



OEMs Refrigerant Strategy for BEVs and PHEVs Remains Open

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Latest thermal management market research by Ducker Carlisle confirms that a majority of carmakers, original equipment manufacturers (OEMs), are currently using R1234yf as the refrigerant of choice in plug-in hybrids (PHEVs) and battery electric vehicles (BEVs). Increasing vehicle electrification however requires OEMs to grant highest attention to their refrigerant selection. Indeed, effective thermal management is critical to enhance battery range and lifespan.

Volkswagen opting for CO₂ as refrigerant (also known as R744) for the MEB platform has raised the pressure on other OEMs to seek innovative refrigerant solutions. A renowned, international thermal management system provider stated: "We are currently receiving numerous proposal requests for R744 heat pumps, suggesting that many OEMs seem to be considering a CO₂ heat pump. When Volkswagen adopts a strategy, others are likely to follow." According to a public statement released by the Volkswagen Group on the EU proposal to restrict the utilization of Per- and Polyfluoroalkyl (PFA) substances, Volkswagen will start converting its BEVs to R744 "in the second half of the decade" and the transition "will take several years, through end of 2030, to shift all major BEV platforms".

At this stage, the strategy of other OEMs remains unclear whether they will make the decision to choose CO₂, remain with R1234yf, or opt for other innovative solutions such as propane (R290). The decision depends on multiple factors, including regulations and subsidies, vehicle type (e.g. passenger car vs. bus) and associated safety concerns, as well as vehicle size and brand positioning.

Regulations and Subsidies

Due to stricter environmental legislation across industries, many OEMs and thermal management suppliers anticipate that the EU will implement a regulation banning R1234yf by 2030. Indeed, the R1234yf gas is a PFA, a type of chemicals that persists in the environment over very long time periods (also known as "forever chemicals").

Exposure to some of those PFAs may lead to severe health issues, hence the proposal from five EU countries to ban their use, including R1234yf. As of now, the proposal is still under review by the European Chemical Agency - conclusions should be submitted to the European Commission by 2025. If a ban were to be voted, OEMs would have to shift to either CO₂ or propane.

Additionally, national government subsidies for thermal systems will favor refrigerants with a lower Global Warming Potential (GWP). In Germany for instance, CO₂ has become the preferred refrigerant for heat pumps in electric buses, due to subsidies up to €6,500 for articulated electric buses.

Vehicle Type and Safety Concerns

The appeal of innovative refrigerants will also depend on the vehicle type and its thermal management design.

Buses, for example, have high heating and cooling requirements, they are therefore more likely to use CO₂ and propane as refrigerant than passenger cars. Thermal management system provider explains: "Propane started to be used in buses a few years ago, and use cases are expected to strongly grow in the coming years due to its excellent thermal performance."

Heat pumps can easily be installed on bus roofs - which minimizes the risk associated with propane's flammability – while the use of propane in passenger cars presents a significant challenge: the heat pump would have to be located under the hood, in the engine compartment, where fire hazard risk is higher, which is likely to raise reluctance to adoption. "R290 is a very efficient, inexpensive refrigerant that has been tested in other areas and, with the right technology, is also a safe refrigerant. The disadvantage is that it is highly flammable. Refrigerant systems must therefore be designed as a closed unit with permanently sealed connections. Hence, according to my current knowledge, propane will not prevail in passenger cars" explained Stefan Schäfer, Business Development Manager at Burger Group.

As a matter of fact, the Environmental Protection Agency (EPA) in the United States does not consider propane an "acceptable alternative for Motor Vehicle Air Conditioners under the Clean Air Act".

The automotive industry, however, does not exclude propane altogether. ZF, for example, presented in June 2023 a new e-drive system (called 'TherMas') with a propane-based heat pump. One circuit is dedicated to the passenger compartment, two other separate circuits are used for the thermal management of the power electronics and the e-drive. ZF announced that this solution doubles the cooling capacity compared to current gases, while safety is ensured through a hermetically sealed system. To date, no OEM has announced any adoption plan for passenger cars yet.

Nevertheless, due to the flammability of propane, it is expected that CO₂ heat pumps will hold a higher market share for both passenger cars and buses. "Since 2018, we have installed over 3,500 CO₂ air/water heat pumps in European buses and anticipate another 2,500 new units this year" stated Karsten Mundt, Sales Director International at Konvekta AG. "Additionally, the increasing demand for CO₂ applications in the automotive sector will drive innovation, lower component prices, and ensure safety as well as efficiency for operators."

Vehicle Size Segment and Brand Positioning

There is a trend for both premium and volume carmakers to increasingly seek heat pump design concepts. Premium OEMs remain significantly more likely to adopt this technology, especially in E- and F-segments where customers demand a high level of comfort, including thermal comfort. In the next 2-5 years, premium OEMs are highly likely to switch from R1234yf to CO2, or to propane - provided the safety concern related to the flammability of propane has been addressed.

Ducker Carlisle's decades of automotive consulting experience and comprehensive expertise in auto and light truck manufacturing, electrification, aftersales, and parts benchmarking help automotive clients secure an advantage in a shifting global market. For further market information on refrigerants, thermal management or other automotive questions, please contact us.

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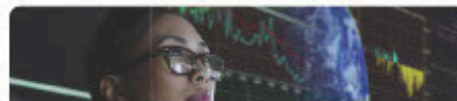
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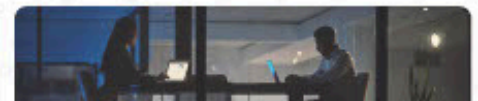


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