HEAT PUMP SYSTEM
BOREALIS 2.0

Efficiency for Comfort - e4c

AURORA
Advanced HVAC Solutions

HEAVAC
Member of Aurora Group

EFFICIENCY FOR COMFORT
ZERO EMISSION

The AURORA Group has developed a new heat pump system for the next generation of electric buses, Borealis 2.0

The challenges of going electric

The biggest challenge of going electric is to maintain the maximum range in combination with the best comfort under all circumstances (ambient temperatures between -15°C to +45 °C) without the use of fossil fuels. The Borealis 2.0 system offers the solution of an efficient combination of optimized thermal comfort and thermal management of battery, driveline and other systems through intelligently controlled warm and cold water circuits inside the heat pump module.
For the construction of the heat pump module, we make use of excellent quality components and lightweight materials. Due to the option of heat recovery, we truly deliver a Zero Emission solution for e-mobility.

A sustainable solution

As opposed to other manufacturers, the AURORA Group has succeeded in the development of an energy-efficient, integrated system for heating, air-conditioning and thermo management in e-buses.
Due to holistic heat recovery the electric energy supply for heating and air conditioning can be reduced by up to 50 % throughout the year. By the integration of the Borealis 2.0 system, the vehicle battery capacity could be reduced by up to 25% at maximum system layout, or at constant battery capacity increase the range of the vehicle respectively. As an additional chiller for battery (pre-)conditioning is no longer necessary, the space required, costs, and mounting effort for the complete system is vastly reduced.

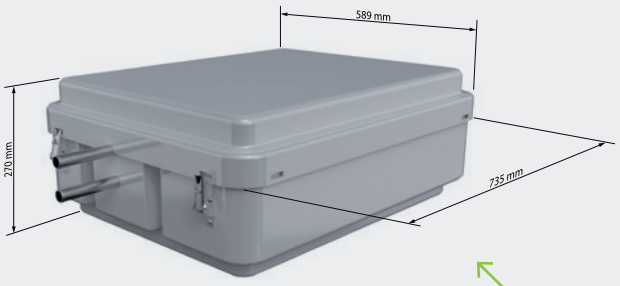
01. In cooperation with customers, the Borealis heat pump system is validated in the AURORA climate hall, where conditions are varied from +45°C down to -15°C. (Nefaz E-bus, in operation by Mosgortrans, Moscow)

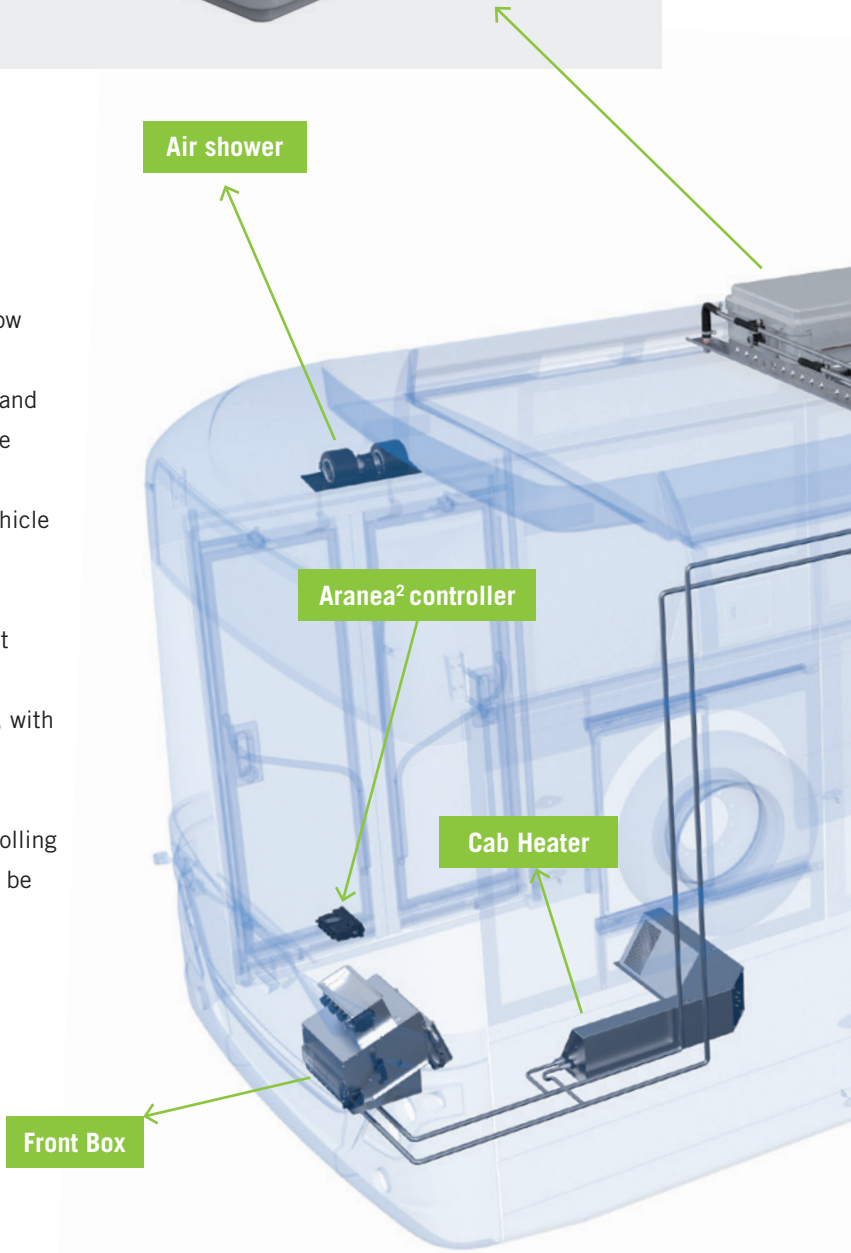
02. Temperatures and other operating parameters of the Borealis heat pump system are gathered, analyzed and transferred into performance indicators by experts from AURORA and HEAVAC. (Ebusco 2.2 bus, in operation by Qbuzz, Dordrecht)

RIGA

Roof module

The Riga is a compact lightweight roof module designed to cooperate with the Borealis heat pump for optimal heat transfer between the coolant and the bus interior. The Riga features "high efficiency" Aluminum micro-channel heat exchangers, "silent" brushless sinus commutated blowers, a recirculation/fresh air valve and optional air quality monitoring.





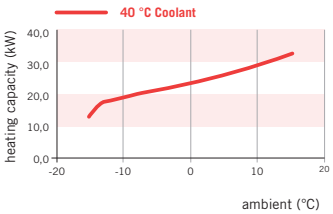
The design

- The use of a heat pump means efficiency due to low energy consumption
- The heat pump module is the heart of the system and is used to generate warm and cold coolant (mixture glycol/water 50/50) on demand
- The warmth and cold is distributed through the vehicle in the most efficient way
- The system uses special and customized high-efficiency components such as high-efficiency heat exchangers
- The climate control is divided into different zones, with priority for the driver's area
- Full automatic climate control for passengers
- Dedicated electronic CAN infrastructure and controlling
- Through its modularity, the Borealis $^{2.0}$ system can be adapted for each vehicle configuration
- With a very small refrigerant cycle, the Borealis $^{2.0}$ heat pump has been designed for low GWP refrigerants (1.5 kg R290) A3 Class refrigerants

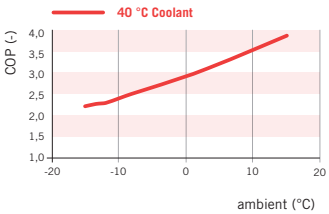
Preliminary data

HEATING

heating capacity @ full performance

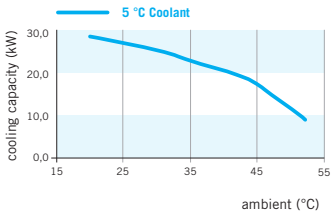


heating COP @ full performance

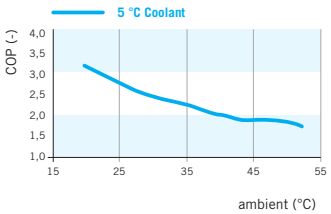


COOLING

cooling capacity @ full performance



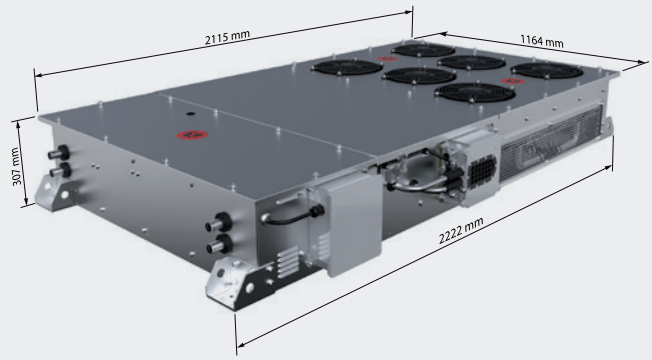
cooling COP @ full performance

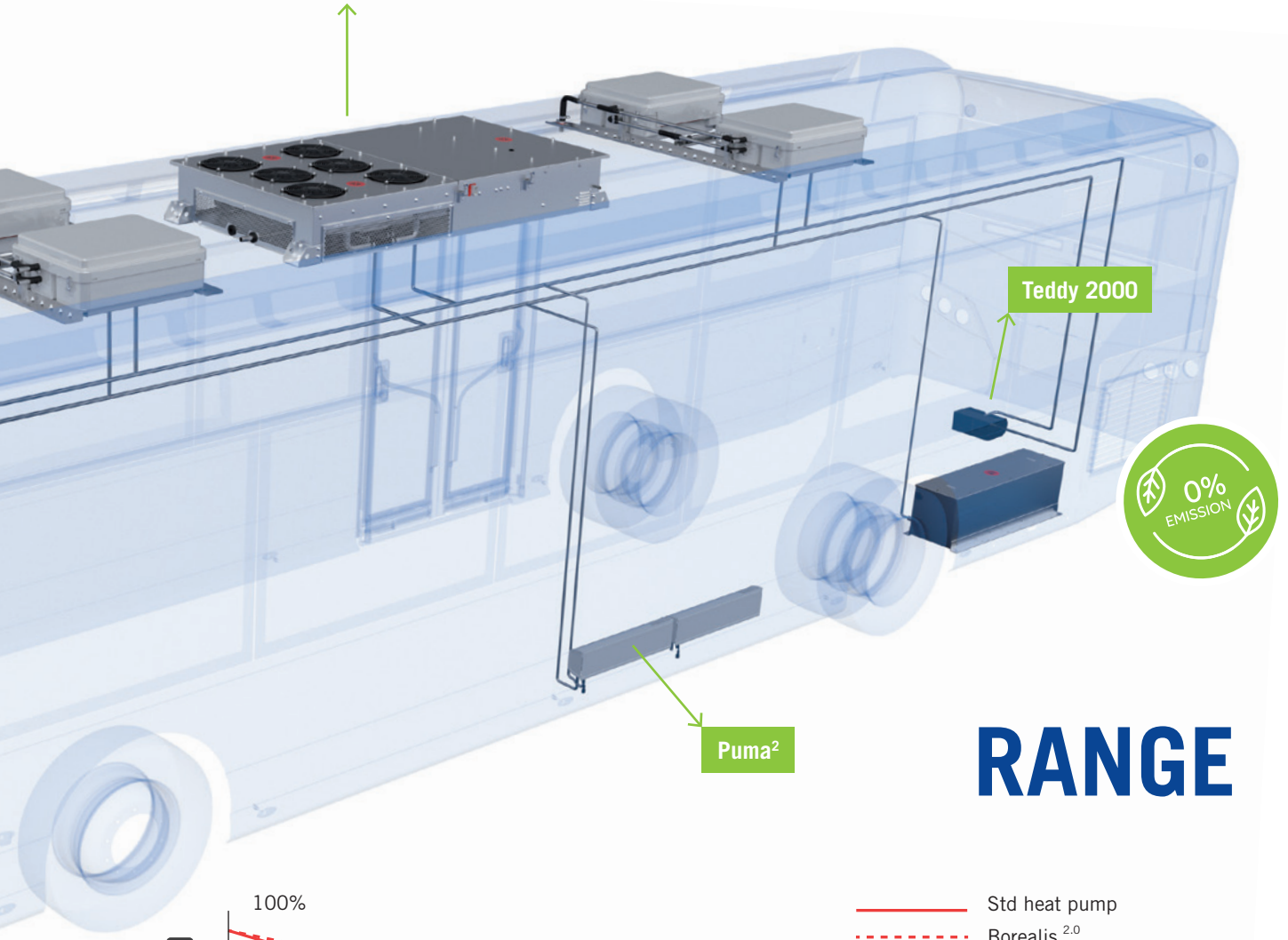


BOREALIS

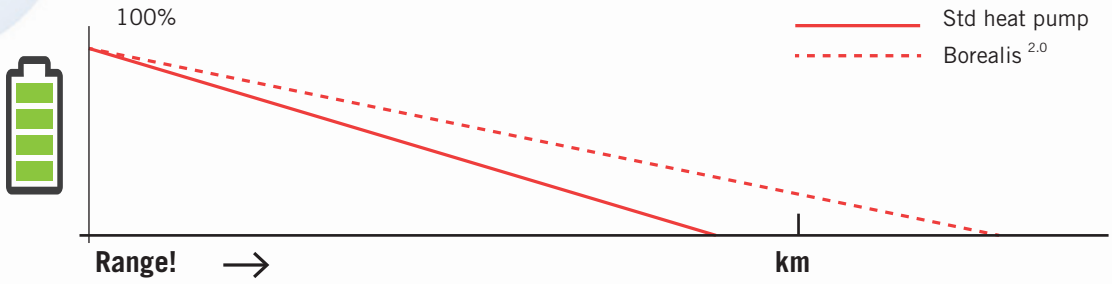
Heat pump module

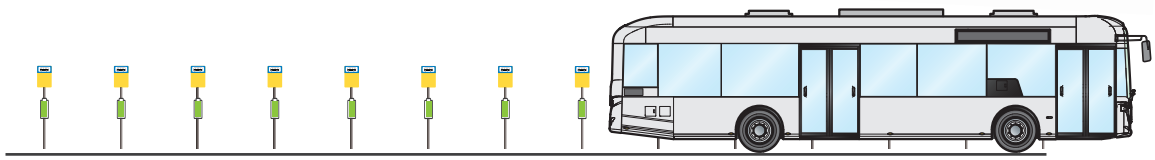
The Borealis is the heart of the system. It is the "most efficient emission-free heat sink/source" available for E-bus today. The Borealis features a coolant-coolant heat pump principle, a nearly hermetic refrigerant cycle, internal heat regeneration, vehicle waste heat utilization, stand-alone operation and an optional battery conditioning application. The Borealis is currently available in an R407C and R134a execution for medium (-15°C -- 45°C) and warm (0°C -- 55°C) climate.





RANGE





FEATURES

- energy-efficient solution
- modular system concept, suitable for various vehicle sizes
- no additional fuel consuming components: a completely zero emission electric solution
- Full integration of battery temperature management
- Integration of waste heat harvesting COP up to 4.5
- Customized pre-conditioning mode
- Optional integration of Heavac electrical pre-heater
- System developed for A3 class refrigerants such as R290 (GWP 3)

BENEFITS

One solution with 50% reduction of energy consumption for heating and maximum integration of functions resulting in:

- Reduction in battery capacity resulting in more passengers
- Or same battery capacity with longer range
- Cost efficient thanks to full integration of battery conditioning and waste heat harvesting
- Lowest Total Cost of Ownership
- Lowest possible operational cost thanks to intelligent continuous-variable blower, pump and compressor speed.
- Four-season solution: heating, ventilation and air-conditioning
- Flexible roof layout
- Borealis $^{2.0}$ is your total system solution.

HEAT PUMP MODULE BOREALIS 2.0

(R290 1,5 kg GWP: 3)

TECHNICAL DATA

Zero Emission Warm-Cold water module for E-mobility

	COOLING	HEATING
COP	2,3	2,5 – 4,5
Capacity conditioning	23 kW	16 kW
Coolant Temperature	5°C	40°C
Ambient	35°C / 70% r.h.	-7°C / 30% r.h.
Dimensions W x L x H	2000 x 1000 x 300 mm	2000 x 1000 x 300 mm
Weight	195 kg	195 kg
Refrigerant	R290 (1,5 kg) alternative 407c (3 kg)	R290 (1,5 kg) alternative 407c (3 kg)

Options:

- Waste heat harvest
- Battery conditioning
- Alternative refrigerant 407c
- Inverter

Integrated Heat Pump System consists of all-Aurora components

- Heat Pump Module Borealis 2.0
- Driver Demister HE (High Efficiency)
- Driver Cab Heater HE
- Roof Heaters Riga HE
- Interior Heaters HE or Forced Air Convectors
- Aranea 2 Electronic CAN controller with dashboard display
- Electrical pre-heater 8,5 or 13 kW

Borealis 2.0 R290 available summer 2020

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