REPORT · BENCHMARK STUDY

Automotive Air Conditioning *& Heat Pumps*

System Comparison & Benchmark

A vehicle-by-vehicle teardown and simulation benchmark of air-conditioning and heat-pump architectures across ten contemporary BEV platforms.

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IN COLLABORATION WITH

SATTELO

SynErgy Thermal Management

WHAT'S INSIDE

One benchmark — *ten BEV platforms.*

A comprehensive comparison of generic AC architectures and vehicle-specific heat-pump configurations — including bill-of-materials cost assessment and simulation-based performance evaluation across contemporary electric passenger vehicles.

VEHICLE PLATFORMS · 10

- VW MEB platform
- VW e-Golf
- Tesla Model S / 3 / X / Y
- Peugeot e208 (Stellantis eCMP)
- Renault Zoe / Nissan Leaf
- BMW i3
- BYD Dolphin 3 (E-platform 3.0)
- Hyundai Ioniq 5 / Kia EV6 (E-GMP)
- Jaguar I-Pace
- Porsche / Audi J1 platform

WHAT THE REPORT COVERS

- BEV thermal-management trends
- AC-system architectures (generic)
- Heat-pump architectures (vehicle-specific)
- Thermal-management use cases
- Bill-of-materials & cost assessment
- Performance & efficiency (simulation)
- Results & recommendations

INSIDE THE FULL REPORT

What the *technical depth* looks like.

Every platform is dissected mode by mode — refrigerant circuit, control strategy, components and performance. A selection of what the full report details:

01

System Architecture

R744 (CO_2) and R1234yf heat-pump layouts per platform. Transcritical vs. subcritical operation, EXV vs. TXV control, chiller / accumulator-IHX and supermanifold integration.

02

Operating Modes & Performance

Mode-by-mode schematics — cabin heating, reheat, cabin & battery cooling. SAE use-case occurrence, hot- and cold-ambient performance, reheat behaviour and yearly energy consumption.

03

Cost & Decision

Costed BOM comparison (supermanifold, octovalve), system cost per architecture, and decision matrices for sub-compact, compact, mid-size, luxury and van segments.

- Heat-pump operation analysed down to −30 °C ambient.
- Simulation-based efficiency across the full SAE use-case spectrum.

Eight chapters, *116 slides.*

WHAT YOU RECEIVE

— 116-slide PDF benchmark report

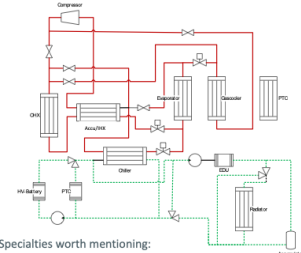
— All platform layouts & operating modes

— Costed BOM & segment decision matrices

— Q&A session with an MDSG / SATTELO thermal-management expert

Examples shown in the full report:

HP-System Layout VW MEB platform (R744)



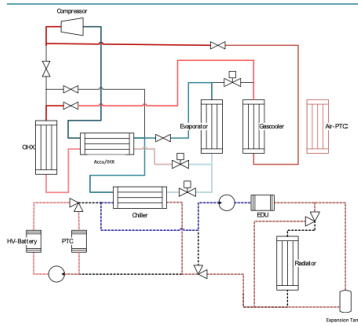
Heating:
- Air HP can even run @ -30°C ambient (vs. -20°C)
- Waste heat recovery (WHR) Drivetrain + Battery
- R744 high efficiency in cold ambients
- During start-up at part load PTC needed

Reheat:
- PTC only for early start-up needed due to WHR

Cooling:
- R744 slightly lower efficiency @ ambients > 35°C
- Passive Drivetrain cooling & Active Battery cooling

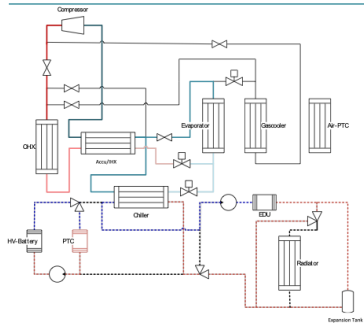
Specialties worth mentioning:
- Transcritical R744 System at significantly higher pressures
- Chiller, Accu/IHX and all valves are combined in a valve unit
- EXVs are bi-directional

VW MEB Mode: Reheat



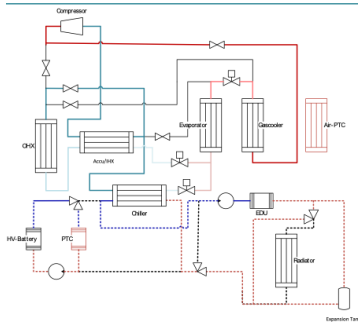
- Transcritical Heat Rejection in HVAC-Gascooler
- Further condensation in OHX
- SOV is controlled as EXV
- HVAC Air is dehumidified and heated (~ 5°C Ambient)
- Waste Heat can be used when more heating power is requested then cooling power

VW MEB Mode: Cabin & Battery cooling



- Transcritical Heat Rejection in OHX at ambient temps > 25°C

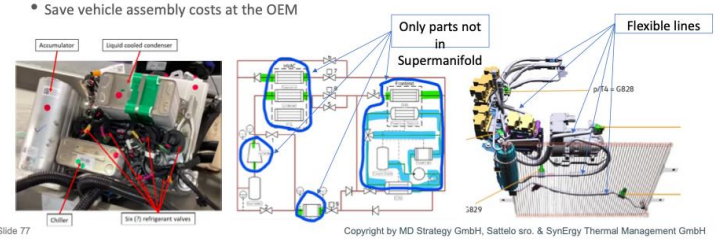
VW MEB Mode: Cabin Heating



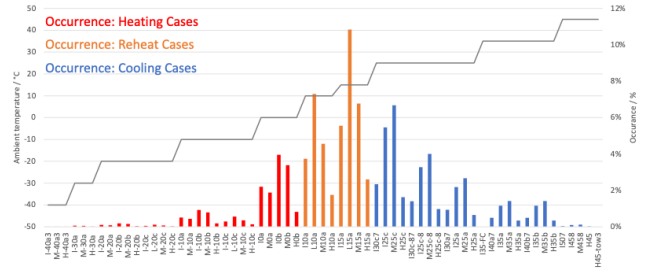
- Two stage heat rejection in HVAC
  - Transcritical: Gascooler
  - Subcritical: Evaporator
- Heatsource:
  - Ambient Heat
  - Waste Heat by Drivetrain

Costed BOM comparison

Supermanifolds (not considered in BOM comparison):
- Cost saving for AC-lines of app. € 50,- (Tesla) to € 70,- (BYD) vs. manifold cost € 10,- = € 50,-
- They do not save part costs if its packaging requires a lot of (R744) flexible lines (VW MEB)
- Save vehicle assembly costs at the OEM



Histogramm: Occurance of SAE use cases



GET THE FULL REPORT

Purchase the report — *talk to an expert.*

The full report includes every platform layout, operating mode, costed BOM, simulation result and segment decision matrix — plus a Q&A session with one of our thermal-management and AC-system experts.

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