

Publication

State of play of CO₂ based heat pumps for EU's automotive industry and citizens

Austria, July 20th, 2026.

1) CO₂ BASED HEAT PUMPS INCREASE THE COMPETITIVENESS OF EU AUTOMOTIVE INDUSTRY IN ELECTRIC VEHICLES

- Restriction of PFAS in light-duty electric vehicles (LDEVs) in the EU would reinforce EU's current lead in CO₂ based heat pumps, create market opportunities and further enhance the strategic autonomy for the European automotive industry.
- 1.25 million LDEVs have already been placed on the EU market with CO₂ based heat pumps (ECHA 2026)
- Given that to date some 10 million LDEVs have been sold in the EU, 10-15% of newly registered LDEVs are equipped with CO₂ based heat pumps (Hanon 2026).
- A CO₂ based heat pump has just become the standard equipment on a strong selling family model of the Skoda brand (Enyaq 2025 Source: Skoda Storyboard)).

2) SEVERAL EU SUPPLIERS ARE CAPABLE OF DESIGNING, DEVELOPING, MANUFACTURING AND DELIVERING PARTS

- Valeo, Hanon Systems and Sanden already produce CO₂ compressors and heat exchanger assemblies at commercial scale in the EU. (ECHA 2026)

3) THE LIFETIME COSTS OF CO₂ BASED HEAT PUMPS ARE SIMILAR TO THOSE OF HFO-1234YF IN ELECTRIC VEHICLES

- Currently the manufacturing costs of CO₂ based heat pumps are €20-€100 more expensive than HFC based heat pumps (ECHA 2026). This is due to smaller production volumes and will vanish in the future with higher volumes and more competition. HFO-1234yf based systems need often an additional electrical heater increasing the direct cost as well as indirect cost, as additional battery capacity is needed for sufficient heating capability.
- The refrigerant cost of CO₂ is upwards of 90% lower than that of HFO-1234yf (which is a patented and licensed PFAS substance from US based Honeywell and Chemours) and thus reducing the maintenance costs significantly. Refilling is cheap and CO₂ does not need to be recovered during maintenance and at the end of life.

4) CO₂ BASED SYSTEMS ARE MORE ENERGY EFFICIENT IN EU'S TEMPERATURES

- In winter conditions CO₂ based heat pumps reduce energy consumption by 2-3 kWh/100km (about 20% lower) during operation.
- Overall, in colder climates CO₂ based heat pumps tend to outperform HFO-1234yf in energy efficiency, since the latter need very often an inefficient electrical heater.
- In hotter climates (above 40°C) CO₂ based heat pumps have about 10% higher energy consumption. However, their cooling capacity and cooling dynamic outperforms that of HFO-1234yf based systems.

5) CO₂ BASED SYSTEMS ARE SAFE

- With 1.25 million CO₂ based LDEVs in operation in the EU, there is no evidence of any safety risks for passengers.
- CO₂ is not toxic to the environment while HFO-1234yf reacts to TFA in the atmosphere where rain washes it down, polluting the drinking water and soils.
- While the pressure in CO₂ based systems is higher the volume of refrigerant is lower than in an HFO-1234yf based system. In other words, the pressure volume ratio for both systems is the same and the systems are equally safe.
- CO₂ is not flammable. HFO-1234yf is mildly flammable (A2L rating) and can burn down to hydrofluoric acid, a very toxic substance.

6) THE EU NEEDS TO CHOOSE THE REFRIGERANT POLICY FOR ITSELF - NOT THE WHOLE WORLD

- The EU cannot – and should not – formulate the refrigerant policy for the whole world.
- Thus, the EU can choose its own policy.
- Cars are manufactured to be operating with different air conditioning and heat pump systems (currently with HFC-134a, HFO-1234yf and CO₂), the steering wheel to be on the left or right, the energy source being petrol, diesel, natural/biogas or electricity. There is no global standard for all cars, including refrigerants.

7) THE PHASE-IN OF CO₂ BASED SYSTEMS COULD BE GRADUAL (EG. IN 5 YEARS) TO ALLOW COST-EFFECTIVE SUBSTITUTION

- Assuming that the Commission's restriction decision enters into effect in 2030 or 2031 the phase-in could start immediately for LDEVs as CO₂ based heat pumps are already in use. There is no need to wait for another 5 years.
- Today already 10-15% of all LDEVs in the EU are running with CO₂ based heat pumps. This natural refrigerant is already technically and economically feasible.
- Due to EU's type approval system, the alternatives could be phased in gradually (e.g. in 5 years starting from entry into effect) to allow cost-effective substitution.
- It is noteworthy that the Commission suggested such a phase in system in 2003 as part of its proposal to regulate HFC-134a in mobile air conditioning (see Article 10 of the Commission's proposal (European Commission 2003)).
- Plug-in Hybrid vehicles should be grouped with LDEVs (not with internal combustion engines) as the majority of Plug-in Hybrids (PHEV) rely on similar technical solutions as battery electric vehicles - both use electrically driven compressors and have a similar system layout.
- The phase-in for Hybrid and internal combustion engine (ICE) cars could also start earlier because the technology is available for them, too. CO₂ based A/C systems have been successfully mass produced in ICEs by Mercedes Benz and Audi in the past.

8) IMPLEMENTING NEW CO₂ BASED SYSTEMS IS ECONOMICALLY FEASIBLE ON NEW LDEV AND PHEV PLATFORMS

- As thermal and safety architectures need to be suited to CO₂, the design and manufacturing of heat pumps for new electric vehicle types (i.e. platforms) is already economically and technically feasible as proven by the 1.3 million cars placed on the market by VW (several brands and models).

9) LEAKAGE OF HFO-1234YF IS NOTORIOUSLY DIFFICULT TO CONTROL

- Refrigerant manufacturers advocate leakage reduction with better design, maintenance and end of life procedures.
- These are difficult and costly to implement and give little assurance of their effectiveness. Every component in a heat pump leaks to a certain extent.
- Leakage from accidents, stone hits to condensers, faulty do-it-yourself repairs and leaky end-of-life dismantling (especially outside the EU) cannot be controlled.
- An attached report (see Graph 1-4) shows that if TFA-creating refrigerants would be banned in 2027, 170 000 tons of TFA could be avoided until 2050. The earlier the EU starts the phase out the more effective the policy is, and the more drinking water could be protected.

REFERENCES:

ECHA (2026) Comments on SEAC draft opinion #20690 (ATMOsphere), #20687 (Obrist) and #20688 (Hanon Systems) available at

https://echa.europa.eu/registry-of-restriction-intentions/-/dislist/details/0b0236e18663449b?dislists_WAR_dislistsportlet_businessIdentifier=0b0236e18663449b

European Commission (2003) Proposal COM(2003) 492 final for the Regulation on certain fluorinated greenhouse gases, available at

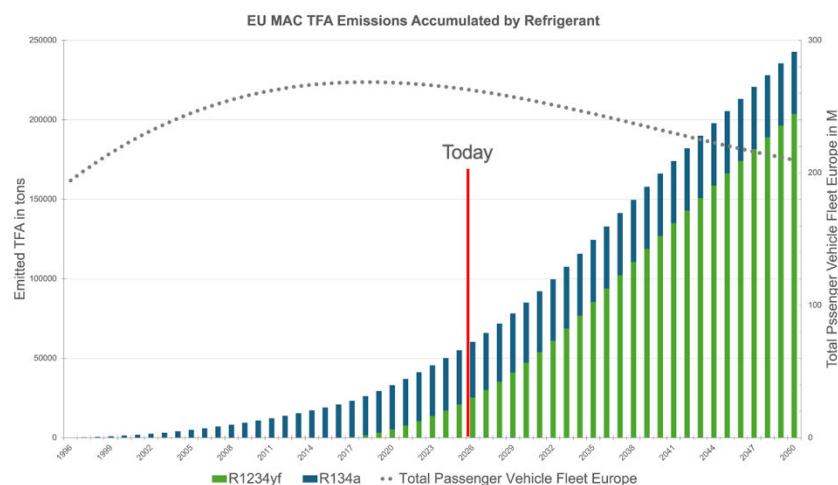
[https://www.europarl.europa.eu/registre/docs_autres_institutions/commission_europeenne/com/2003/0492/COM_COM\(2003\)0492_EN.pdf](https://www.europarl.europa.eu/registre/docs_autres_institutions/commission_europeenne/com/2003/0492/COM_COM(2003)0492_EN.pdf)

Hanon (2026): TFA contamination from fluorinated gases in mobile-air-conditioning systems and already PFAS-free alternatives. Dr. Roman Heckt and Dr Henning Freitag May 2026, available at

<https://www.linkedin.com/company/hanonsystems/posts/?feedView=all>

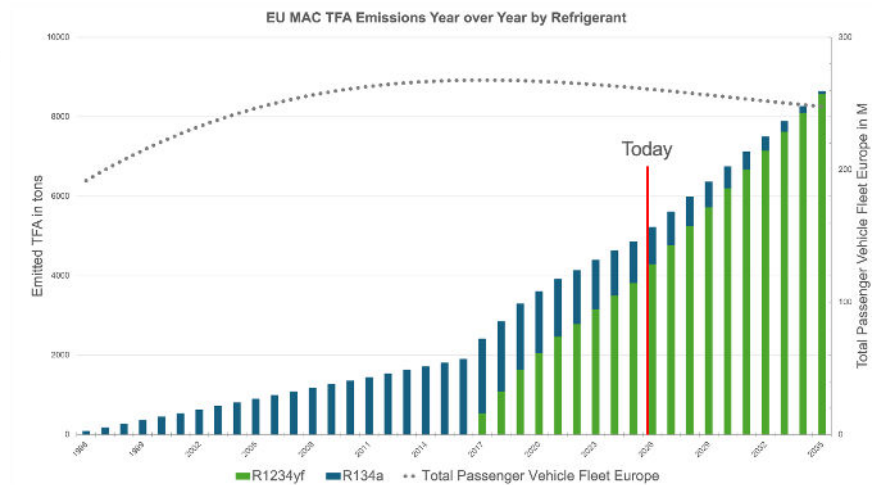
EU MAC TFA Emissions Outlook Accumutatively Current Market Projection

- If the automotive sector stays on this trajectory, **c. 250 000t TFA** will have leaked into the atmosphere by 2050!



EU MAC TFA Emissions Outlook Yearly Current Market Projection

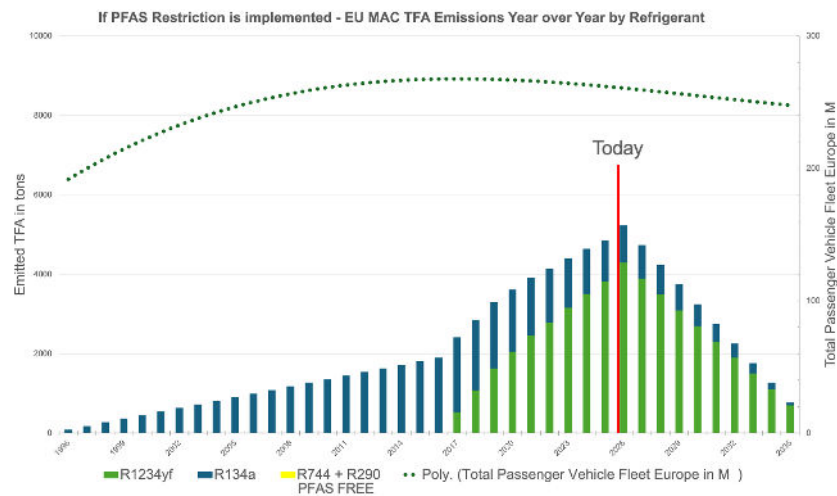
- By 2035 almost the whole fleet of passenger vehicles in Europe will be using R1234yf.
- By then **over 8 000t of TFA** will be emitted yearly just through refrigerant leakage from cars!



Confidential © All rights with Obrist Powertrain GmbH

MAC TFA Emissions Outlook Yearly PFAS Restriction

- A strict PFAS ban will cause an immediately effective way to reduce TFA emissions!
- If the PFAS restriction is implemented, and natural refrigerants R744 and R290 are phased in, TFA emissions from the automotive sector will drop to the same level as around the year 2000!



Confidential © All rights with Obrist Powertrain GmbH

EU MAC TFA Emissions Outlook Accumutatively PFAS Restriction

- In this scenario **c.170 000t of TFA** Emissions can be avoided!
- A strict ban on PFAS, and therefore R1234yf is necessary!
- Any further delay could cause massive harm to public health and the ecosystem!

