The battery line

City buses are already seen as a green mode of transport. But that's clearly not enough for Vienna's public transit company "Wiener Linien": since fall 2012 it has been operating the first bus line using vehicles powered entirely by batteries.

The red and white city buses roll almost silently through the Hofburg Palace complex, their sound barely noticeable beneath the clip-clop of horse-drawn carriages. These innovative electric buses, drawing their entire energy for operation, heating and air conditioning from their on-board batteries, silently make their rounds of the Austrian capital.

This is made possible by a new operational concept developed by Siemens for the transit company Wiener Linien and implemented in collaboration with the Italian bus manufacturer Rampini. For this series of twelve compact, versatile midibuses, no cables are required; the batteries are charged via rooftop current collectors. And rather than drawing power during operation on the roads, the buses recharge overnight at the depot and during short daytime waiting periods at the end station.

Innovative technology for efficient urban transport

At the heart of this innovative bus technology is a water-cooled electric drive motor – a three-phase motor with approximately 90 percent efficiency. This is a clear improvement over conventional diesel motors, which only manage around 25 percent efficiency. The motor rating of 85 kW (around 115 hp) may appear relatively low at first glance. For city operation, however, this is more than sufficient, since electric motors – unlike combustion motors – can deliver their full power even from a standstill.

To store the required energy, each bus has nine batteries of high-performance, lithium-ferrite cells. These batteries, which boast a total capacity of 96 kilowatt hours, are the

> **"With its new e-buses, Vienna is taking an important step into the future."**
>
> Renate Brauner, Vice Mayor, Executive City Councilor for Finance, Economic Affairs and Public Utilities

most efficient accumulators currently available for this purpose. Three batteries are installed toward the front of the roof, five in the rear and one under the bus in place of the diesel tank.

The connection to the power supply of Vienna's tram network is provided by permanently installed sections of contact wire and special rooftop current collectors, which can be raised at the push of a button when the bus is parked. The bus batteries are charged overnight at the depot with enough energy to drive 150 kilometers. So with around 8 kilometers from the depot to the first stop, and a route of roughly 7 kilometers, the buses can operate all day on a single charge. To preserve the lifetime of the battery cells, however, the buses are connected to the electricity grid for 10 to 15 minutes each time they reach the end station.

Even during a journey the regenerative braking system of the electric buses keeps topping up the batteries. As soon as the driver releases the gas pedal the energy recuperation system is activated and the electric motor acts as an electric generator brake. When the brake is first activated the recuperation effect is increased, and the mechanical disc brakes bring the vehicle safely to a standstill. Naturally, alongside the electronically controlled braking, Vienna's electric buses are equipped with other technical safety and assistance systems such as an anti-blocking braking system, anti-slip control, electronic stability control and starting prevention for when a door is open.

Low cost, high comfort

One advantage is that many components have already been tried and tested in daily operation – the Siemens engineers were even able to design the bipolar rooftop current collectors using mainly series-production components. This makes most service tasks easier for Wiener Linien to carry out with their own personnel. In general terms, the maintenance requirement of electric vehicles is lower than that of vehicles with a combustion engine. And since their energy requirement is considerably smaller, the bottom-line operating costs remain remarkably low.

The versatile low-floor buses of inner-city line 2A are perfect for passengers: running past major museums and right through the Hofburg Palace complex, the buses operate quietly and emission free. All the while they offer the high level of comfort that public transport users in Vienna have come to expect.

Award for operational concept

The Forum for Transport and Logistics in Germany has presented Wiener Linien with the EBUS Award for its operational concept. The EBUS is an environmental prize for buses in public transport systems. The decisive factor for the award is the fact that the line is served exclusively with electric buses, which is a unique manner of implementation in Europe. Around 50 companies in seven categories applied for the award.

Wiener Linien has already received the first environmental award for its operational concept (see info box). Much more importantly, the new electric buses have immediately proven themselves in daily operation. Now the transit company is taking the next logical step: in summer 2013 the next battery-powered bus line will begin operation – and it may well not be the last. ■