

6 Years of Automotive R744

Bringing sustainable cooling into the subcompact segment

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Agenda



- Platform overview
- Usage scenarios of modern EVs
- Optimizing for energy usage
- New MEB+ R744 heatpump



VW Group - custom BEV platform MEB

R744 heatpump availability in the EU [2020-2026]



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Volkswagen ID. Polo



Volkswagen ID. Cross



Volkswagen ID.3 neo



Volkswagen ID.4



Volkswagen ID.5



Volkswagen ID.7



Volkswagen ID. Buzz



Cupra Raval



Cupra Born



Cupra Tavascan



Škoda Epiq



Škoda Elroq



Škoda Enyaq



Škoda Enyaq Coupe



Škoda Peaq



Audi A2 e-tron



Audi Q4 etron Sportback



Audi Q4 etron

> 1,5 Million R744 Systems sold



Usage scenarios of modern EVs

Optimizing for the customer

	Usage of cars irrespective of propulsion method (2025)	Usage of BEV cars (2025)
trips per car per day (average)	1,6	2,2
duration per drive [min]	26	24
distance travelled in total per day [km]	26	38
driving time per day [min]	42	52
average velocity [km/h]	37	43

Source: Study „mobility in Germany“, Federal Ministry of Transport, 2025 Source: VW fleet study, 2025

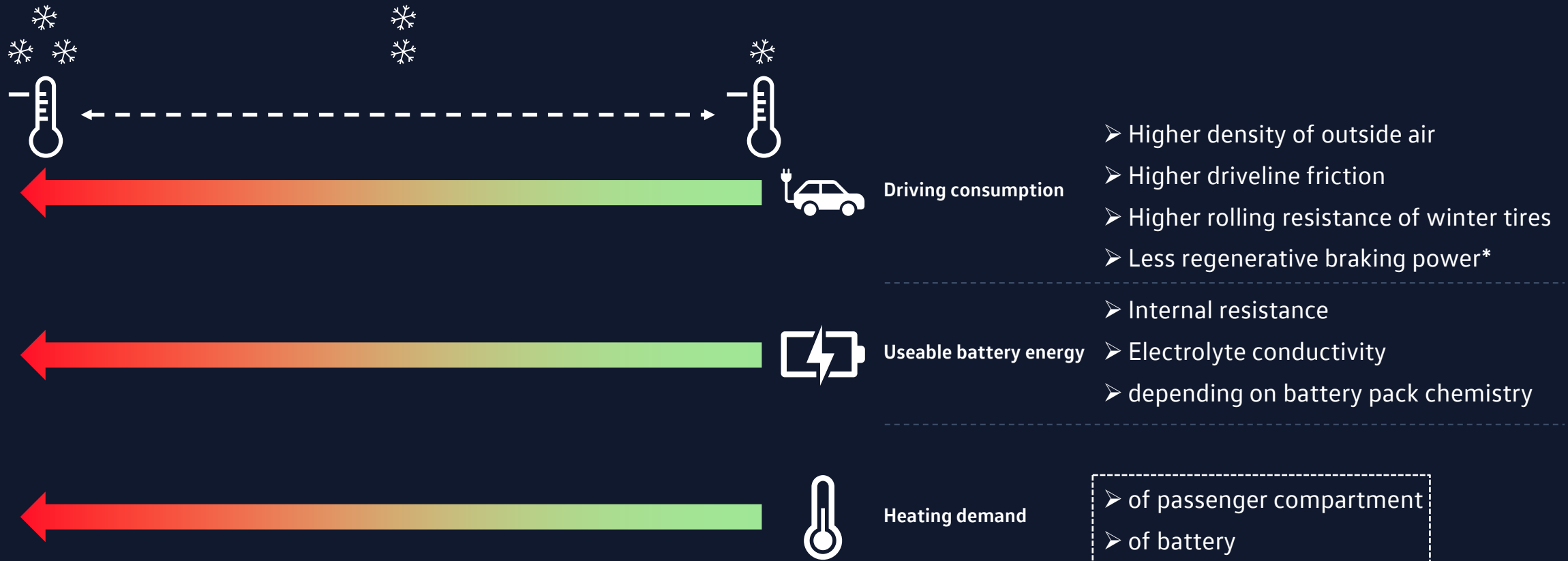
- Short drives dominate car usage
- > 2/3 of drives have a duration of less than 20 minutes

➤ thermal management needs to be optimized in hardware and software to fit the customers dominant usage scenario



EV consumption in cold weather

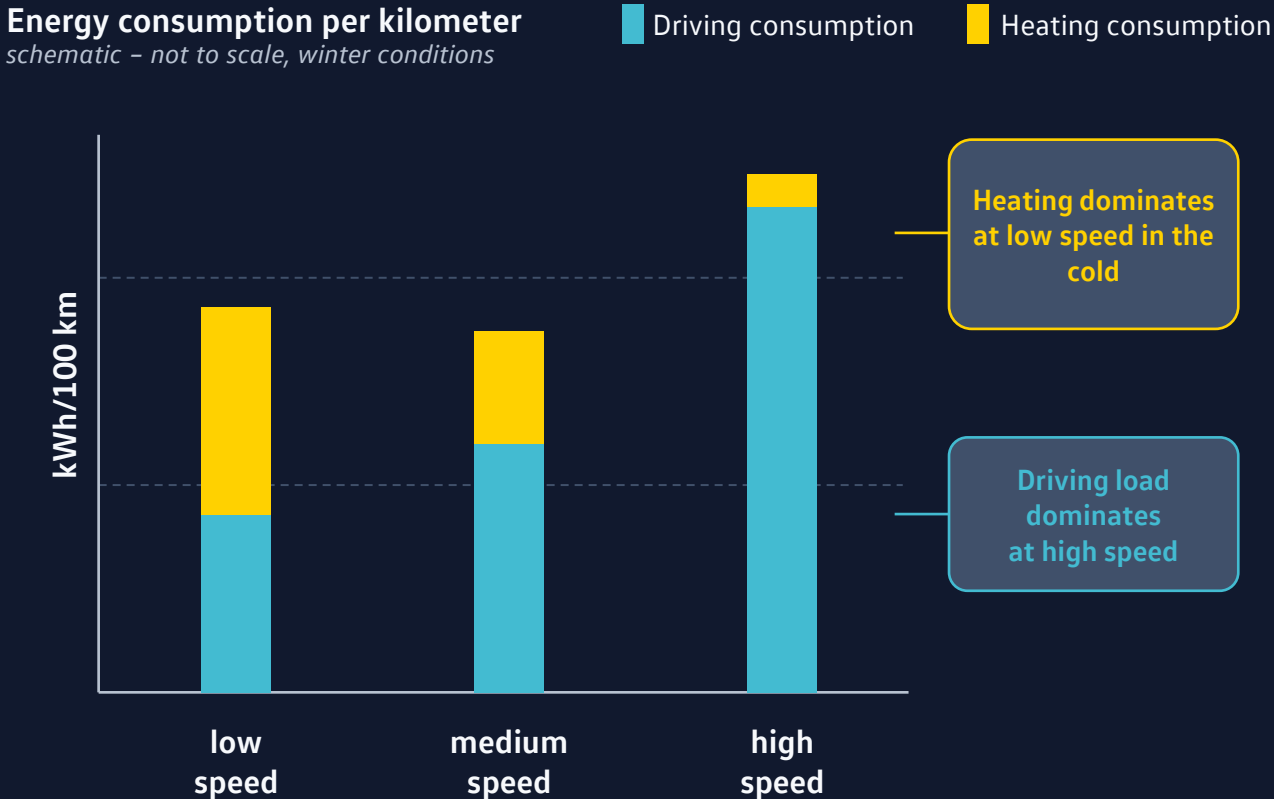
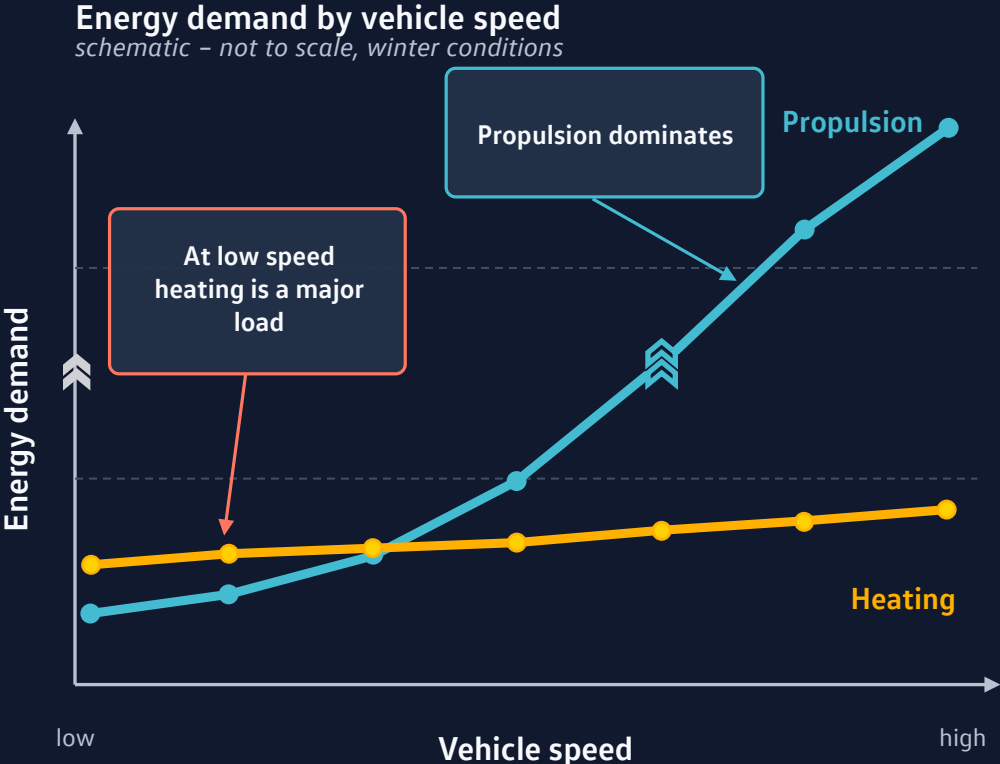
Influencing factors



➤ Optimization of energy usage is key in winter driving conditions

EV consumption in cold weather

relationship of vehicle speed and heating

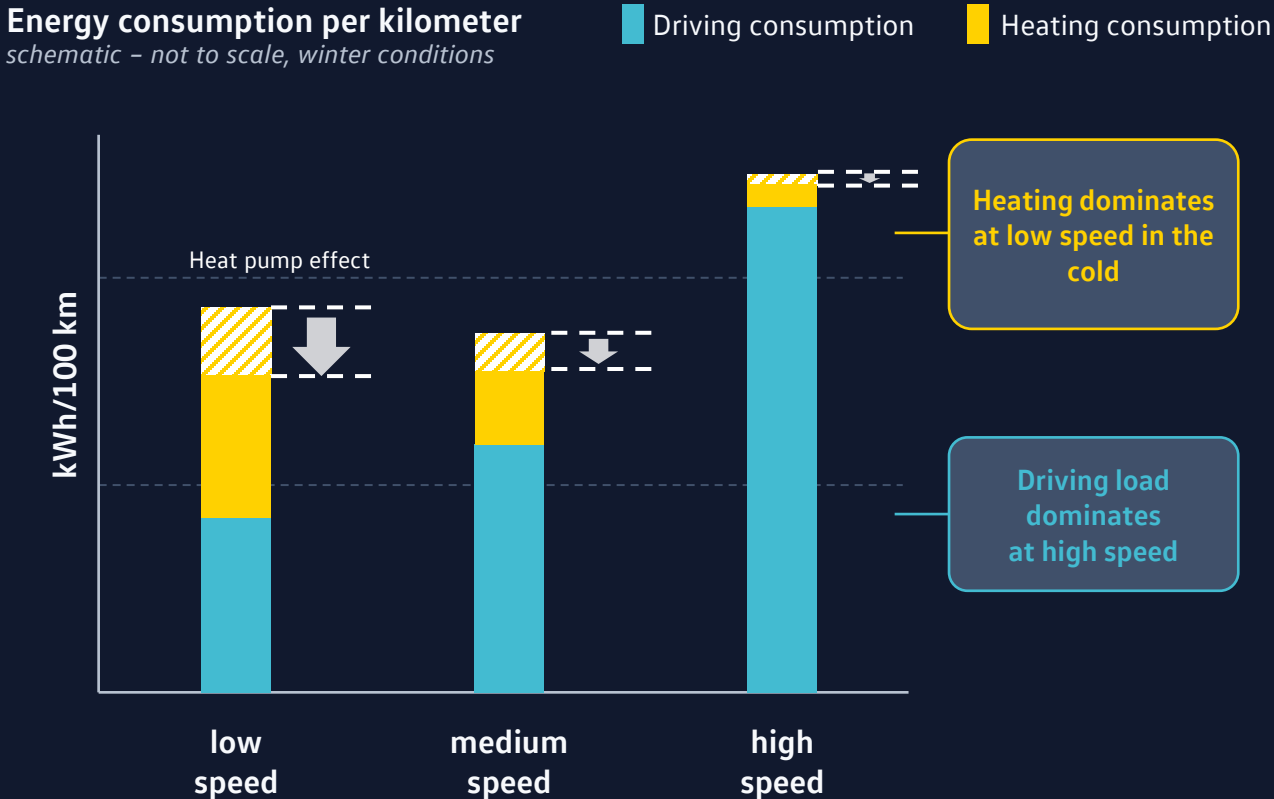
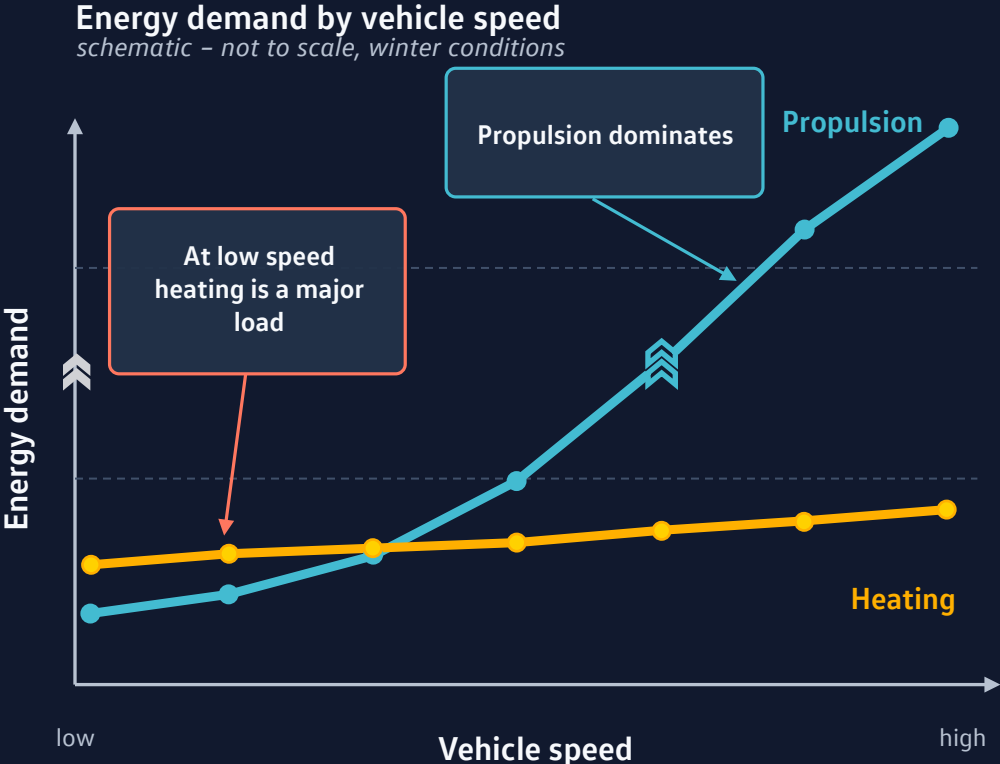


➤ The more a vehicle is used at low speeds/short drives in the cold, the more it profits from a heat pump



EV consumption in cold weather

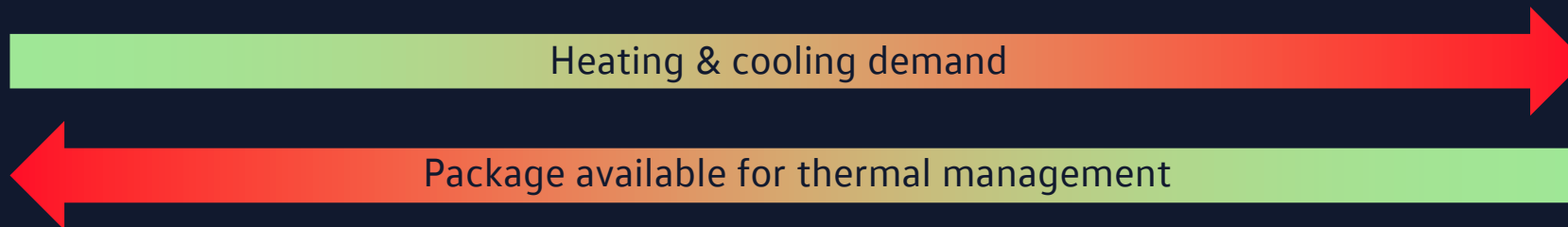
relationship of vehicle speed and heating



➤ The more a vehicle is used at low speeds/short drives in the cold, the more it profits from a heat pump



R744 heat pump utilization across vehicle classes and platforms



➤ Design of a thermal management system needs to be scalable to bridge vehicle classes

Designing a thermal management system... in a smaller package



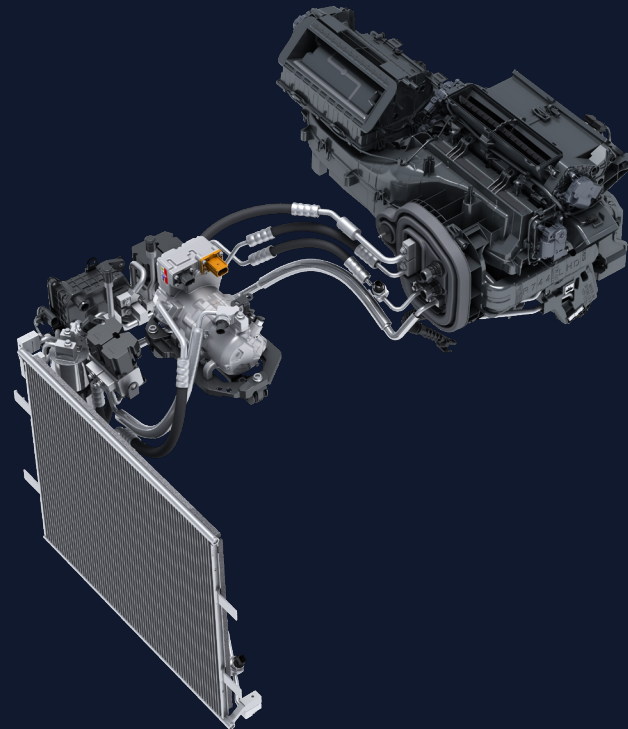
- Smaller interior
 - Less energy required for heating and cooling
- Smaller package
 - Components need to be optimized and packaged efficiently



HIGHER FUNCTIONAL INTEGRATION

Combined functions
Shared heat exchangers
Integrated modules

Bringing sustainable heating and cooling... into the subcompact car segment



Heat pump – refrigerant circuit

- Compared to VW's compact class heat pump design two significant changes have driven development:
 - Package restrictions affected the air conditioning unit
 - Heating is achieved by a coolant-based heat exchanger
 - Instead of two separate HV-heaters (1 air & 1 coolant) one combined, more powerful coolant heater is used
 - Complexity of the coolant circuit rises

Bringing sustainable heating and cooling... into the subcompact car segment

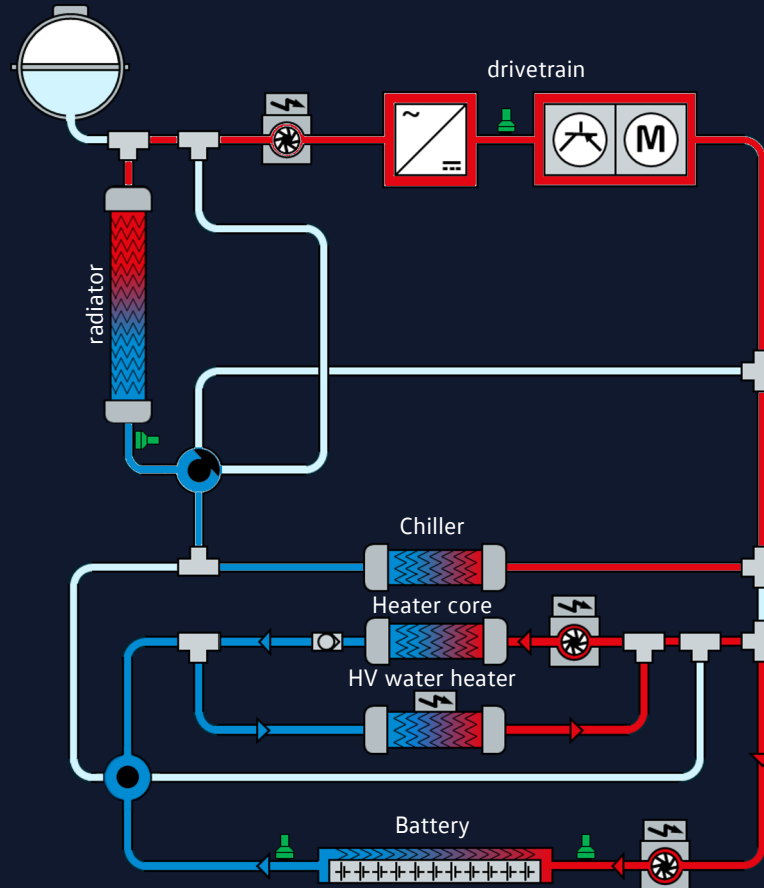


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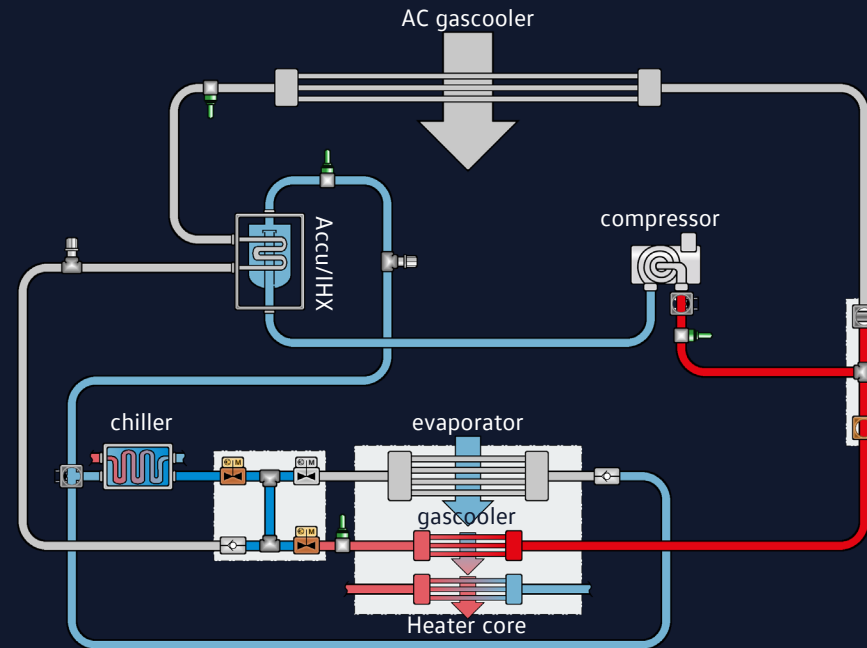


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Heat pump – coolant circuit

- Heating the battery
- Heating the passenger compartment with a coolant heat exchanger
 - Using heat from the drivetrain and the ambient air



Heat pump – refrigerant circuit

- Heating the passenger compartment
 - Using heat from the drivetrain and the ambient air

- Starting in 2026 a new dedicated heat pump design using R744 will be available in the cars based on the MEB+ platform
- The system is optimized for the smaller package available



Bringing sustainable heating and cooling... into the subcompact car segment

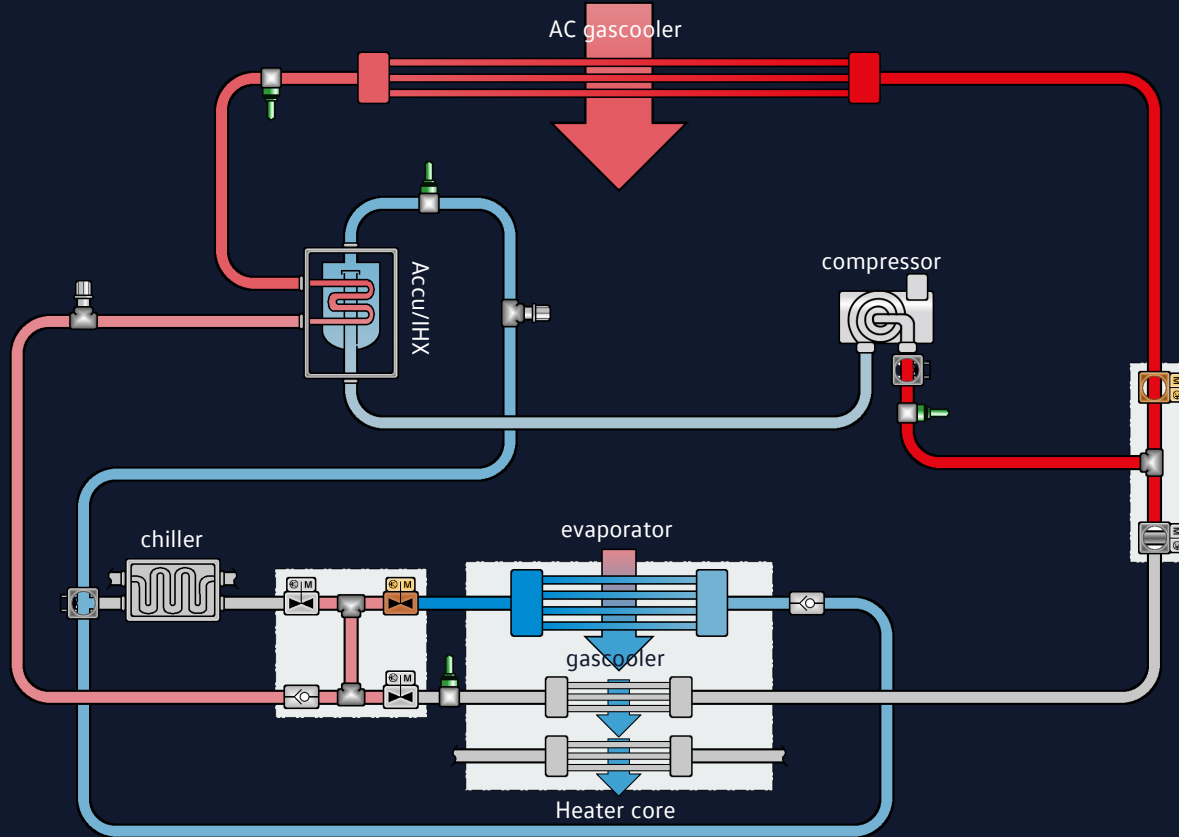


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Passenger cabin cooling

- Complexity of refrigerant circuit decreases slightly
- Development of new parts to optimize operation
 - First instance of R744 check valves in MAC
- A/C operation modes are comparable to the compact class heat pump design
- R744 enables a direct evaporation system for cabin-cooling leading to
 - higher thermal efficiency
 - better cooling dynamics
 - weight advantage



Summary

- Short, slow drives dominate car usage
- Heat pumps can generate a significant benefit in these conditions
- Heat pump designs need to be able to be scaled across vehicle classes
- Volkswagen has modified its established R744 heat pump to bring natural cooling and heating into the subcompact class
- More than 1.5 million R744 MAC units have already been sold

Every year, R744 grows faster than the year before.

And in the subcompact segment, sales have only just begun.



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