Valeo

BUS COMPETENCE FOR

YOU

PRODUCTS FOR BEST BUS CLIMATE

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How we conduct the way to e-mobility
with our best bus climate

Best eBus Climate

EDITORIAL

"We are convinced that the future, particularly of public transport, lies in electromobility."

DEAR READERS,

E-mobility and the electrification of auxiliary equipment pose one of the most exciting challenges of our time. Although many problems have yet to be solved, we know that electrobuses will help to shape the image of the modern metropolises of tomorrow. The principle is simple yet diverse: they produce less greenhouse gases, pollutants and noise – and the bottom line is a better quality of life.

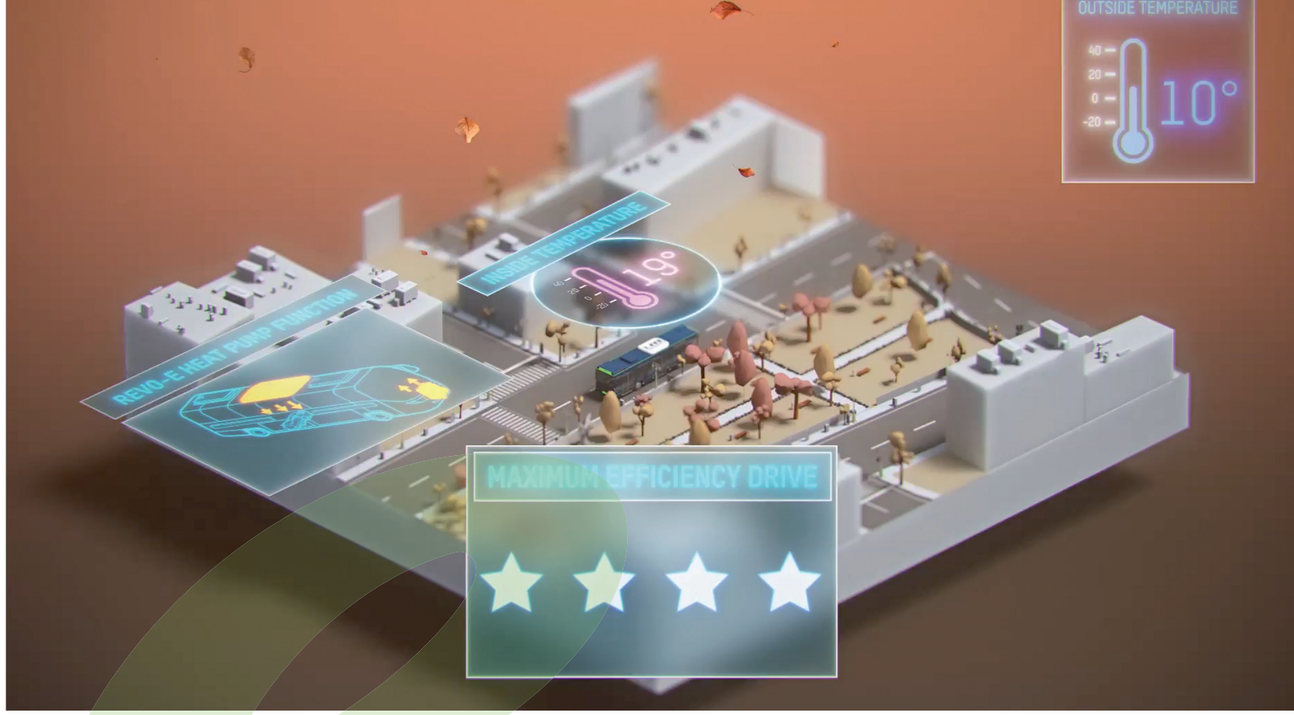
But we cannot ignore the discussion about the limited supply of useable waste heat available for heating hybrid and electric buses, and the low energy density of today's traction batteries. We may talk about electric booster heaters for bringing the temperature in the passenger compartment up to a comfortable level without causing emissions, but we are unable to fully dispense with fossil fuels. We have as yet to find a substitute that offers similar advantages and a comparable mode of action. It's something like the Stone Age versus the future, the invention of fire versus new energy resources which perhaps still have to be discovered.

For us as bus climate specialists there is no single optimum climate control concept. The key lies in a holistic approach – the interplay of vehicle concepts, ambient situations and air conditioning components that have been thought through, right down to the last detail. Our assignment is to optimally use the energy available in the bus and, in addition, exploit all possibilities of energy recovery.

To achieve this we must add "Intelligence" to the "E". The latter comprises an innovative higher-level control system, consistent lightweight construction of air conditioning components and advanced power electronics. "Entelligence" helps to economise, i.e. by reducing energy consumption with a clever climate control strategy and extending the range of all bus systems.

R. Basile

Dr. Robert Basile
Director Engineering HVAC Products & Systems



ENTELLIGENCE MAKES THE DISTANCE

Due to the low energy density of today's traction batteries and the limited supply of useable waste heat in hybrid and electrobuses, the energy supply to the vehicle's air conditioning continues to present a key challenge.

Depending on the required power requirements of the respective HVAC components and ambient temperatures, a reduction of more than 50% in range must be expected. Compensating for this energy deficit calls for innovative air conditioning and heating solutions which make best use of the limited energy resources. This results in a sustained improvement in efficiency, an increase in the available range and last but not least the more ecological and economical operation of buses. The main prerequisite is the use of highly innovative climate control components (air conditioning systems, heat pumps and heaters) which satisfy the most stringent requirements for energy efficiency and lightweight construction.
If we also consider the specific requirements for hybrid or electrobuses, it is possible to develop heating and cooling strategies which can be operated with a high level of efficiency in the overall system by means of superordinate, highly intelligent control technology.

Holistic air conditioning at the highest level of technology

That's what Valeo Entelligence stands for: a holistic approach to the ecological and economical air conditioning of hybrid and electrobuses. Different air conditioning components are interlinked and activated for the first time by means of a newly-developed control software. Depending on the ambient conditions (primarily temperature), battery level and geographic position, the control system always selects the Valeo component offering maximum efficiency.

Behind this name is an intelligent air conditioning strategy for buses. The energy requirement for the respective air conditioning task is estimated in advance and the components selected with the aid of an optimization process. Accordingly, the most efficient component for the respective task can be selected from the available air conditioning components (e.g. fossil or electrically powered heater, heat pump) to suit the current heating power requirement, existing restrictions (driving in a zero-emission zone) or remaining electrical sources (traction battery charging status, SOC). If required, a number of different heat sources can be operated parallel in boost mode.

Communication with Valeo Entelligence is mapped via the Body Interface components: the core element is an intelligent control sub-unit, and the Valeo touch display offers for the first time an interface for analytical values and feedback to the user.

In summary, Valeo Entelligence stands for innovative HVAC solutions which ensure that the best use is made of existing energy resources, thereby significantly increasing the range of hybrid and electrobuses – according to the motto "Entelligence makes the distance".

OUR HEROES OF THE ENTELLIGENCE BUS CLIMATE

We need heroes, even if they are "only" special HVAC components; but they are indispensable for turning bus air conditioning into a "best-eBus climate". Systems that are specially tailored to the demands placed on electromobility public transport – and we have them!

REVO-E GLOBAL

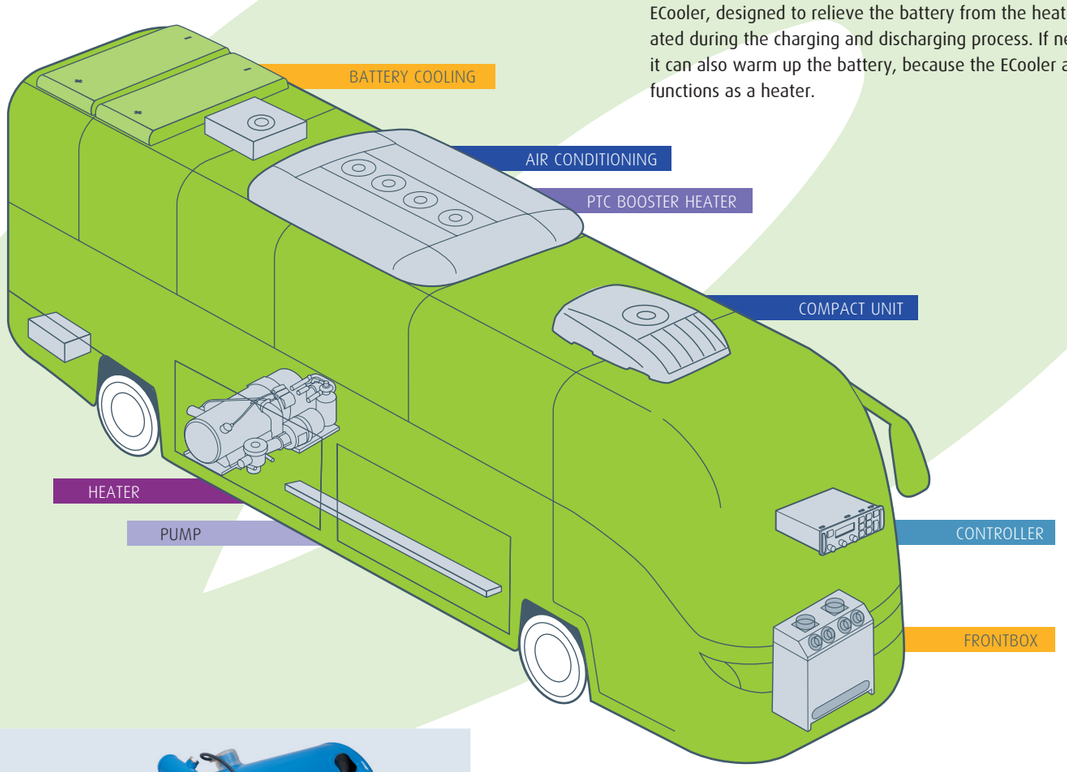
Air conditioning unit
With the virtually maintenance-free REVO-E Global we are supplementing our range of electrical rooftop air conditioning units worldwide. It is specially oriented to the requirements of the global markets. Great emphasis was thereby placed on lightweight construction, performance and easy installation. In addition to heat pump technology, a PTC heater is also available to the customer.

PTC BOOSTER HEATER

PTC booster heater
The new high-voltage PTC heaters complement our heating systems. They are intended for use whenever the air outlet temperature must be increased in heat pump operation, de-icing procedures are in progress or there is simply an additional need for heating. In operation the PTC heaters can be infinitely adjusted by means of an electronic control unit developed by Valeo.

CITYSPHERE

Compact units
Our compact Citysphere unit for urban, mini- and midibuses with the wind chill effect developed by us never fails to create a pleasant temperature. Maintenance costs are eliminated and service expenses are extremely low.



Battery cooling
Anyone who reflects on electromobility now and in the future should place a special focus on the core element of these drives: the battery. In order to optimally harness the power before and during operation, it must be kept within a narrow temperature window. For this purpose we developed the ECooler, designed to relieve the battery from the heat generated during the charging and discharging process. If needed, it can also warm up the battery, because the ECooler also functions as a heater.

THERMO AC/DC

Heaters
The heater, operated by direct (600 VDC) or alternating (400 VAC) current, is our response to the drives of the future: 100 % emission-free, i.e. no offensive smells due to exhaust gas and no noise. With a heat output of 7, 13 or 20 kW and an efficiency factor of 98%, the heater is suitable even for outside temperatures as low as -40 °C.

SPUMP

Pumps
In the course of development of innovative HVAC components, several years ago Valeo decided to produce the required pumps in-house. The pump with a watertight EC motor (IP 68 tested) is now available for the first time – brushless and magnetically coupled. The new versions with PWM and CAN feature variable speed control. The integral control unit can be used for additional functions which enable completely new mounting positions and fields of application, e.g. cooling of hybrid components.

E-COOLER

ALU-FRONTBOX

Frontbox
In view of today's demands on intelligent bus air conditioning, a familiar component has acquired a new role: it must "think" in advance! Whether heating or cooling, it must support the other components and control the climate in the driver's section independently of the passenger compartment.

BODY INTERFACE COMPONENTS

Control system
The solutions to modern electromobility lie in intelligent cross-linking of HVAC components in the bus. The core element of the modular Body Interface Concept is an intelligent control sub-unit. Display elements are existing displays in the bus or the Valeo touch display.

All-electric REVO-E rooftop A/C unit with heat pump and Citysphere S form a single unit on the hybrid bus.

DEVELOPED, TRIED AND PROVEN: OUR E-BUS SOLUTIONS WORLDWIDE

The trend towards electrification in the automotive world is unstoppable. The Chinese market, in particular, is growing at a rapid pace and with a broad bandwidth. The demands placed on HVAC systems are more complex and differentiated than ever before, and present a new challenge to manufacturers.

In recent years, Valeo Thermal Bus (formerly Spheros) has positioned itself as a partner for optimum heat management in buses with hybrid and electric drive. Today, the company markets a full range of e-bus solutions in the HVAC sector for all climate zones, bus sizes and market requirements. The key question is always: How can the energy balance in hybrid and electrobuses be improved, resources saved and the range extended? Answers are provided by the Valeo system approach, with the aid of which HVAC components are finely tuned and intelligently controlled, achieving maximum range and perfect climate comfort. From the pilot project to series production, Valeo's e-bus expertise has meanwhile been tried and proven worldwide.

Sileo E-Bus from Bozankaya.

Since 2015 all-electric A/C systems functioning according to the heat pump principle have been implemented in buses. The idea is to operate these mainly in the transitional period, and as a source of heat in winter, by drawing energy from the ambient air. This enables energy-efficient regulation of the temperature in the passenger compartment at moderate outside temperatures. An auxiliary heater is only necessary at extremely low temperatures. The reverse effect ensues in summer for interior cooling. Optimum cross-linking of the climate control components and the use of a heat pump save power, the diesel motor is activated less frequently to recharge the battery, and CO2 emissions are reduced. There is no difference in passenger comfort.

Collaboration with technical university to boost the efficiency in everyday operation.

For the "Pilot line 64 – Efficient electromobility in Dresden" research project, two REVO-E air conditioning units with heat pump function, a Citysphere S driver's A/C unit and two diesel heaters (Thermo 230 and Thermo 350) were installed in a city bus operated by the Dresden public transport undertaking. The basic REVO-E unit with its highly efficient individual components and intelligent control concept was already launched on the market in 2013, and has repeatedly proven to be an excellent performer. The system has a cooling capacity of 26 kW and a heat output of about 14 kW.

Here again, specially developed component cross-linking enables the A/C system to be used as a heat pump (heating) at low outside temperatures. For the validation trials, the vehicle was equipped with numerous sensors, with the aid of which all the required data such as temperature, pressure, current, voltage and brightness was collected. Scientists at the TU Dresden thereupon endeavoured to devise measures to boost the efficiency of buses in everyday operation.

Valeo Entelligence: our most efficient A/C system for hybrid and electrobuses

In addition, validation trials with Valeo Entelligence – presently the most efficient A/C system for hybrid and electrobuses – were successfully completed with an electrobus of a European bus manufacturer. The same data was collected as in Dresden, and the current position of the bus was ascertained by GPS tracking. The most efficient air conditioning strategy for the respective application was determined on the basis of the data collected. The first measurement results not only confirmed, but even exceeded the expectations of our experts. They attest to the efficacy of the system and underline the enormous potential of Valeo Entelligence.

A key role in the success of Valeo's global electrification strategy is played by the versatile REVO-E Global concept with its modular approach. The additional option of heat pump and/or PTC heater offers a higher mileage while the temperature in the passenger compartment remains comfortable, even at low outside temperatures. Furthermore, the fully automatic and highly efficient defrosting function enables the heat pump to be used at extremely low outside temperatures.

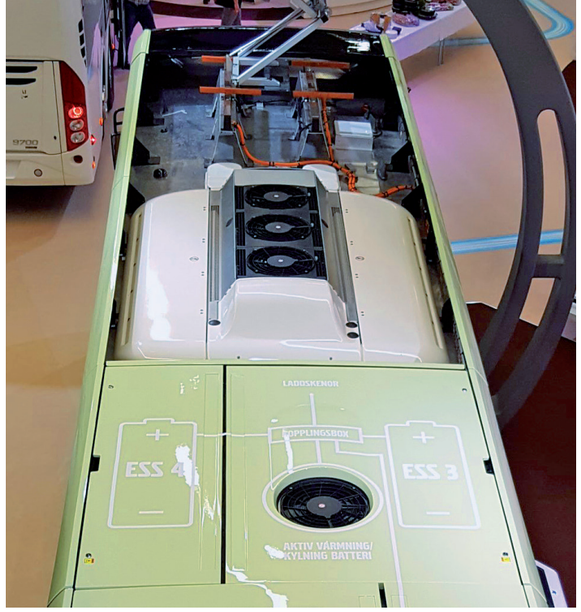
Particular attention has been paid to the lightweight construction, extended scope of operation and simple installation. Valeo is working intensively with coolant R-744 (CO2). With the heat pump function this permits heater operation in the electrobus at outside temperatures as low as -25°C. In the heating sector, Valeo also offers a broad spectrum of solutions for hybrid, plug-in applications, fuel cell operation or all-electric buses.

The hybrid plug-in buses of a European bus manufacturer have been equipped with the REVO-E since 2014. In addition, Valeo's E-cooler (battery cooler) ensures systematic cooling of the lithium batteries on the bus roof.

REVO-E Global plays a key role in Valeo's global electrification strategy

Today, China is considered to be the largest market for electromobility, and it is on the path to global market leadership. The first export buses are being prepared for series production, equipped with a highly efficient HVAC system. The REVO-E Global, equipped with heat pump function and/or PTC heater, the all-electric Thermo AC/DC heater, the SPump water pump and intelligent controller satisfy needs in many Asian and European markets. In South America, Valeo's CC205-E electrically powered A/C units are already being installed in midibuses.

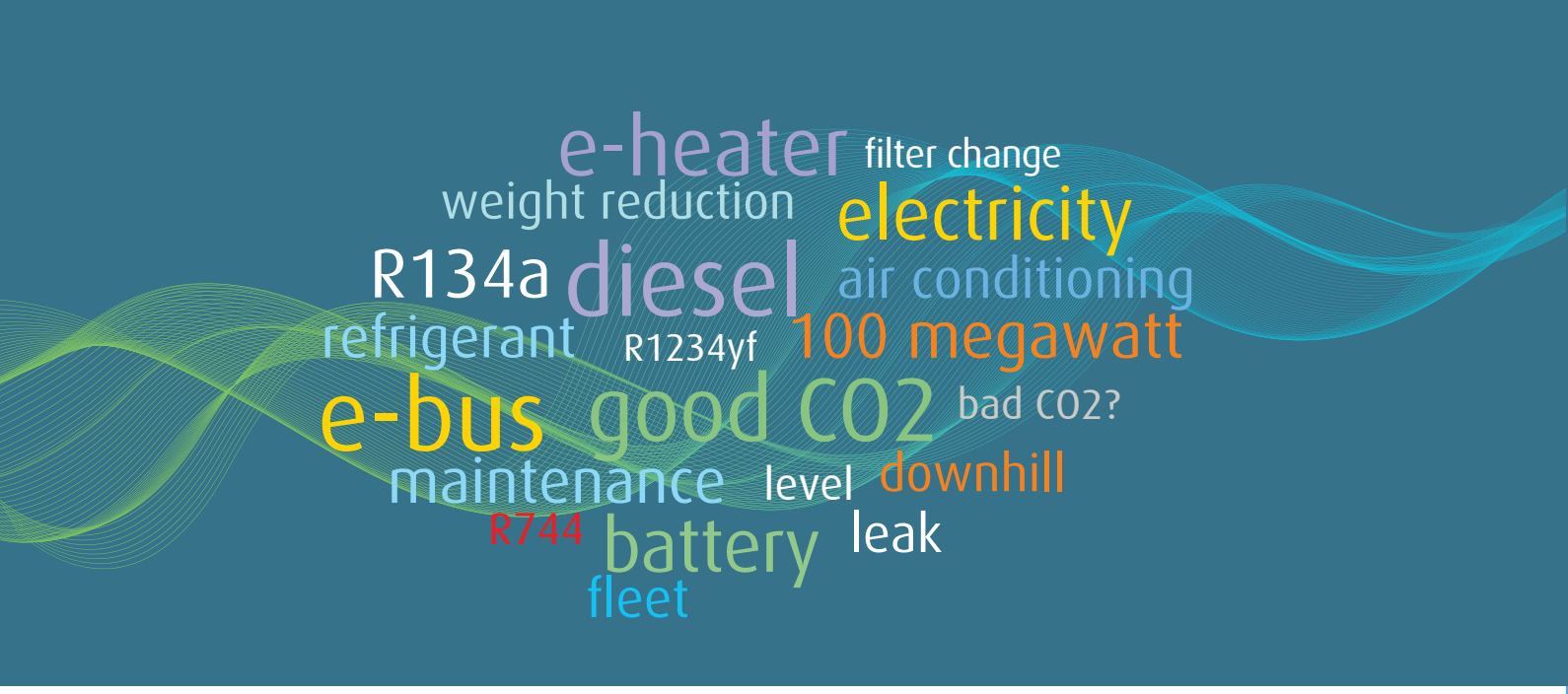
A further challenge of the future will be to supply climate control systems for self-driving microbuses worldwide. Small systems, likewise with heat pump function for extended temperature ranges, will be needed for this purpose. The first development programmes have been launched, and promise to generate many fascinating discussions.



The Volvo 7900 hybrid & electric hybrid features the REVO-E and 1x E-Cooler.

Hyundai Elec City with REVO-E Global, Thermo DC and SPump.

The REVO-E Global, Thermo DC high voltage heater and SPump are planned for the Hyundai Elec City.



VALEO BUS HEADQUARTERS WITH TECHNOLOGY CENTRE AT THE GERMAN LOCATION

As an independent entity within the Valeo Group, the new Valeo Thermal Commercial Vehicles Germany GmbH has its company headquarters in Gilching near Munich.

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The modern technology centre that was put into operation two years ago with central development, testing, prototype construction and administration offers space not only for further growth in the workforce; its technical facilities also enable it to cater for the increasing demands on the market and take on new development and customer projects.

A mobile bus climate testing laboratory for (double-decker) buses up to 20 metres long was put into operation in early 2017. Parallel to climate tests, a second lane will enable test vehicles to be equipped and retrofitted or, e.g. prepared for field trials. The increasing number of electrically powered vehicles also places new demands on climate control components. Air conditioning systems are increasingly being provided with a heat pump function, enabling highly efficient heating.
A few weeks ago a special test facility for heat pumps that

measures both the cooling and heating capacity of an air conditioning system was put into operation.