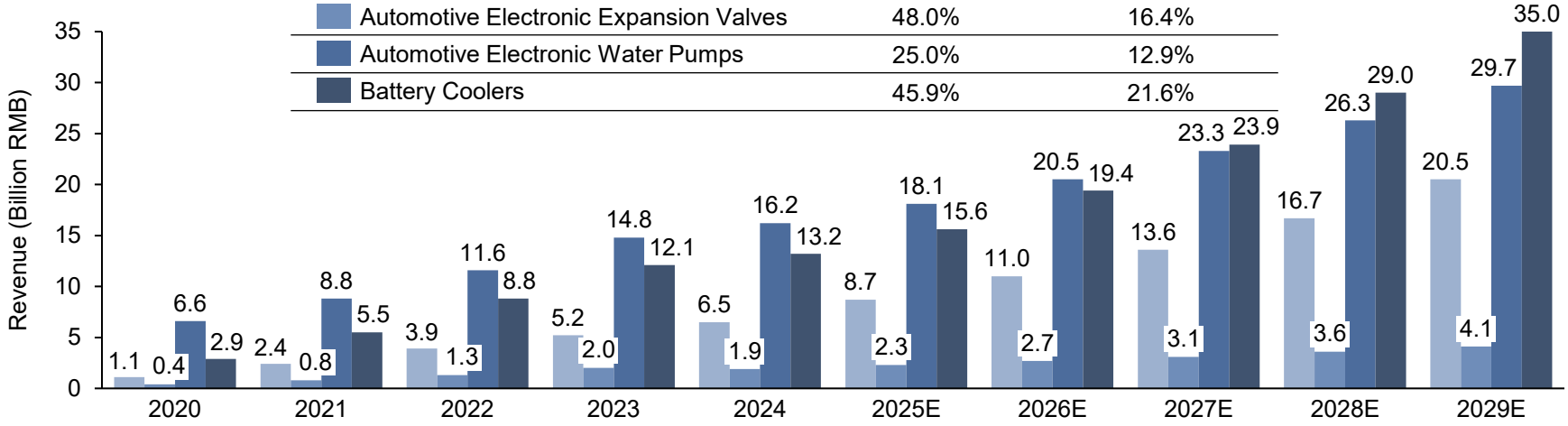
Source: International Organization of Motor Vehicle Manufacturers; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Revenue of Global Crucial Automotive Thermal Management System Component

Revenue of Automotive Thermal Management System Components by Crucial Components (Global), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
Integrated Modules(1)	55.1%	25.9%
Automotive Electronic Expansion Valves	48.0%	16.4%
Automotive Electronic Water Pumps	25.0%	12.9%
Battery Coolers	45.9%	21.6%



- In recent years, the global penetration rate of NEVs increased from 6.7% in 2020 to 23.6% in 2024, and is expected to further increase to 43.7% by 2029. NEVs are becoming increasingly important in the global automotive market, prompting the significant development of NEV thermal management systems.
- Taking into account (i) the functions to achieve the control of cooling and heating process within NEV thermal management systems and (ii) the impact on system performances such as control accuracy, efficiency and energy conservation, the integrated modules, automotive electronic expansion valves, automotive electronic water pumps, and battery coolers are four crucial components in NEV thermal management systems. Specifically, the integrated modules optimize space utilization and enhance system efficiency by integrating multiple functions. The automotive electronic expansion valves effectively facilitate the cooling and heating functions within the NEV thermal management systems. Automotive electronic water pump are responsible for driving the circulation of coolant, absorbing heat, and transferring it to the outside air through a cooling device. Battery coolers introduce the refrigerant from the air conditioning system, which absorb the heat transferred from the battery cooling circuit in the evaporator and carry the heat away.
- Further, as of December 31, 2024, there were over 30 types of components in NEV thermal management system, among which the integrated modules, automotive electronic expansion valves, automotive electronic water pumps and battery coolers accounted for 5.6%, 1.6%, 13.9% and 11.4%, respectively, of the global market size of NEV thermal management system components in terms of revenue in 2024, totaling an aggregate of 32.5%. Automotive electronic expansion valves, automotive electronic water pumps and battery coolers are representative components of valves, pumps and heat exchangers of automotive thermal management systems, respectively, in the era of automotive electrification. These components ensure the precise control of cooling and heating process within NEV thermal management systems and effectively manage the temperatures of cabin areas, batteries and motors of NEVs. Additionally, automotive electronic expansion valves, automotive electronic water pumps and battery coolers hold a relatively higher share in their respective categories compared to the share of other components in the same category, accounting for 13.9%, 86.2% and 10.8%, respectively, of the global market size of valves, pumps and heat exchangers within automotive thermal management systems components in terms of revenue in 2024.
- The global market size of integrated modules in terms of revenue increased from RMB1.1 billion in 2020 to RMB6.5 billion in 2024, with a CAGR of 55.1%, and is expected to reach RMB20.5 billion in 2029, with a CAGR of 25.9% from 2024 to 2029. The global market size of automotive electronic expansion valves in terms of revenue increased from RMB0.4 billion in 2020 to RMB1.9 billion in 2024, with a CAGR of 48.0%, and is expected to reach RMB4.1 billion in 2029, with a CAGR of 16.4% from 2024 to 2029. The global market size of automotive electronic water pumps in terms of revenue increased from RMB6.6 billion in 2020 to RMB16.2 billion in 2024, with a CAGR of 25.0%, and is expected to reach RMB29.7 billion in 2029, with a CAGR of 12.9% from 2024 to 2029. From 2020 to 2024, the global market size of battery cooler in terms of revenue increased from RMB2.9 billion to RMB13.2 billion, with a CAGR of 45.9%, and is expected to reach RMB35.0 billion in 2029, with a CAGR of 21.6% from 2024 to 2029.

Source: International Organization of Motor Vehicle Manufacturers; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

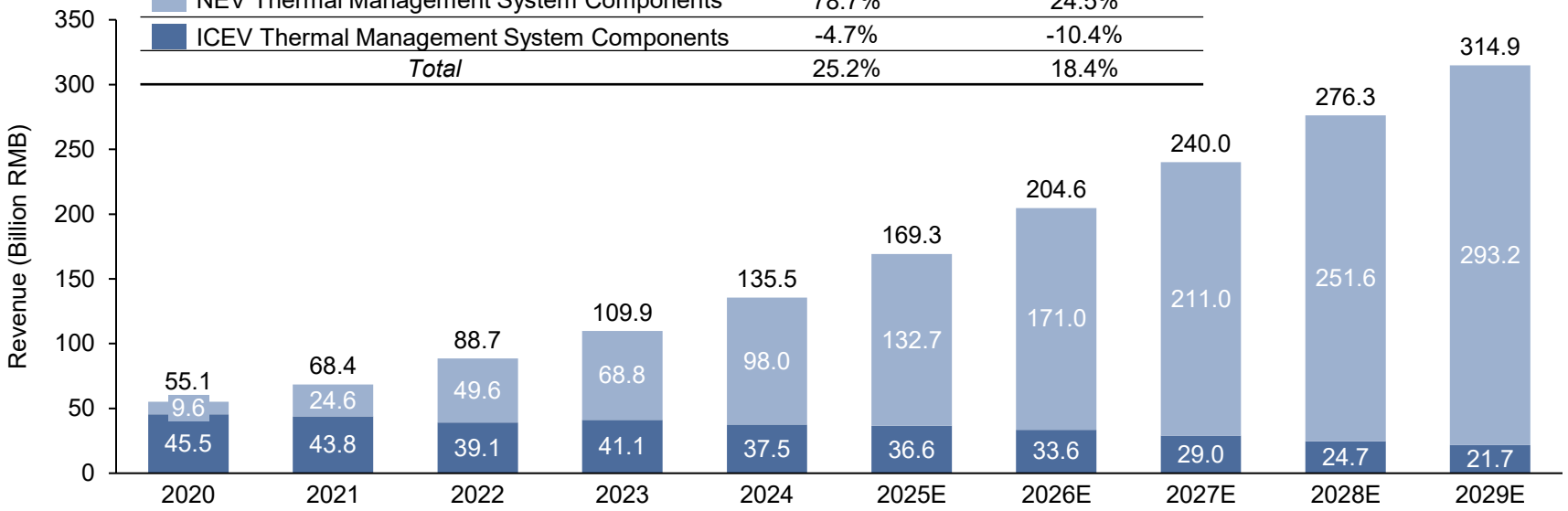
Note (1): Integrated modules are classified under both automotive thermal management system components categories and automotive thermal management system components, as they do not have sub-branches

Analysis of Automotive Thermal Management System Component Market

Revenue of Automotive Thermal Management System Component Market in China

Revenue of Automotive Thermal Management System Component Market (China), 2020 – 2029E

Revenue	*CAGR (2020-2024)*	*CAGR (2024-2029E)*
NEV Thermal Management System Components	78.7%	24.5%
ICEV Thermal Management System Components	-4.7%	-10.4%
Total	25.2%	18.4%



- The market size of automotive thermal management system components in China in terms of revenue increased from RMB55.1 billion in 2020 to RMB135.5 billion in 2024, with a CAGR of 25.2%. In particular, the revenue generated by thermal management system components for NEVs in China increased from RMB9.6 billion in 2020 to RMB98.0 billion in 2024, with a CAGR of 78.7%. By 2029, the market size of automotive thermal management system components in China in terms of revenue is expected to reach RMB314.9 billion, with a CAGR of 18.4% from 2024 to 2029. In particular, the revenue generated by thermal management system components for NEVs in China is expected to reach RMB293.2 billion, with a CAGR of 24.5% from 2024 to 2029.

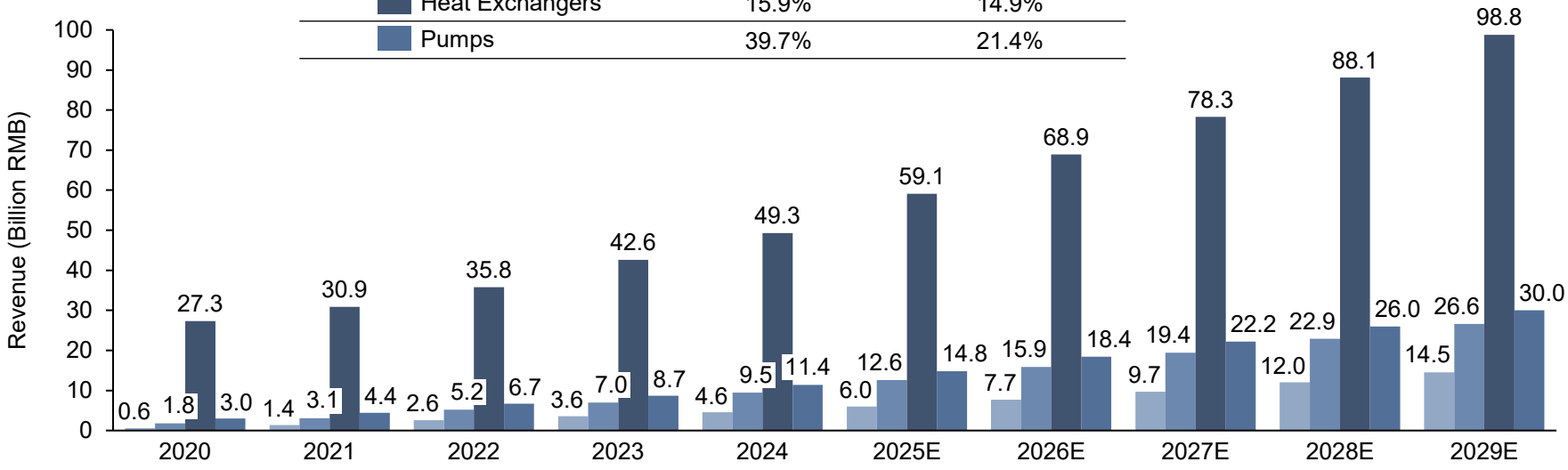
Source: China Association of Automobile Manufacturers; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Revenue of Crucial Automotive Thermal Management System Component Categories in China

Revenue of Crucial Automotive Thermal Management System Components Categories (China), 2020 – 2029E

Revenue	CAGR (2020-2024)	CAGR (2024-2029E)
Integrated Modules	67.6%	25.9%
Valves	52.1%	22.9%
Heat Exchangers	15.9%	14.9%
Pumps	39.7%	21.4%



- The market size of integrated modules, automotive valves, automotive heat exchangers and automotive pumps in China in terms of revenue reached RMB4.6 billion, RMB9.5 billion, RMB49.3 billion and RMB11.4 billion in 2024, growing at a CAGR of 67.6%, 52.1%, 15.9% and 39.7%, respectively, and is expected to reach RMB14.5 billion, RMB26.6 billion, RMB98.8 billion and RMB30.0 billion in 2029, with a CAGR of 25.9%, 22.9%, 14.9% and 21.4% from 2024 to 2029, respectively.

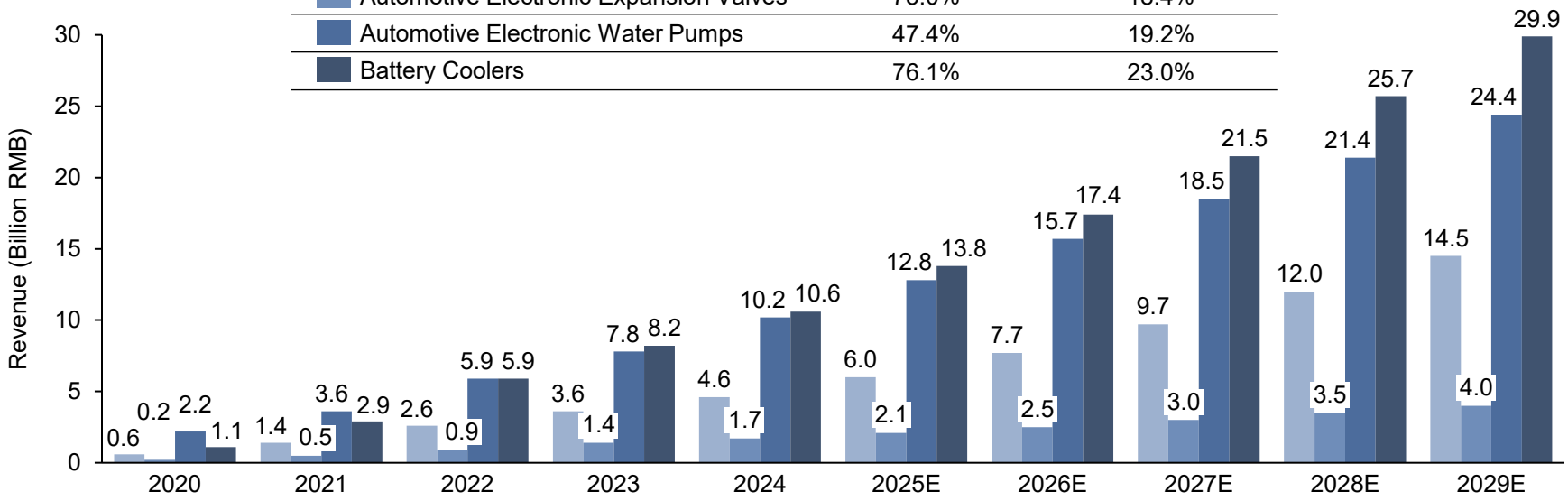
Source: China Association of Automobile Manufacturers; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Revenue of Crucial Automotive Thermal Management System Component in China

Revenue of Crucial Automotive Thermal Management System Components (China), 2020 – 2029E

Revenue	*CAGR (2020-2024)*	*CAGR (2024-2029E)*
Integrated Modules(1)	67.6%	25.9%
Automotive Electronic Expansion Valves	75.0%	18.4%
Automotive Electronic Water Pumps	47.4%	19.2%
Battery Coolers	76.1%	23.0%



- In recent years, the penetration rate of NEVs in China increased from 5.4% in 2020 to 40.9% in 2024, and is expected to further increase to 76.8% by 2029. The increasing penetration rate of NEVs in China promotes the significant growth of integrated modules, automotive electronic expansion valves, automotive electronic water pumps and battery coolers, which are crucial components in NEV thermal management systems.
- The market size of integrated modules in China in terms of revenue increased from RMB0.6 billion in 2020 to RMB4.6 billion in 2024, with a CAGR of 67.6%, and is expected to reach RMB14.5 billion in 2029, with a CAGR of 25.9% from 2024 to 2029. The market size of automotive electronic expansion valves in China in terms of revenue increased from RMB0.2 billion in 2020 to RMB1.7 billion in 2024, with a CAGR of 75.0%, and is expected to reach RMB4.0 billion in 2029, with a CAGR of 18.4% from 2024 to 2029. The market size of automotive electronic water pumps in China in terms of revenue increased from RMB2.2 billion in 2020 to RMB10.2 billion in 2024, with a CAGR of 47.4%, and is expected to reach RMB24.4 billion in 2029, with a CAGR of 19.2% from 2024 to 2029. From 2020 to 2024, the market size of battery coolers in China in terms of revenue increased from RMB1.1 billion to RMB10.6 billion, with a CAGR of 76.1%, and is expected to reach RMB29.9 billion in 2029, with a CAGR of 23.0% from 2024 to 2029.

Note (1): Integrated modules are classified under both automotive thermal management system components categories and automotive thermal management system components, as they do not have sub-branches

Source: China Association of Automobile Manufacturers; Interviews Conducted by Frost & Sullivan with Experts from Leading Market Players; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Market Drivers

	Major Drivers
1	Rapid development of NEV industry
2	Growing demand for reliable TMS

Drivers	Main Content
Rapid development of NEV industry	• Owing to the de-carbonization goals of the global automobile industry, the improvement of NEV technologies, and the development of NEV charging infrastructure, the global NEV industry has been experiencing rapid development. The global sales volume of NEVs grew from 5.2 million in 2020 to 21.4 million in 2024, with a CAGR of 42.7%, while the global sales volume of ICEVs experienced a decrease from 72.8 million in 2020 to 69.2 million in 2024, with a CAGR of -1.3%. Meanwhile, technological advancements such as 5G and the Internet of Things ("IoT") have accelerated the development of intelligent connected vehicles, and the commercialization of autonomous driving technology is gradually unfolding, which has further increased the penetration of NEVs. From 2020 to 2024, the global penetration rate of NEVs increased from 6.7% to 23.6%. The continuously developing NEV industry has driven the rapid expansion of the automotive thermal management system component market.
Growing demand for reliable thermal management system	• Advancements in NEV battery and charging technology require more reliable thermal management system to ensure charging safety. Batteries are prone to overheating during the charging process, and improper temperature control may affect performance or even cause safety issues. Therefore, an efficient thermal management system is crucial for maintaining the optimal operating temperature of batteries, ensuring the safety and performance. With the development of high-voltage fast charging and battery technologies, the need for rapid heat dissipation increases, which drives the demand for efficient automotive thermal management system, thereby stimulating the growing demand for thermal management system components.

Source: Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Future Opportunities

Future Opportunities

Integrated and modular design	• With the advancements in automotive thermal management technology, the automotive thermal management system components are evolving towards an integrated and modular design. Integrated thermal management system connects some or all circuits of the motor systems, battery systems, electronic control systems and air conditioning systems into a large circulation loop, which can not only achieve comprehensive thermal management and reduce energy waste, but also effectively reduces overall vehicle weight and space occupied. Modular design of automotive thermal management system can shorten the assembly time, enhance the versatility across different vehicle models and reduce the maintenance costs of these systems.
Development of intelligent control	• Intelligent thermal management system can monitor the vehicle's operating conditions and environmental parameters in real time through intelligent components. They automatically adjust the operating modes and parameter settings of the thermal management system to improve efficiency and performance. The intelligent control can not only achieve precise temperature regulation, but also adapt to various situations based on user characteristics and current or future road conditions, as well as weather information. Additionally, the advancement of autonomous driving technology will significantly increase the computational power requirements of automotive chips, leading to more prominent chip cooling issues, which will drive the growing demand for efficient thermal management system components.
Green and efficient development	• With the increasing global attention to environmental protection and sustainable development, green and low-carbon development is the core goal of automotive thermal management system. The advancements of battery cooling and heating technology, the development of heat pump technology, and the replacement of refrigerants with weak greenhouse effects promote the optimization of vehicle energy consumption, which raises higher requirements for product performance of thermal management system components.
Globalization	• Under the trend of global economic integration, the global procurement of automotive thermal management system components has become a major trend in the automotive industry. As market competition intensifies, major automobile manufacturers in the world have been dedicated to seeking the best suppliers of automotive thermal management system components and advanced technical solutions worldwide, which provides broad development opportunities for automotive thermal management system component manufacturers to expand business layout in overseas markets.

Source: Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Competitive Landscape Overview

- The global automotive thermal management system component market is highly concentrated. Leading companies leverage first-mover advantages to accumulate expertise in core components and system development capabilities. They also possess technical advantages in system integration. As of December 31, 2024, there were over 400 market participants in the global automotive thermal management system component market. Our competitors in the global automotive thermal management system components market mainly include DENSO Corporation, Hanon Systems, Valeo SE and MAHLE GmbH, among others. In terms of revenue in 2024, the global top five providers of automotive thermal management system components accounted for approximately 77.9%, among which our Group ranked fifth, with a market share of approximately 4.1%

Main Participants in Global Automotive Thermal Management System Component Market

DENSO MAHLE SANHUA DunAn 盾安环境

Valeo Hanon Systems FUJIKOKI 银轮股份 YINLUN CO.,LTD SONGZ 松芝股份

BOSCH SANDEN TUOPU 拓普 ATC Aotecar® 奥特佳

Source: Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Ranking and Market Share (1/7)

Top Ten Providers of Automotive Thermal Management System Components in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (RMB Billion)	Market Share
1	Company K(1)	Japan	84.7	30.3%
2	Company L(2)	Korea	54.1	19.3%
3	Company M(3)	France	35.7	12.8%
4	Company N(4)	Germany	31.8	11.4%
5	**Our Group**	**Zhejiang Province, China**	**11.4**	**4.1%**

- In terms of revenue in 2024, the global top five providers of automotive thermal management system components accounted for approximately 77.9%, among which our Group ranked fifth, with a market share of approximately 4.1%.

Note:
(1) Company K is a group established in 1949 and listed on the Nagoya Stock Exchange in 1951 and the Tokyo Stock Exchange in 1953, engaging in the provision of automotive component and systems, industrial products and home appliances.
(2) Company L is a group established in 1986 and listed on the Korea Exchange in 1996, engaging in the provision of automotive thermal and energy management solutions.
(3) Company M is a group established in 1923 and listed on the Euronext Paris in 1932, engaging in the provision of components, integrated systems, and modules for the automobile industry.
(4) Company N is a private group established in 1920, engaging in the provision of engine systems, filtration, electrics, mechatronics, and thermal management.

Source: Annual Reports; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Ranking and Market Share (2/7)

Top Three Providers of Integrated Modules in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (RMB Billion)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**4.3**	**65.6%**
2	Company K	Japan	1.1	16.5%
3	Company M	France	0.5	7.5%

- The global market of integrated modules is concentrated, with less than 15 market participants as of December 31, 2024. In terms of revenue in 2024, the top three providers of integrated modules accounted for approximately 89.6%, among which our Group ranked first, with a market share of approximately 65.6%.

Source: Annual Reports; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Ranking and Market Share (3/7)

Top Three Providers of Automotive Valves in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (RMB Billion)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**2.6**	**19.3%**
2	Company G	Japan	2.0	14.4%
3	Company A	Zhejiang Province, China	0.8	5.7%

- The global market of automotive valves is relatively concentrated, with less than 70 market participants as of December 31, 2024. In terms of revenue in 2024, the top three providers of automotive valves accounted for approximately 39.4%, among which our Group ranked first, with a market share of approximately 19.3%.

Source: Annual Reports; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Ranking and Market Share (4/7)

Top Five Providers of Automotive Pumps in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (RMB Billion)	Market Share
1	Company P(1)	Germany	5.5	29.4%
2	Company K	Japan	3.9	20.7%
3	Company L	Korea	2.8	15.1%
4	**Our Group**	**Zhejiang Province, China**	**1.6**	**8.6%**
5	Company Q(2)	Germany	1.3	6.8%

- The global market of automotive pumps is concentrated, with less than 50 market participants as of December 31, 2024. In terms of revenue in 2024, the top five providers of automotive pumps accounted for approximately 80.6%, among which our Group ranked fourth, with a market share of approximately 8.6%.
- The global market of automotive heat exchangers is concentrated, with less than 50 market participants as of December 31, 2024. In terms of revenue in 2024, the top five providers of automotive heat exchangers accounted for approximately 77.4%. Our Group accounted for approximately 1.4% of the market share.

Note:
(1) Company P is a private group established in 1868, engaging in the provision of automotive technology and service.
(2) Company Q is a private group established in 2019, engaging in the provision of automotive drivetrain and powertrain technologies.

Source: Annual Reports; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Ranking and Market Share (5/7)

Top Three Providers of Automotive Electronic Expansion Valves in terms of Revenue (Global), 2024

Ranking	Company Name	Headquarters	Revenue (RMB Billion)	Market Share
1	**Our Group**	**Zhejiang Province, China**	**0.9**	**48.3%**
2	Company G	Japan	0.5	24.1%
3	Company A	Zhejiang Province, China	0.3	17.3%

- The global market of automotive electronic expansion valves is concentrated, with less than 20 market participants as of December 31, 2024. In terms of revenue in 2024, the top three providers of automotive electronic expansion valves accounted for approximately 89.7%, among which our Group ranked first, with a market share of approximately 48.3%.

Source: Annual Reports; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Ranking and Market Share (6/7)

Top Three Providers of Battery Coolers in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (RMB Billion)	Market Share
1	Company N	Germany	5.4	40.9%
2	Company R(1)	United States	2.1	15.9%
3	**Our Group**	**Zhejiang Province, China**	**0.8**	**5.9%**

- The global market of battery coolers is relatively concentrated, with less than 30 market participants as of December 31, 2024. In terms of revenue in 2024, the global top three providers of battery coolers accounted for approximately 62.7%, among which our Group ranked third, with a market share of approximately 5.9%.

Note:

(1) Company R is a group established in 1916 and listed on the New York Stock Exchange in 2004, engaging in the provision of automotive thermal management components.

Source: Annual Reports; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market
Ranking and Market Share (7/7)

Top Five Providers of Automotive Electronic Water Pumps in terms of Revenue (Global), 2024

Ranking	Company	Headquarter	Revenue (RMB Billion)	Market Share
1	Company P	Germany	4.5	27.8%
2	Company K	Japan	3.1	19.1%
3	Company L	Korea	2.2	13.6%
4	**Our Group**	**Zhejiang Province, China**	**0.9**	**5.5%**
5	Company S(2)	Zhejiang Province, China	0.5	3.1%

- The global market of automotive electronic water pumps is relatively concentrated, with less than 50 market participants as of December 31, 2024. In terms of revenue in 2024, the global top five providers of automotive electronic water pumps accounted for approximately 69.1%, among which our Group ranked fourth, with a market share of approximately 5.5%.

Note:

(2) Company S is a private group established in 2016, engaging in the provision of automotive thermal management solutions.

Source: Annual Reports; Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Challenges of Refrigeration and air-conditioning control components and automotive thermal management system components

Challenges

Fluctuations in Downstream Demands	• Refrigeration and air-conditioning control components and automotive thermal management system components have various downstream applications, including refrigeration and air-conditioning products, ICEVs and NEVs, home appliances, data centers, and cold-chain transportation industries. Changes in market demands from these downstream industries could impact operational conditions and financial outcomes. If downstream demands cannot maintain robust growth, market participants may face challenges in business operation and profitability
Keep up with Technological Advancements	• The rapid advancement of technologies and the emergence of new industry standards present significant challenges to manufacturers of refrigeration and air-conditioning control components and automotive thermal management system components. These manufacturers must continually invest in R&D to keep pace with technological upgrades and process improvements, ensuring alignment with ever-evolving industry standards. Failure to do so could lead to a decline in their competitiveness.
Cost Control Capabilities	• The raw materials used in the production of refrigeration and air-conditioning control components and automotive thermal management system components primarily include copper and aluminum, which are bulk commodities known for significant price volatility. If market participants face substantial increases in raw material costs that were not anticipated during price negotiations with customers, their profitability may be adversely affected. Consequently, establishing a robust cost control mechanism has become one of the major challenges.

Source: Frost & Sullivan Analysis

Analysis of Automotive Thermal Management System Component Market

Entry Barriers of Refrigeration and Air-Conditioning Control Components and Automotive Thermal Management System Components

Entry Barriers

Technical Barrier

- The refrigeration and air-conditioning control component market and automotive thermal management system component market have high technical barriers. Established market players need to master knowledge of production processes for diversified components to cater the customers' requirements. Additionally, these components must be compatible with numerous downstream applications such as different air conditioners and vehicle models, which raises higher requirements for the technical capabilities of market players. However, it is rather difficult for new entrants to accumulate the relevant technologies in a short period of time.

Customer Barrier

- Established market players need to obtain customer recognition and establish trust through long-term cooperation. Since there are differences in the requirements for refrigeration and air-conditioning control components and thermal management system components among different customers, market players need to collaborate deeply with their customers and participate in the product development process as early as possible. For new entrants, it takes a considerable amount of time to attract new customers and establish their own customer reserves.

Production Barrier

- Established market players generally have established stringent standards for product design and production processes. They also have to strictly adhere to quality management systems to ensure high standards of product qualities. Additionally, leading manufacturers with large-scale production can benefit from economies of scale to respond quickly to market demand, complete timely delivery of various large orders, and effectively reduce costs. New entrants need a lot of time to accumulate experience and expertise in production and achieve large-scale production.

Capital Barrier

- The refrigeration and air-conditioning control component market and automotive thermal management system component market require a large amount of investment in production facilities and equipment, which raises a high capital barrier for new entrants. Additionally, sufficient working capital is necessary to meet customers' procurement needs. New entrants may face financial pressure due to limited production capacity and market share in the initial stages.

Source: Frost & Sullivan Analysis

Content

- Electromechanical actuators are one of the core components of a bionic robot system, which is responsible for converting electrical signals into corresponding mechanical motions to achieve precise control of the joints or moving parts of bionic robots. Electromechanical actuators mainly include motors, reducers and sensors, among others. The coordinated operation of these components provides the required torque and speed, allowing bionic robots to move along the predetermined trajectory. Based on motion types, electromechanical actuators are primarily categorized into rotary actuators and linear actuators. Rotary actuators are designed to drive joints for rotational movement and are suitable for applications like shoulder, elbow and hip joints. Linear actuators generate straight-line motion and are ideal for scenarios requiring linear displacement, such as the extension or contraction of limbs. The precise control, high-precision positioning and real-time monitoring capabilities of electromechanical actuators are crucial for enhancing the movement performance, stability and intelligence of bionic robots, and are key components that drive technological progress and enable broad applications of bionic robotics.
- At present, the bionic robotics industry is still in the exploring stage. Electromechanical actuators manufacturers generally establish stable collaborations with bionic robotics manufacturers to jointly develop products that cater to market demand, and continually refine the design and performance of electromechanical actuators based on customers' feedback. Driven by the supporting policies such as the "Guiding Opinions on Innovative Development of Humanoid Robots" (《人形機器人創新發展指導意見》) issued by the Ministry of Industry and Information Technology in 2023 and proposed to achieve batch production of bionic robots by 2025 and realize large-scale development by 2027, the accelerated production plans by leading industry players, the technological breakthroughs in mechanical design, motion control and artificial intelligence, and the performance improvement and cost reduction of core components, the bionic robot industry is expected to realize mass production in the near future. As bionic robot technology matures and achieves mass production, the demand for electromechanical actuators in the bionic robotics market is expected to significantly increase, thereby driving the rapid growth of market size.
- From 2020 to 2024, the global market size of bionic robot electromechanical actuators in terms of revenue increased from RMB93.9 million to RMB1,376.1 million, with a CAGR of 95.7%. As the downstream demand continues to grow, by 2029, the global market size of bionic robot electromechanical actuators in terms of revenue is expected to reach approximately RMB62.8 billion, representing a CAGR of 114.7% from 2024 to 2029.

Source: Frost & Sullivan Analysis

Analysis of Global and China's Bionic Robot Electromechanical Actuator Market

Market Drivers and Future Opportunities

Market Drivers

1 Aging Population and Rising Labor Costs

2 Supportive Policies

Drivers	Main Content
Aging Population and Rising Labor Costs	• As many countries transition into aged societies, labor resources are becoming increasingly scarce. In 2023, the proportion of individuals aged 60 and above in the global population reached 14.2%, and it is expected to reach 16.7% by 2030. Bionic robots become an alternative for replacing labor force due to their ability to imitate human movements, adapt to complex environments and perform delicate tasks. Meanwhile, with the economic development, labor costs are gradually rising. To maintain competitiveness, companies need to find effective ways to reduce labor costs. Bionic robots equipped with efficient electromechanical actuators can help companies to reduce long-term operational costs, and improve production flexibility and responsiveness. Therefore, the aging population and rising labor costs have stimulated the demand for bionic robots, thereby accelerating the development of the bionic robot electromechanical actuator market.
Supportive policies	• The Chinese government attaches great importance to the development of the robotics industry and has issued a series of policies to support its growth. For instance, in 2023, the Ministry of Industry and Information Technology ("MIIT") issued the "Guiding Opinions on Innovative Development of Humanoid Robots" (《人形機器人創新發展指導意見》), which emphasized to strengthen the development of foundational components and develop actuators with high power density. Additionally, in 2021, the MIIT and other 14 departments jointly issued the "14th Five-Year Plan for Development of Robotics Industry" (《"十四五"機器人產業發展規劃》), which proposed to achieve breakthroughs in a number of core technologies and high-end products in the robotics industry by 2025, with the performance and reliability of key components reaching the level of similar international products. These policies collectively support the development of the bionic robot electromechanical actuators industry, and accelerate technological advancements and market expansion.

Source: Frost & Sullivan Analysis

Analysis of Global and China's Bionic Robot Electromechanical Actuator Market

Market Drivers and Future Opportunities

Future Opportunities

Technology innovation	• With the development of advanced technologies such as artificial intelligence ("AI"), sensing technology and new materials, bionic robot electromechanical actuators have made significant progress in performance and expanded their applications. Electromechanical actuators manufacturers have been dedicated to enhancing competitiveness through continuous technological innovation. For instance, the application of AI and digital technologies has improved the fine-control capabilities of electromechanical actuators. AI technology enables the analysis of actuator movement patterns and environmental changes, optimizes control strategies and achieves more precise motion control. Meanwhile, digital technologies, such as high-precision sensors, high-speed data processing, and Internet of Things ("IoT") connectivity, further enhance the response speed and operational accuracy of actuators, which ensures that the real-time motion status of actuators can be captured and accurately fed back to the control system, thereby enhancing the system stability and reliability. Due to technological innovation, electromechanical actuators can adapt to a wider range of application scenarios and task requirements.
Expanding downstream applications of bionic robots	• With continuous technological advancements, the downstream applications of bionic robots have expanded from the industrial sector to multiple industries, including education and entertainment, emergency rescue, medical services and logistics services, among others. The extensive application scenarios stimulate a growing demand for bionic robot electromechanical actuators, and raise higher requirements for product performance. For instance, applied in medical services, humanoid robots are utilized for surgical assistance, rehabilitation therapy and elderly care, which requires actuators to have enhanced flexibility, safety and response speed.
Industrial chain synergy	• As the domestic production rates of core components such as motors, reducers and sensors continue to increase, domestic manufacturers are gaining competitive advantages in these critical areas. Electromechanical actuators manufacturers that establish stable cooperative relationships with upstream component manufacturers and downstream bionic robots manufacturers can facilitate synergy along the industrial chain, which can ensure the stable and adequate supply of key components, reduce production costs, respond to market demands timely, and promote technological advancements in the entire industrial chain.

Source: Frost & Sullivan Analysis

Analysis of Global and China's Bionic Robot Electromechanical Actuator Market

Entry Barriers

Entry Barriers	
Technology Barrier	• As a critical component of bionic robots, the design and manufacturing of electromechanical actuators involve multiple disciplines including mechanical design, electronic engineering and materials science, among others, which requires market participants to have sufficient technical accumulation. To develop products with a precise control of position, speed and force, electromechanical actuators manufacturers need to possess expertise in material selection, production processes and control algorithms. Moreover, with continuous evolution of market demand, the participants need to maintain their competitiveness through continuous technological innovation and product iteration. Therefore, new entrants without sufficient technical reserves and strong capabilities in technological innovation may find it difficult to master core technologies of electromechanical actuators in a short period of time, while the participants with early advantages, technical reserves and manufacturing capabilities such us our Group can obtain prominent competitiveness and quickly capture market shares.
Capital Barrier	• The electromechanical actuators industry requires substantial capital investment to support research and development, prototyping, mass production and product iteration. During the R&D process, participants need to invest in the procurement of advanced equipment, the recruitment and training of specialized talents, technology research and product development. Entering the production stage, participants need to invest in the establishment of production facilities and the procurement of raw materials and components to ensure the stable production. Therefore, sufficient capital investment is one of the major barriers for new entrants.
Customer Resource Barrier	• Currently, the bionic robotics industry is still in the exploring stage. Established electromechanical actuators manufacturers need to establish cooperative relationships with bionic robot manufacturers, fully cooperate with customers in product development and application testing, and continuously optimize product design and performance. Once bionic robots achieve mass production, electromechanical actuators manufacturers will establish long-term and stable partnerships with their customers, ensuring steady demands. New entrants may find it difficult to gain customer trust in a short time, whereas participants that have early business layout can establish their own customer base and quickly capture market shares
Talent Barrier	• The bionic robot electromechanical actuators market is a technology intensive industry. The manufacturers require talents with theoretical foundation and practical experience to design and develop high-performance and reliable electromechanical actuators. Moreover, as electromechanical actuator technology continues to evolve, the manufacturers need to have innovative talents to promote technological innovation and product upgrades. However, the talents with expertise in bionic robot electromechanical actuators are relatively rare, and cultivating these talents requires a lengthy period of time. Therefore, new entrants may face significant challenges in establishing sufficient talent reserves.

Source: Frost & Sullivan Analysis

Content

Appendix

- We are the world's largest manufacturer of refrigeration and air-conditioning control components and a global leader in automotive thermal management system components in terms of revenue in 2024, according to Frost & Sullivan. Our market share in the global refrigeration and air-conditioning control component market was approximately 45.5% in terms of revenue in 2024, according to Frost & Sullivan. In the global automotive thermal management system component market, we held a market share of approximately 4.1% in terms of revenue in 2024, ranking fifth globally, according to Frost & Sullivan.
- According to Frost & Sullivan, in 2024, under our refrigeration and air-conditioning product component business, our four-way reversing valves, electronic expansion valves, micro-channel heat exchangers, service valves, solenoid valves, Omega pumps and ball valves ranked first in their respective global markets in terms of revenue, with market shares of 55.4%, 51.4%, 43.4%, 39.1%, 47.7%, 53.6% and 32.8%, respectively. In the same year, under our automotive component business, our automotive electronic expansion valves and integrated modules ranked first in their respective global markets in terms of revenue, with market shares of 48.3% and 65.6%, respectively.
- Our market share of refrigeration and air-conditioning control components, in terms of revenue, reached the first place in the world in 2013, according to Frost & Sullivan.
- As of December 31, 2024, we established business relationships with all top ten largest refrigeration and air-conditioning manufacturers in terms of revenue in 2023, whose global market share totaled 75.6%, according to Frost & Sullivan. As of the same date, we had established business relationships with all top ten largest automotive manufacturers in terms of revenue in 2023, whose global market share totaled 55.0%, according to Frost & Sullivan.
- According to Frost & Sullivan, we ranked first in the refrigeration and air-conditioning control component market in terms of revenue, in 2024. According to Frost & Sullivan, in terms of revenue, in 2024, we ranked first in the global market of refrigeration and air-conditioning valves, heat exchangers and pumps, and ranked second in the market of refrigeration and air-conditioning controllers. In the same year, our four-way reversing valves, electronic expansion valves, micro-channel heat exchangers, service valves, solenoid valves, Omega pumps and ball valves ranked first in their respective global markets in terms of revenue, with market shares of 55.4%, 51.4%, 43.4%, 39.1%, 47.7%, 53.6% and 32.8%, respectively. In the same year, our pressure sensors ranked second in the global sensors market in terms of revenue, with a market share of 15.9%.

Source: Annual Reports; Frost & Sullivan Analysis

Appendix

- According to Frost & Sullivan, in terms of revenue, in 2024, we ranked first in the global market of automotive valves and integrated modules, respectively, and ranked fourth in the global market of automotive pumps. In 2024, our automotive electronic expansion valves and integrated modules ranked first in their respective global markets in terms of revenue, with market shares of 48.3% and 65.6%, respectively. In the same year, our battery coolers and automotive electronic water pumps ranked third and fourth in their respective global markets in terms of revenue, with market shares of 5.9% and 5.5% respectively.
- According to Frost & Sullivan, the global sales volume of NEVs has increased from 5.2 million units in 2020 to 21.4 million units in 2024, and is expected to further increase to 47.2 million units by 2029.
- Nowadays, the rapid development of NEVs, along with the advancements in battery and charging technologies, is driving the market demand for reliable automotive thermal management systems, according to Frost & Sullivan.
- For instance, the Ex-factory Defect Rate of our electronic expansion valve product category under our refrigeration and air-conditioning product component business decreased from 3.09 PPM in 2022 to 3.05 PPM in 2023, and further reduced to 2.99 PPM in 2024. According to Frost & Sullivan, such Ex-factory Defect Rates are lower than the industry average, which ranged from 10 PPM to 15 PPM during the Track Record Period. These figures underscore our commitment to high quality.
- During the Track Record Period, we achieved a solid revenue growth with stable and industry-leading margins.
- The refrigeration and air-conditioning control components are core sub-components of refrigeration and air-conditioning product components, designed to enable functions including system monitoring, regulation and intelligent control, among others. We primarily operate in (i) the refrigeration and air-conditioning control component industry,(ii) automotive thermal management system component industry and (iii) strategic emerging industries including bionic robot electromechanical actuator industry.

Source: Annual Reports; Frost & Sullivan Analysis

Abbreviations and Terms

Abbreviations and Terms

- **CAGR:** compound annual growth rate
- **China:** if not specified, refers to mainland China, excluding Hong Kong, Macau and Taiwan
- **GDP:** gross domestic product
- **R&D:** research & development
- **RMB:** Renminbi, the lawful currency of the PRC

Limitations in Source of Information

- Interviews with end-users, venders and distributors are conducted to collect information for this report, based on a best-efforts basis.
- Frost & Sullivan will not be responsible for any information gaps where interviewees have refused to divulge confidential data or figures.
- In instances where information is not available, figures based on similar indicators combined with Frost & Sullivan in-house analysis will be deployed to arrive at an estimate.
- Frost & Sullivan will state the information sources at the bottom right-hand corner of each slide for easy reference.

Note to Numeric Calculations

- Value and percentage figures in this report are all rounded. Figures may not add up to the respective totals owing to rounding.
- The base year is 2024. The historic period is from 2020 to 2023. The forecast period is from 2025 to 2029.

Methodologies

- Frost & Sullivan is an independent global consulting firm, which was founded in 1961 in New York. It offers industry research and market strategies and provides growth consulting and corporate training. Its industry coverage in the PRC includes automotive and transportation, chemicals, materials and food, commercial aviation, consumer products, energy and power systems, environment and building technologies, healthcare, industrial automation and electronics, industrial and machinery, and technology, media and telecom.
- The Frost & Sullivan's report includes information on overview of global and China's macro economy, analysis of global and China's refrigeration and air-conditioning control component market, analysis of global and China's automotive thermal management system component market, analysis of global and China's energy storage thermal management system market, analysis of global and China's bionic robot electromechanical actuator market, and analysis of global and China's inverter controller market.
- The market research process for this study has been undertaken through detailed primary research which involves discussing the status of the industry with leading industry participants and industry experts. Secondary research involved reviewing company reports, independent research reports and data based on Frost & Sullivan's own research database.
- Projected total market size was obtained from historical data analysis plotted against macroeconomic data as well as specific related industry drivers.
- Frost & Sullivan's report was compiled based on the below assumptions:
  - Global economy is likely to maintain steady growth in the next decade;
  - Global social, economic, and political environment is likely to remain stable in the forecast period;
  - Market drivers like surging demand for air conditioners, accelerated urbanization and rising living standards, favourable policies, growing requirements for product performance, among others.