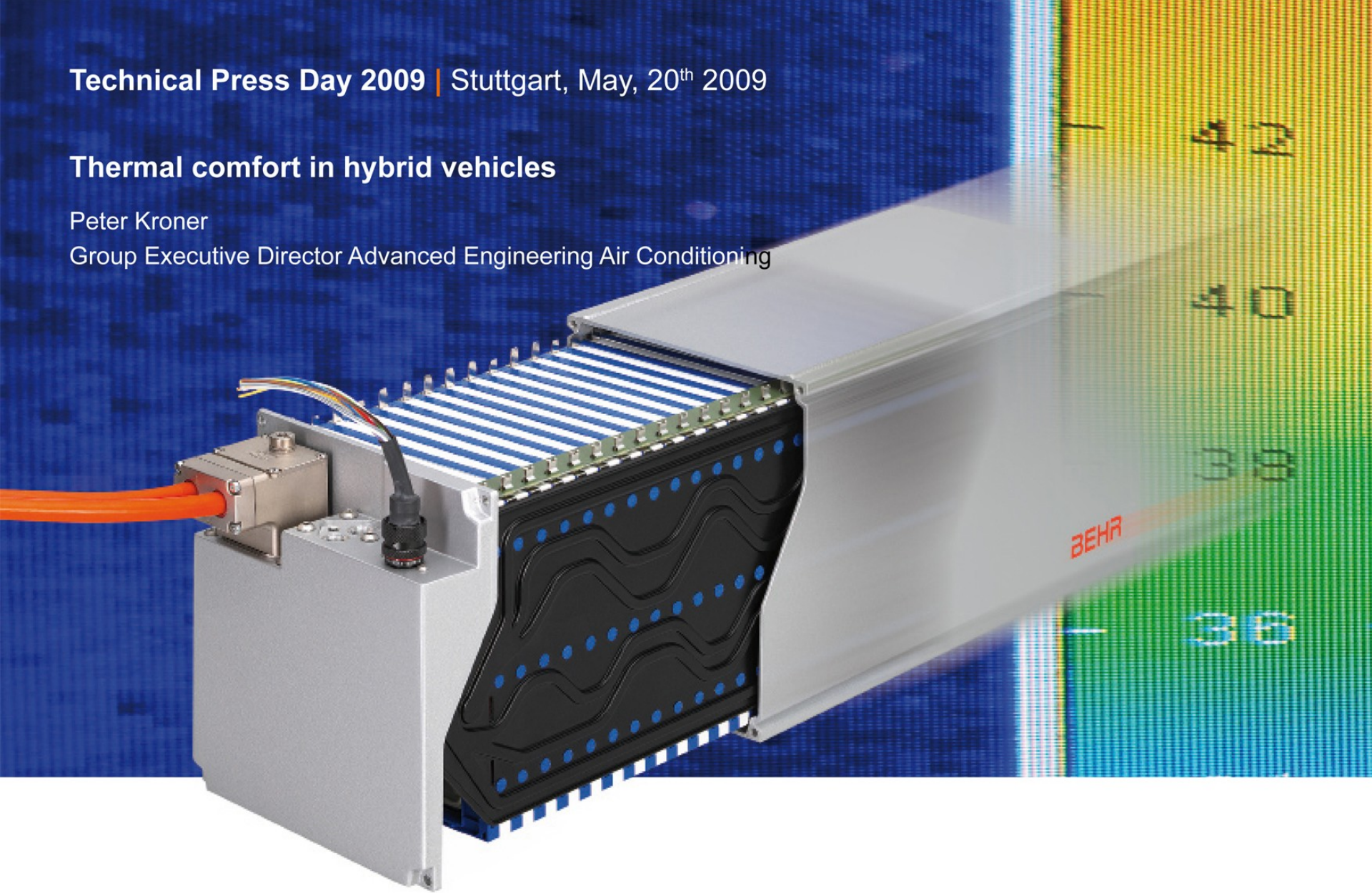


Technical Press Day 2009 | Stuttgart, May, 20th 2009

Thermal comfort in hybrid vehicles

Peter Kroner

Group Executive Director Advanced Engineering Air Conditioning



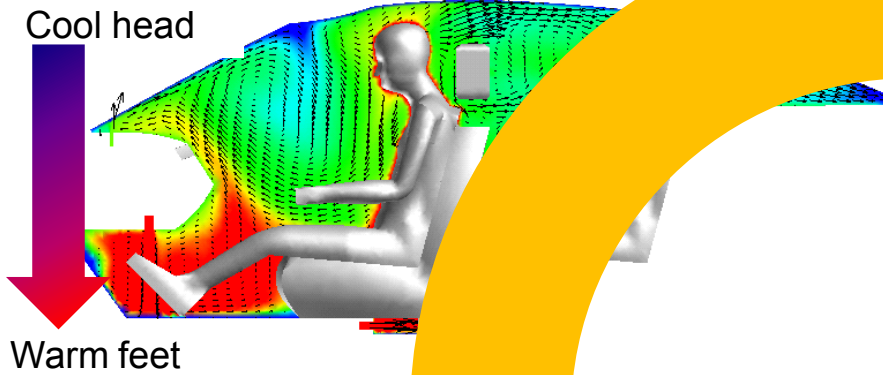
Heat up. Cool down.

BEHR

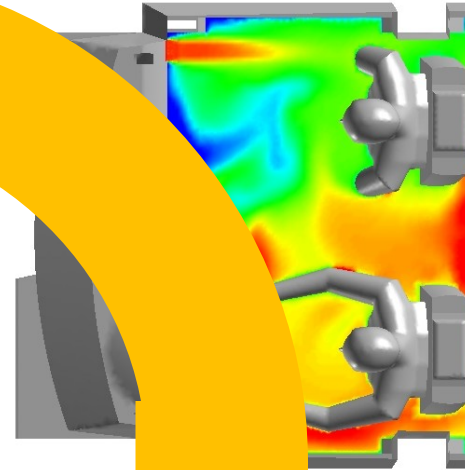
Air conditioning comfort in the vehicle

Holistic, individual, psychologically appropriate

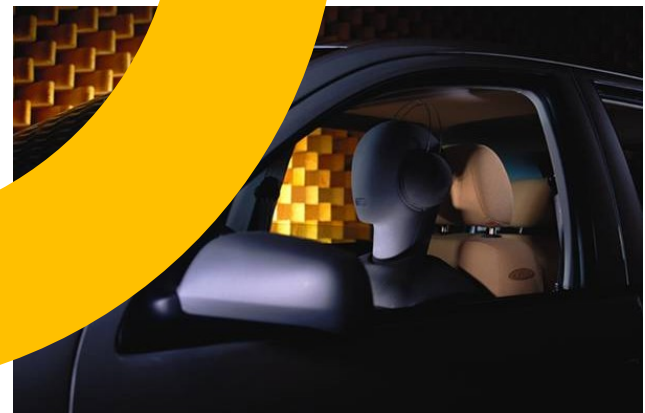
Stratification



Zone-based air conditioning



Acoustics

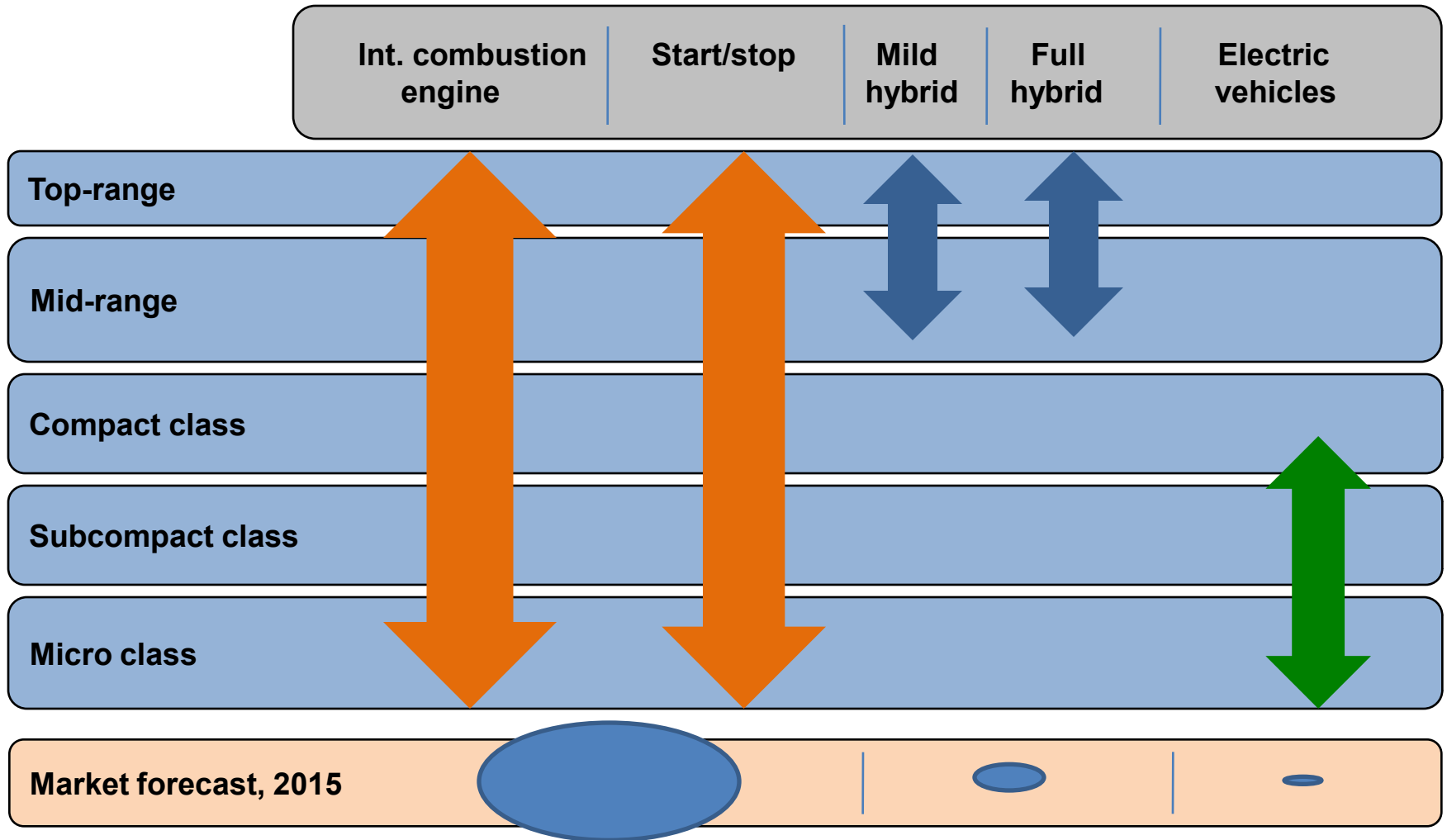


Draft-free ventilation



Vehicle design concepts

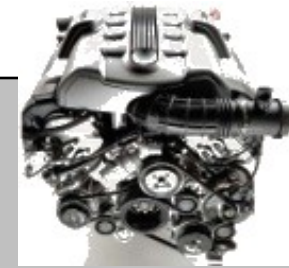
Market forecast, 2015



A/C systems in vehicles with internal combustion engines

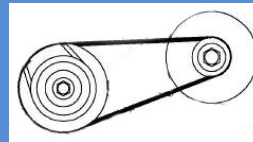
Internal combustion engine

Electrical system: $U = 12\text{ V}$



Behr systems

Cooling Refrigerant compressor (belt-driven)



Cooling output available anytime

ECO-A/C®
High performance
Heat exchangers

Heating Engine waste heat



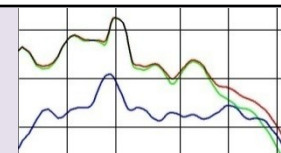
Heating after cold start and in standard operation

ECO-Heat
High performance
Heat exchangers

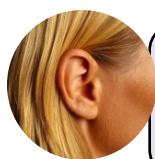
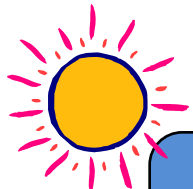
Efficiency Increased fuel consumption due to air conditioning

ECO-A/C®
ECO-Heat

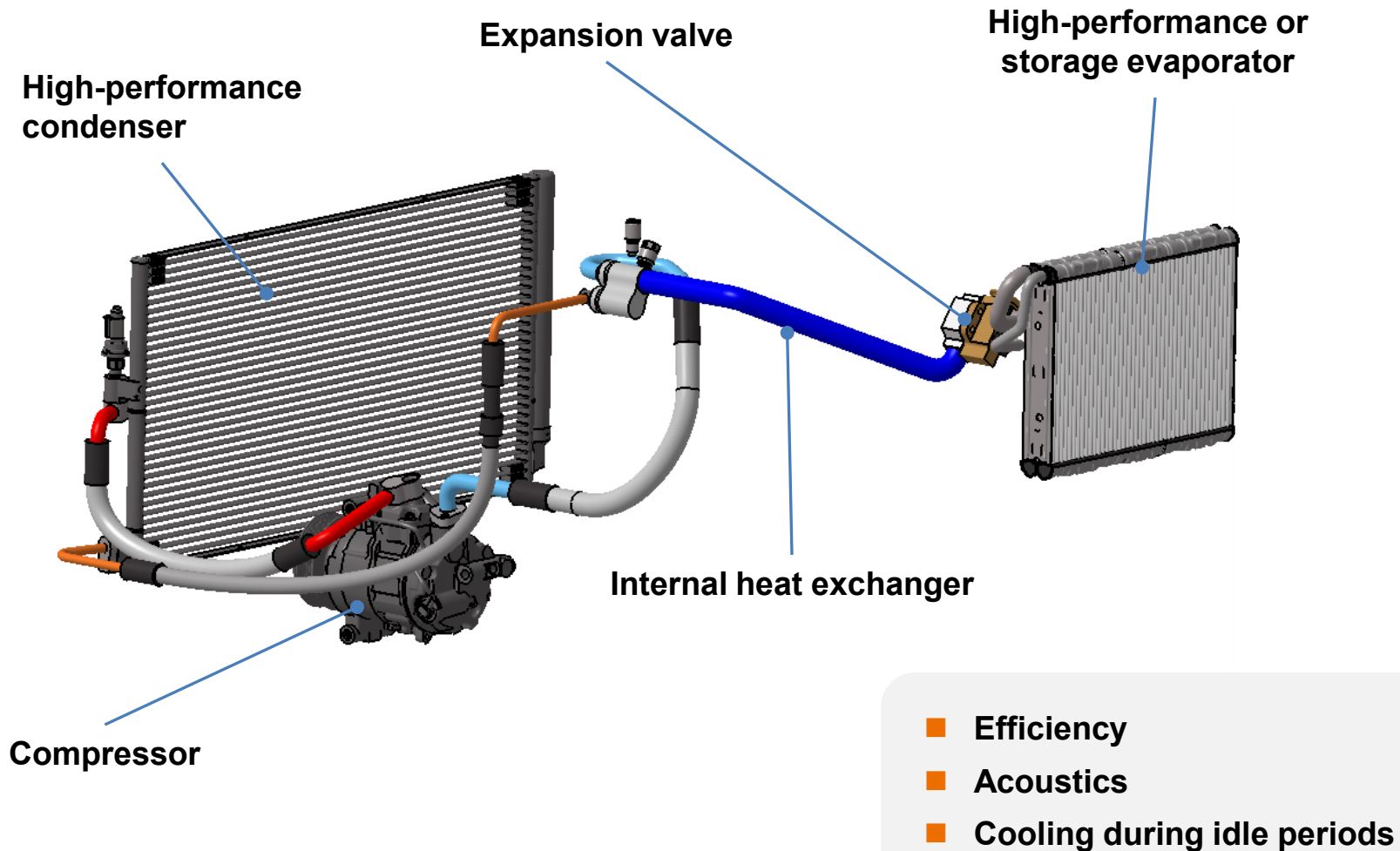
Acoustics Base level by combustion engine



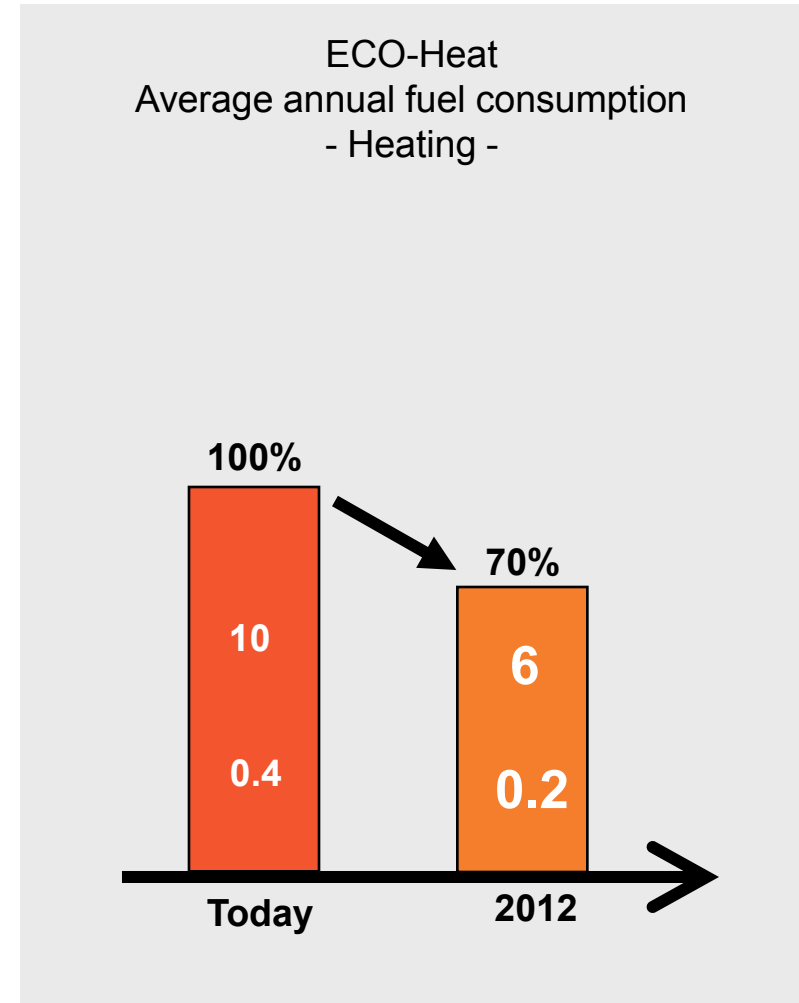
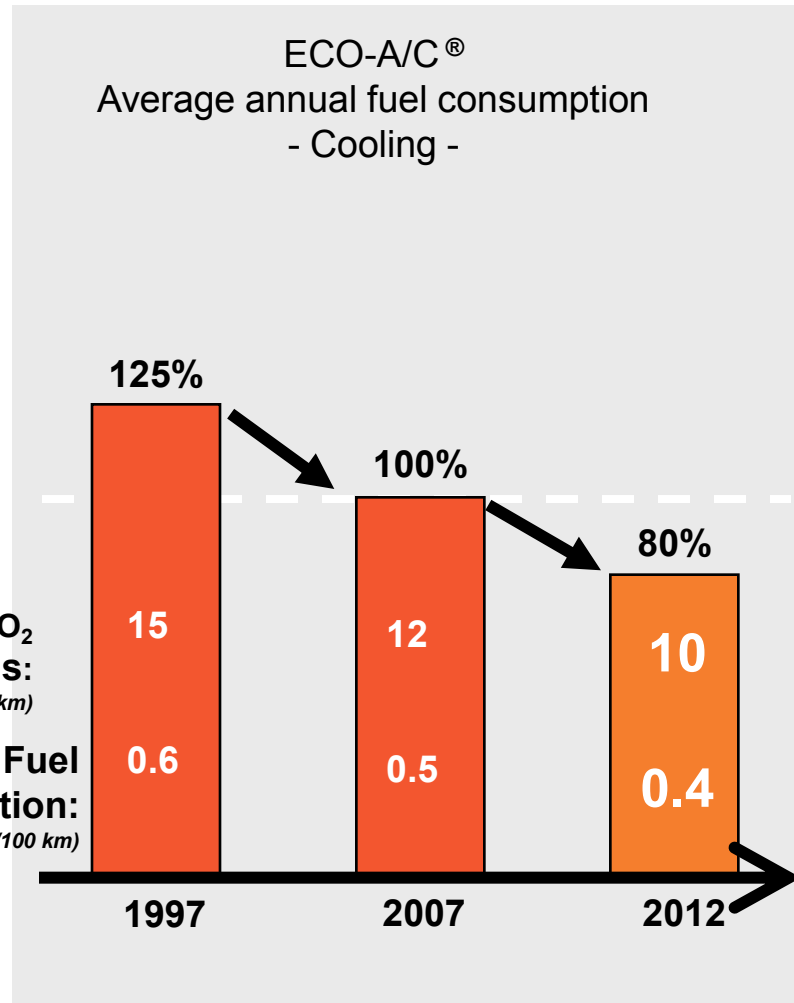
Silent HVAC
Silent blower



Refrigerant circuit of an automotive air conditioning system



Potential fuel consumption and CO₂ reductions using ECO-A/C[®] and ECO-Heat



Air-conditioning system in micro and mild hybrids

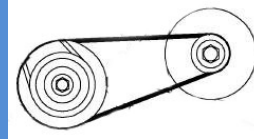
Electrical system:

Micro => U = 12 V, start/stop

Mild => U > 12 V, P_{el} < approx. 15 kW, start/stop, recuperation, Li-ion batteries

Behr systems

Cooling Refrigerant compressor (belt-driven)



No cooling during idle periods

ECO-A/C®
Storage evaporator

Heating Engine waste heat



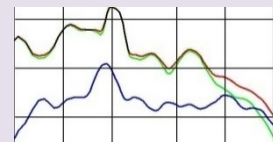
Residual heat and/or PTC during idle periods

ECO-Heat

Efficiency Increased fuel consumption due to air conditioning

ECO-A/C®
ECO-Heat

Acoustics Idle periods without internal combustion engine noise



Silent HVAC
Silent blower

Air-conditioning system in full hybrids

Electrical system

$U \gg 12 \text{ V}$, $P_{el} > \text{approx. } 15 \text{ kW}$, start/stop, recuperation,

Electric-powered, plug-in charging, Li-ion batteries

Behr systems

Cooling Refrigerant compressor (electric)



“from battery”
Engine-independent cooling possible

ECO-A/C®
Battery cooling

Heating Engine waste heat and/or electric



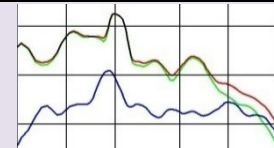
Heating management necessary

ECO-Heat
High-voltage PTC

Efficiency Increased fuel consumption due to air conditioning

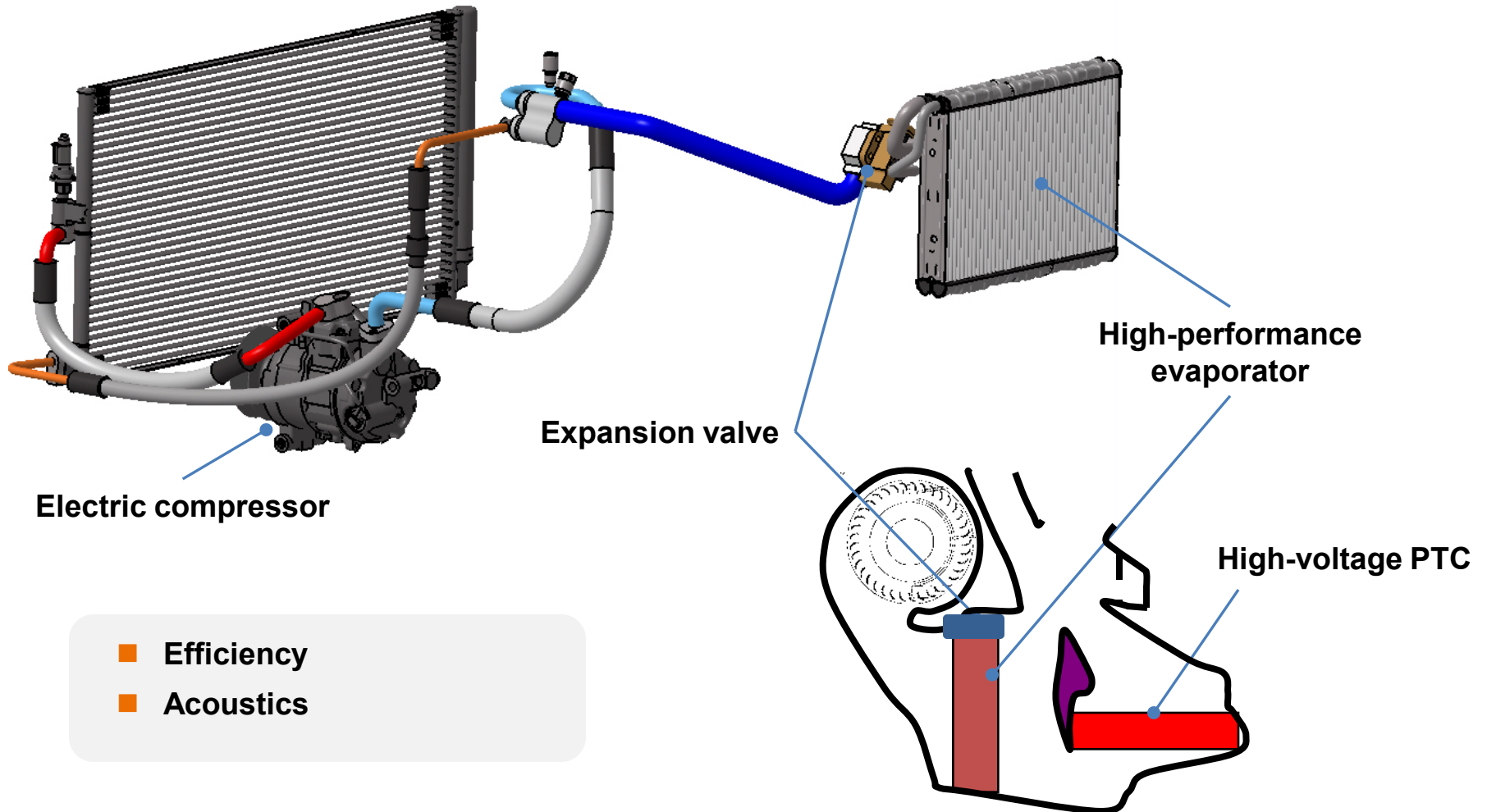
ECO-A/C®
ECO-Heat

Acoustics Idle and elec. powered periods without internal combustion engine noise



Silent HVAC
Silent blower

Air conditioning system (refrigerant circuit and HVAC module) for electric vehicles



Air-conditioning systems in electric vehicles with/without range extender

Electrical system:

Battery and electric engine

Supporting measures in vehicle

Extension:

- Range extender
- Plug-in charging

Behr systems

Cooling Refrigerant compressor (electric)



“from battery”
Engine-independent cooling possible

ECO-A/C®
Battery cooling

Heating electric



Electric air and/or water-based heating

High-voltage PTC

Efficiency Air conditioning impacts on potential range



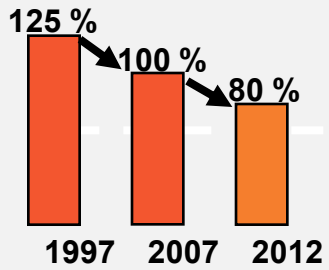
ECO-A/C®

Acoustics Air-conditioning system acoustics unmasked

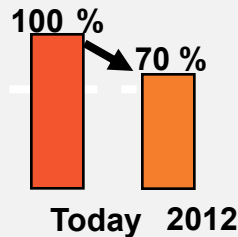
Silent HVAC
Silent blower

Air conditioning systems and components for new vehicle designs

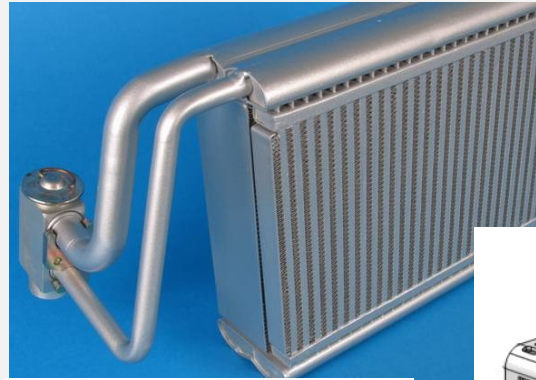
System



ECO-A/C®



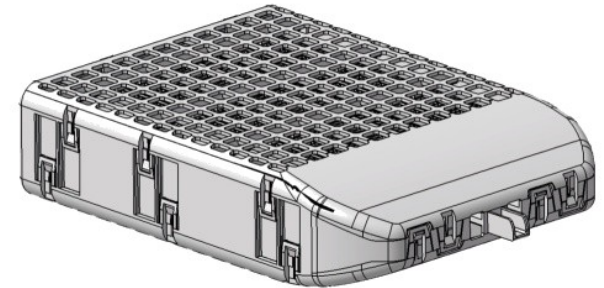
ECO-Heat



Storage evaporator

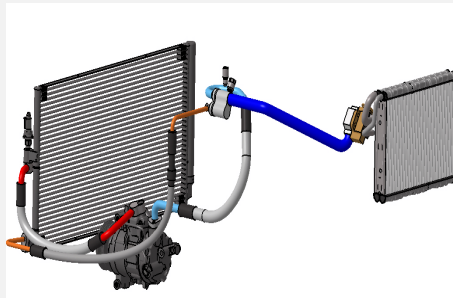
Components

Battery cooling

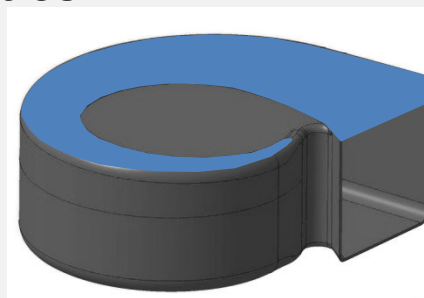


High-voltage PTC

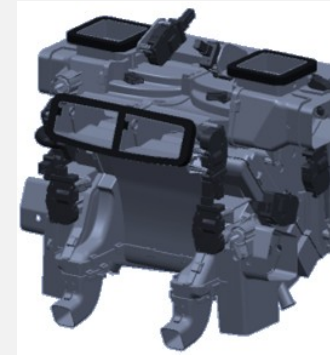
Acoustics



A/C circuit acoustics



Silent blower



Silent HVAC