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# New Energy Vehicle Thermal Management System Market Research Report, 2021

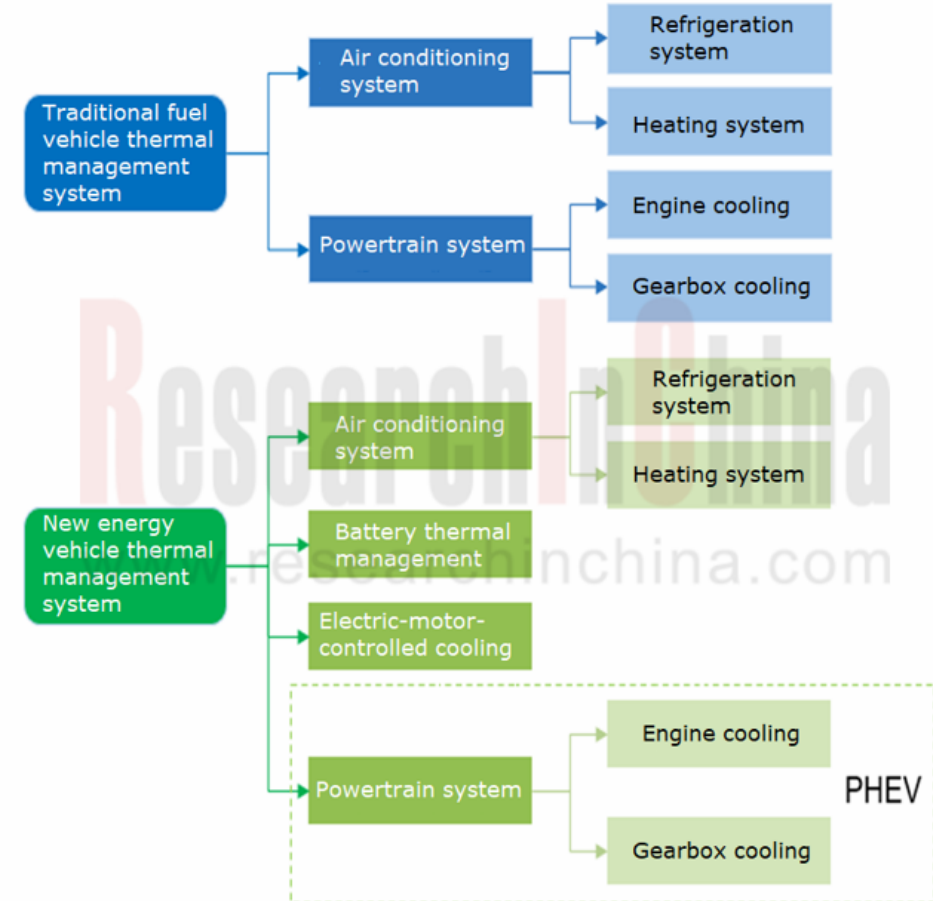
Sept. 2021

Research on EV Thermal Management System: Fast iterative Application of New Technologies such as Heat Pump Air conditioning and Fourth-generation Refrigerant

**China's new energy vehicle thermal management system market size will exceed RMB40 billion in 2025**

Due to the low efficiency of the internal combustion engine and the sufficient residual heat from the engine, the temperature management of traditional fuel vehicles mainly focuses on cooling and heat dissipation, with a relatively simple structure. In contrast, the new energy vehicle thermal management system is more complex, including refrigeration system, heating system (PTC/heat pump), battery thermal management system (air cooling /liquid cooling /direct cooling), and electric-motor-controlled cooling system (liquid cooling/independent heat exchange) and PHEV's unique engine cooling and gearbox cooling systems. Therefore, the value of a new energy vehicle is higher.

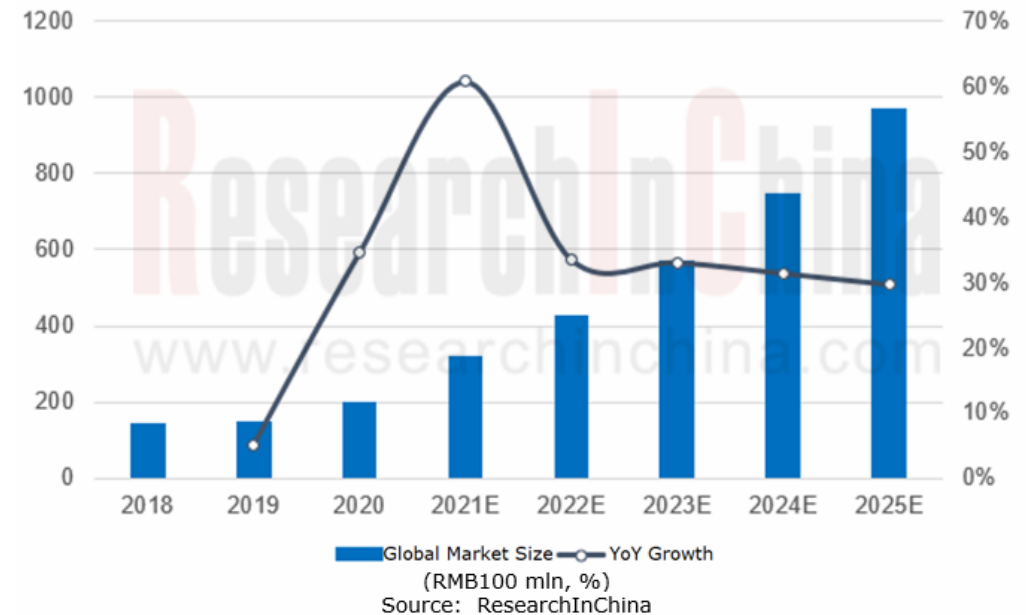
## The Thermal Management System of New Energy Vehicles is More Complicated than That of Traditional Fuel Vehicles



Source: ResearchInChina

With the popularization of new energy vehicles, the automotive thermal management system has become complicated, with an increasingly complex structure and a higher integration level. The upgrade from independent modules to system engineering directly makes the cost of the automotive thermal management system swell from RMB1,600-2,500 (traditional fuel models) to RMB6,000-7,000 (new energy models). By 2025, 15 million new energy vehicles will be sold globally, so that China's new energy vehicle thermal management system market size is expected to hit RMB40.1 billion, accounting for more than 40% of the global scale.

Global New Energy Vehicle Thermal Management System Market Size, 2018-2025E



## As new technologies evolve rapidly, the application of the heat pump air conditioning system and the fourth-generation refrigerants like CO2 and R1234yf will accelerate

(1) Heat pump air conditioners will gradually be included in the standard configuration of high-end new energy passenger cars

At present, there are two main air conditioning system solutions for battery-electric vehicles:

- ❑ Air conditioning system with cooling function only + PTC (Positive Temperature Coefficient) heating;
- ❑ Heat pump air conditioning system.

For new energy passenger cars, most domestic air conditioning system manufacturers use PTC air heaters for heating (PTC water heaters are generally available in plug-in hybrid vehicles), that is, PTC is heated by consuming battery power, which features high energy consumption. The heat pump air conditioning system adopts air as the heat source, and its heating and cooling share the same system. Thanks to heating, dehumidification and high energy efficiency ratio, it is the perfect solution for the high energy consumption of new energy vehicle air conditioners and longer recharge mileage of electric vehicles.

At present, more and more new energy vehicle manufacturers, including Nissan, Renault, BMW, Volkswagen, Audi, Toyota, Tesla, BYD, SAIC, GAC and Geely, have adopted heat pump air conditioning systems.

## Some Models Equipped with Heat Pump Air Conditioners and Suppliers

Brands	Models	Suppliers
Geely	PMA-2 platform	Yinlun Machinery
SAIC Passenger Vehicle	MG ZS	Songz Automobile Air Conditioning
NIO	ES6	Aotecar
Toyota	Prius, Corolla Dual Engine E+ (PHEV)	Co-developed by Denso and Toyota
Volkswagen	New E-golf	Hanon
Renault	Renault ZOE	Denso
Nissan	Nissan Leaf	Denso
Kia	Soul	Hanon
SAIC	Roewe i5	Sanden Behr
SAIC	Roewe MARVEL-X	Huayu Sanden
Tesla	Model Y	Aotecar
Volkswagen	MEB	Kelai (pipelines)
Volvo	Volvo XC40	Sanhua Intelligent Controls
Geely	Geometry A	Yinlun Machinery
BYD	Han, Dolphin Platform	BYD

Source: ResearchInChina

(2) The fourth-generation air conditioning refrigerants will become the main technical direction of automakers in the future

With a long history, refrigerants are an indispensable part of the air conditioning system. As people's awareness of environmental protection improves and requirements are proposed on the performance of air conditioning systems, refrigerants have undergone several updates since 1830:

- ❑ The first generation of refrigerants mainly focus on workability. Main representatives: NH<sub>3</sub>, etc.;
- ❑ The second-generation refrigerants mainly feature safety and toxicity. Main representatives: R11, R12, etc.;
- ❑ The third-generation refrigerants, mainly the refrigerants with low ODP (ozone depletion potential), pay attention to the destruction of the ozone layer. Main representatives: R22, R134a, etc.;
- ❑ The fourth-generation refrigerants, like the refrigerants with zero ODP and low GWP (global warming potential), begin to be involved with the issue of global warming. Main representatives: CO<sub>2</sub>, R1234yf, etc.

Automotive air conditioning refrigerants are transitioning from the third generation to the fourth generation. The first-generation refrigerants, mainly R11 and R12, damage the ozone layer severely and pose a greenhouse effect. Now, R12 has been eliminated and been banned on new cars in China since 2002. With the steady progress of environmental protection policies, the replacement of R-134a is inevitable, but automakers have different opinions on using which refrigerant, R-1234yf or CO<sub>2</sub>, to substitute it.

## Features of Different Air Conditioning Refrigerants

	R-134a	R-1234yf	R744(CO <sub>2</sub> )
Molecular weight	102	144	44
Critical temperature (°C)	101	95	31
Critical pressure (Mpa)	4.17	3.38	7.38
Critical point density (Kg/m <sup>3</sup> )	512	478	468
Cooling capacity per unit of weight at 0°C (KJ/Kg)	120	125	140
Cooling capacity per unit of volume at 0°C (KJ/Kg)	2860	2633	22600
Adiabatic index	1.12	1.09	1.3

Source: Dongfeng Motor Corporation Technical Center

**OEMs choose thermal management technology roadmaps and system architectures according to their own needs, bringing many development opportunities for domestic suppliers.**

Compared with mature fuel vehicles, automakers are still exploring and redefining the technology roadmaps and system architectures of the thermal management system for new energy vehicles. Major automakers have proposed their own solutions, especially Tesla and Volkswagen are the forerunners whose exploration in the thermal management system of new energy vehicles may indicate the future development direction of the industry.

Tesla's thermal management system solutions have evolved into the fourth generation. From Model S to Model 3, then to Model Y, the architecture of Tesla's thermal management system is becoming more and more complex, with much more working modes. Volkswagen started to explore heat pump air conditioning technology earlier and has accumulated rich experience. However, due to the small scale of new energy vehicles, its heat pump technology has not been widely promoted within the group. In the future, with the mass production of models on the battery-electric MEB platform, Volkswagen's sophisticated heat pump technology will bolster its new energy products greatly.

## Air Conditioning and Battery Thermal Management System Technologies of Major New Energy Vehicle Models

Models	Air conditioning thermal management mode	Battery thermal management mode
Model S	APTC	WPTC
Model X	APTC	WPTC
Model 3	APTC	Motor waste heat
Model Y	APTC (low pressure) +Heat pump	Motor waste heat + heat pump
NIO ES8	APTC	WPTC
NIO ES6	Heat pump	WPTC
Xpeng G3	WPTC	WPTC
WM EX5	WPTC, one for two	
Lixiang ONE	APTC	WPTC
Always U5	WPTC, one for two	
BYD Dolphin	Heat pump	Heat pump
BYD Han	APTC	WPTC

Source: ResearchInChina

In the thermal management system market for traditional energy and new energy vehicles, traditional foreign-funded giants such as Denso, Valeo, Hanon, Mahle, etc. still dominate the supply of first-level system integration by virtue of deep technology accumulation and enormous customer resources, while domestic counterparts supply system components.

With the popularization of new energy vehicles in China, domestic manufacturers, such as Yinlun Machinery and Sanhua Intelligent Controls, quickly seize domestic new energy vehicle companies thanks to rapid response, cost control and geographical advantages, and have obtained experience in mass production of thermal management integrated systems. On April 18, 2021, Huawei released TMS 2.0, a smart car thermal management solution, which will be mass-produced in 2022. Compared with TMS 1.0 installed on BAIC ARCFOX, it has a higher level of integration, and it is improved in energy efficiency, calibration efficiency and experience.

Domestic Tier1 companies started with parts in the early stage, focusing on the R&D and production of valves, pumps, and pipelines. They have broken the foreign monopoly, mastered the key technology of core components, entered the thermal management industry, endorsed the scale and products of key customers by binding foreign system integration customers, and accumulated valuable experience in system integration. On this basis, they are gradually transforming into suppliers of automotive thermal management solutions, offering more product types to domestic OEMs.

**New Energy Vehicle Thermal Management System Layout of Tier1 Suppliers**

Enterprises	System integration				New energy thermal management system components				
	Battery thermal management	Air Conditioning System	Heat pump system	Cooling plate	Battery cooler	Electronic water pump	Electronic expansion valve	Pipeline	Electric compressor
Denso	✓	✓	✓						✓
Mahle	✓	✓	✓						✓
Valeo	✓	✓	✓						✓
Hanon	✓	✓	✓						✓
Yinlun Machinery	In research		✓	✓	✓	✓			
Sanhua Intelligent Controls			✓	✓	✓	✓	✓		
Aotecar	✓	✓	✓						✓
Kelai								✓	
Zhongding Group	✓							✓	
Songz Automobile Air Conditioning	✓	✓	In research		✓				
Feilong Auto Components						✓			

Source: ResearchInChina

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## Beijing Headquarters

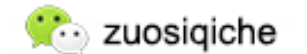
TEL: 13718845418

FAX: 010-82601570

Email: [report@researchinchina.com](mailto:report@researchinchina.com)

Website:  
[www.researchinchina.com](http://www.researchinchina.com)

WeChat: [zuosiqiche](https://www.wechat.com/p/zuosiqiche)



## Chengdu Branch

TEL: 028-68738514

FAX: 028-86930659