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**Global and China
Automotive Comfort System
(Seating system, Air
Conditioning System)
Research Report, 2024**

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The penetration of comfort functions rises, and zero-gravity seats usher in a boom period

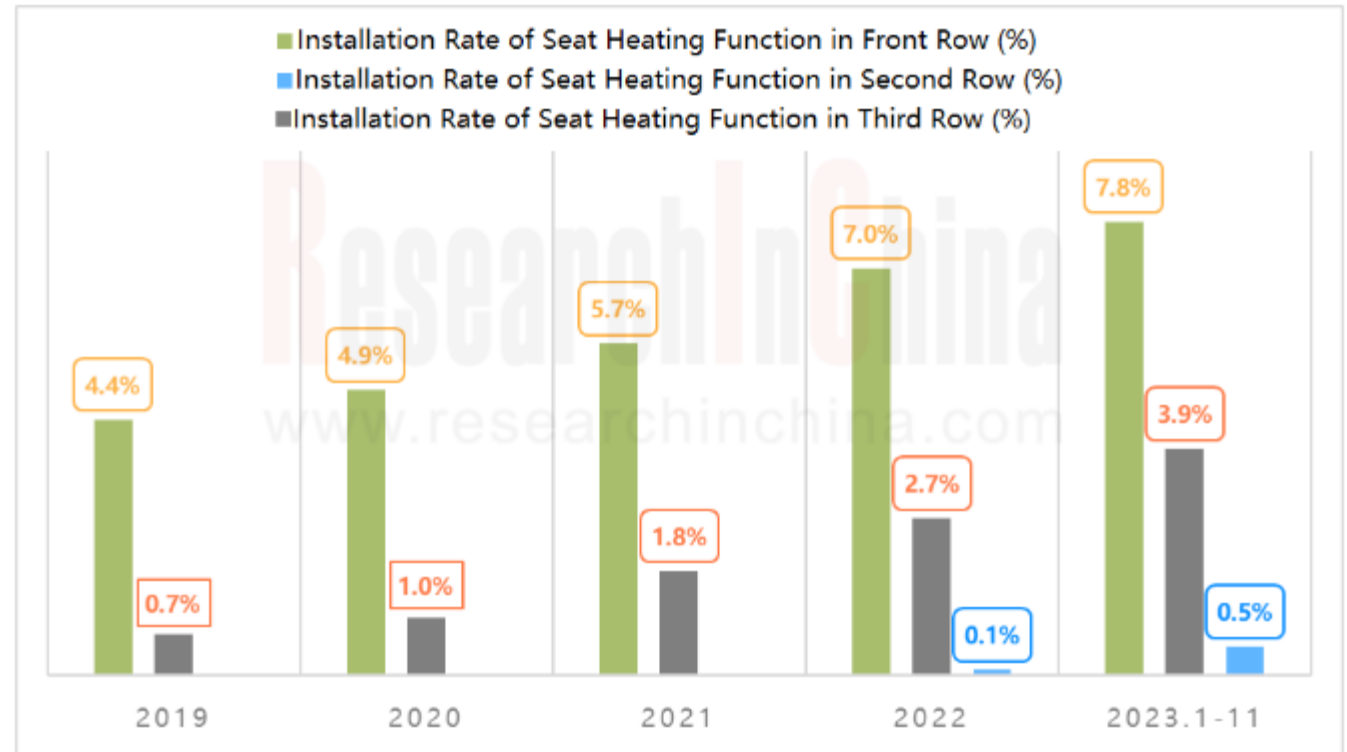
Automotive comfort systems include seating system, air conditioning system, soundproof system and chassis suspension to improve comfort of drivers and passengers. This report highlights seating system and air conditioning system.

Seating system: the penetration of comfort functions rises, and zero-gravity seats usher in a boom period.

As intelligent vehicles gain popularity, automotive seats have ever more comfort functions such as heating, ventilation, massage, electric leg/foot rests and memory seat. Not only is the penetration of these functions on the rise, but they also begin to spread from the front row to the third row of seats.

In the case of seat heating function, from January to November 2023, its installation rate in the front row and the second row was 7.8% and 3.9%, respectively. Since 2022 the third row of seats has also begun to be equipped with heating function, and the main models include Li L8/L9, WEY Gaoshan and NIO ES8.

Installations and Installation Rate of Seat Heating Function, 2019-Nov. 2023



Source: ResearchInChina

The installation of zero-gravity seats has reached a small peak

In terms of entire seats, the installation of zero-gravity seats has reached a small peak. Since being installed on AITO M7 (RMB289,800-379,800) in July 2022, zero-gravity seats have been mounted on models like IM LS7 (RMB309,800-459,800), AITO S7 (RMB249,800-349,800), ZEEKR X (RMB189,800-209,800), WEY Blue Mountain DHT (RMB273,800-308,800), Denza D9 (RMB335,000-445,000), and Trumpchi E8 (RMB209,800-229,800). They have been optional as driver's and copilot seats of Deepal S7 (RMB149,900-202,900), a model launched in June 2023.

Vehicle Models Equipped with Zero-gravity Seats and Their Suppliers (Part)

Model	AITO M7	IM LS7	Deepal S7	Luxeed S7
Time To Market	2022.07	2023.02	2023.06	2023.11
Price (RMB10,000)	28.98-37.98	30.98-45.98	14.99-20.29	24.98-34.98
Position of Zero Gravity Seat	Second row right	Rear row right	Driver's and co-pilot seats (optional: RMB12,000)	Co-pilot seat
Supplier	Lear	Yanfeng	Magna	Yanfeng
Lying Angle	113°	121°	120°	115°
Electrical Control	14-way	-	Driver's seat: 16-way Copilot seat: 14-way	18-way
Massage	√	16-node	8-node	10-node
Ventilation	√	√	√	√
Heating	√	√	√	√
Leg Rest	√	4-way electric leg rest	4-way electric leg rest	4-way electric leg rest

Source: ResearchInChina

In the future, zero-gravity seats will be equipped with various sensors to enable adaptive adjustment, health monitoring and other functions, and comfort functions will keep being upgraded.

Faurecia: In April 2023, Faurecia introduced Zero-Gravity Captain Chair. It offers additional comfort with sensors able to identify potential physical pain and then activate corrective actions to alleviate any discomfort. It incorporates high-tech comfort solutions, such as an inflatable neck pillow and a headrest that automatically adjusts to its occupant's height. As well as lower-back support and massage functions with pressure mapping to enhance relaxation, it includes a new, immersive haptic solution called VIBE, where tactile sensations are created by the car seat, stimulating the user's sense of touch. When activated, digital 4D sound algorithms automatically create vibrations that accompany any sound played on the vehicle's audio system.

Faurecia's Zero-Gravity Captain Chair



Source: Faurecia

Yanfeng: In January 2024, Yanfeng launched the new-generation Hover Seat equipped with Seat Sensing Posture ID technology. Based on zero-gravity research, this seat actively relieves fatigue for passengers during driving by detecting the user's body languages such as sitting posture, fatigue level and body size.

Adaptive Welcome Mode for Different Body Sizes: When a passenger gets into the car, the seat's pressure pad sensors accurately recognize information about his/her body size and automatically adjust the headrest, lumbar support and side wings to make the seat more closely fit his/her body.

Seating Position Recognition and Fitting: The sensor determines the seating posture of the occupant according to the pressure distribution to the seat. Equipped with a matrix of multi-faceted support blocks, the seat automatically adjusts the blocks to give the most comfortable support to the body where needed.

Fatigue Detection and Automatic Massage: The seat detects the occupant changing their posture over time, then determines the degree and location of fatigue, and automatically triggers the partition massage function.

Yanfeng's New-generation Hover Seat



Source: Yanfeng

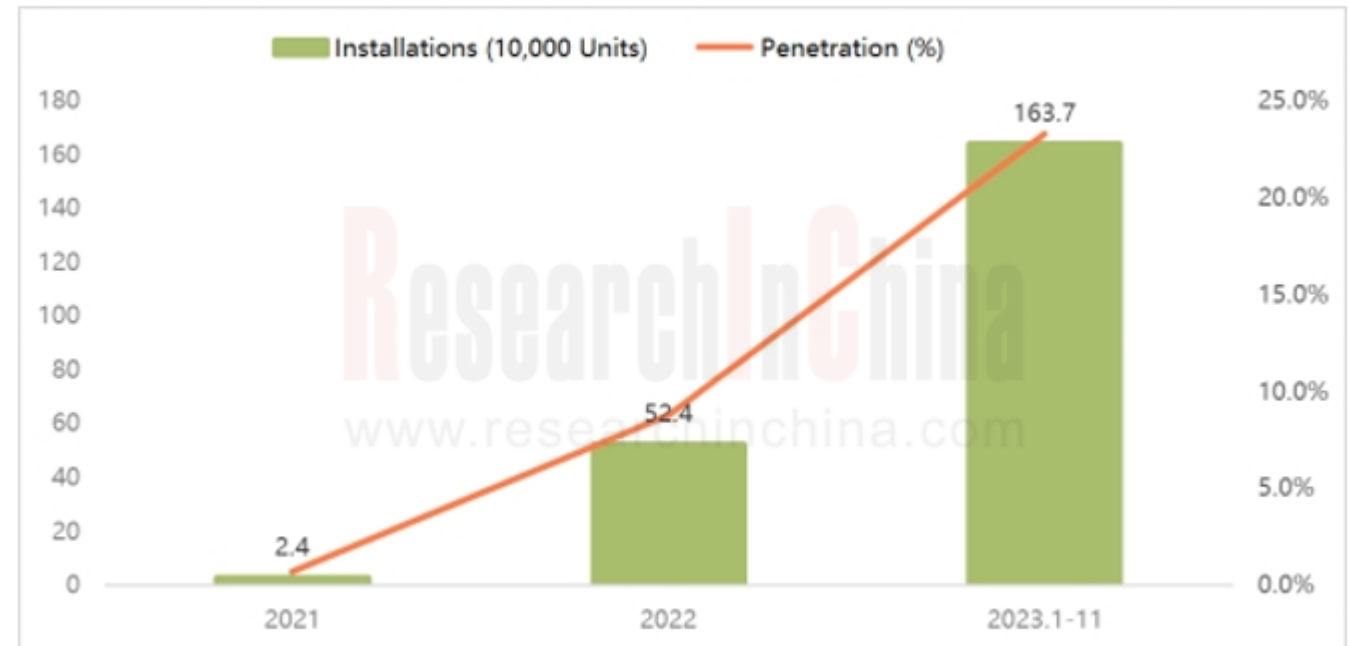
Air conditioning control systems become personalized, energy-efficient and active

Air conditioning system: as the installation rate of heat pump air conditioners rises, air conditioning control systems become personalized, energy-efficient and active.

Heat pump air conditioner is an air conditioning system that integrates cooling and heating functions. Its core components include a compressor and a heat exchanger, which control indoor temperature by absorbing or dissipating heat in the air. By virtue of high heating efficiency, obvious energy saving effect, improvement of cruising range and other benefits, heat pump air conditioner has become a new track in the development of electric vehicle air conditioning systems.

The data from ResearchInChina show that in China electric vehicles have begun to carry heat pump air conditioners since 2021, with a surging penetration, up to 23.3% from January to November 2023.

Installations and Penetration of Heat Pump Air Conditioners, 2021-Nov. 2023



Source: ResearchInChina

Heat pump air conditioner refrigerants are typically R-134a, R-1234yf and R744

Heat pump air conditioner refrigerants are typically R-134a, R-1234yf and R744 (carbon dioxide, CO₂). R744 can extend the cruising range of vehicles because of its better effects in environmental protection, safety, flow heat exchange and low temperature heating, and the prices of its raw materials are low. In the future, CO₂ heat pump systems using R744 refrigerant will become mainstream. Chinese suppliers have started deploying the CO₂ heat pump market:

Summary of Products of Suppliers Deploying CO₂ Heat Pump in China

Supplier	Product	Overview and Mass Production
Midea Welling	CO ₂ Electric Compressor	The CO ₂ electric compressor offers heating efficiency of COP=2.5 at -15°C and COP=2 at -30°C, meeting the needs of both high-efficiency refrigeration and low-temperature heating. Compared with conventional heat pumps, it increases the cruising range by 20%. It has been mass-produced and installed on Xpeng G6 (launched in June 2023).
Sanhua Intelligent Controls	CO ₂ Heat Pump Air Conditioning Valve System	CO ₂ heat pumps have been installed on some European models, including CO ₂ electronic expansion valve, CO ₂ stop valve/one-way valve/regulating valve, four-way valve and gas-liquid separator.
Kelai Mechatronics	CO ₂ High-Pressure Piping System (Refrigerant Pipe)	Kelai Mechatronics is the supplier of CO ₂ heat pump air conditioner pipes for Volkswagen MEB. The self-developed CO ₂ high-pressure piping system has been mass-produced for Volkswagen MEB platform. It is a solution to the problem of refrigerant leakage at high pressure in CO ₂ heat pumps, with high technical barriers.
Tenglong Auto Parts	CO ₂ Heat Pump Air Conditioning Valve System	In February 2021, the company was designated as the supplier of the thermal management valve group integrated module for CO ₂ heat pump system of Volkswagen MEB platform. The content-per-car value of this product exceeds 2,000 yuan, and the annual supply will reach 40,000 sets in the life cycle of seven years. This product is used in Volkswagen's model Aero to control the effective operation of the entire heat pump system in different working conditions such as cooling and heating.

Source: ResearchInChina

OEMs also head in the direction of refinement

Moreover in terms of air conditioning function, OEMs also head in the direction of refinement. AI algorithms make air conditioning systems controlled in multiple zones, and allow the driver and passengers to set their own temperatures, meeting the needs of different occupants. AI algorithms not only enable accurate control over parameters like refrigerant circulation and fan speed, but also take into account their impacts on battery cruising range to achieve energy-saving control effects.

NIO ES8 (launched in December 2022) packs an intelligent five-zone independent air-conditioning system, which uses a self-developed air-conditioning energy consumption calculation method to achieve: five-zone temperature control, five-zone blowing mode, and four-zone air volume adjustment, accurately controlling 0.5°C in the range of 15-31°C. This system can be controlled via voice interaction or mobile phone APP remotely.

- Front row: 2-zone temperature control, 2-zone blowing mode, 2-zone air volume control
- Second row: 2-zone temperature control, 2-zone blowing mode, 1-zone air volume control
- Third row: 1-zone temperature control, 1-zone blowing mode, 1-zone air volume control

The OTA Update 4.6.2 has been officially pushed to Li L9 (launched in June 2022), adding a new mode of air conditioning energy saving. In this mode, the car will reduce the power of air conditioning and automatically adjust seat heating and steering wheel heating. While maintaining interior comfortable temperature, this mode cuts down energy consumption and increases the available cruising range of the car in EV mode. In urban commuting in winter (outdoor temperature: <0°C), the CLTC range can be increased by up to 50%.

IM LS6 (launched in October 2023), with its air-conditioning smart air outlet function, automatically turns off the air outlet in unoccupied positions by reading seat signals, making the air-conditioning system more efficient.

FAW-Volkswagen ID.7 VIZZION (launched in December 2023) is equipped with Smart Air, a hidden intelligent air conditioner that can memorize the height of different passengers, and set and adjust the height of the air outlet. Equipped with a climate sensor, it can automatically adjust the wind speed and air outlet angle according to the in-car environment, and automatically turn on defogging and defrosting functions according to humidity and temperature.

Future automotive air conditioning algorithms will use advanced technologies

Future automotive air conditioning algorithms will use advanced technologies such as deep learning and neural networks to enable air conditioning systems to self-learn and optimize, more accurately predict the driver's needs, directly and actively adjust temperature, air volume and mode, minimizing manual adjustments by users and achieving more precise temperature control and energy efficiency optimization.

Smart Air Hidden Intelligent Air Conditioner in Volkswagen ID.7 VIZZION



Source: Volkswagen

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