



CASE STUDY



1 | Challenge: **Development of a climate-neutral drive system for bridging non-electrified subsections of line**

In its search for a supplier and partner of traction battery systems, HOPPECKE succeeded in winning over train manufacturer Stadler with its expertise in the field of lithium-ion energy storage systems and many years of experience in the rail sector.

In Germany, all major centers are now connected to each other and within cities by electrically powered trains, subways and city trains. Nevertheless, around 40% of the German rail network has so far been dependent on the use of diesel locomotives because it is non-electrified due to the lack of overhead lines. In Europe, by contrast, as much as around 45% of the rail network is non-electrified. This mainly concerns those lines that run far into the interior of the country and where it is not economical to install and permanently maintain current-carrying overhead lines.

For trouble-free bridging of the non-electrified sections of the route, the use of a climate-neutral battery-powered vehicle - the Battery Electric Multiple Units (BEMU) is ideal.

This makes it possible to charge the batteries while the train is traveling under overhead contact lines and at non-electrified terminal stops.

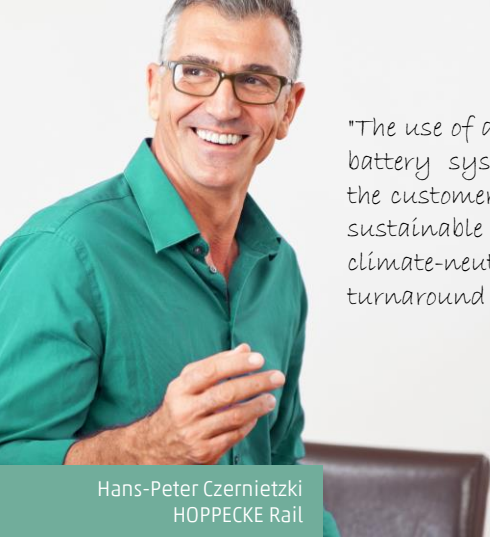
Stadler is a renowned train manufacturer with its headquarter in Bussnang in eastern Switzerland. The company looks back on a successful 75-year history in train development. At its German site in Berlin-Pankow, the long-standing company already expanded its extensive product portfolio in 2018 with the development of the Stadler FLIRT³ battery-powered test vehicle. To include a CO₂-neutral train for non-electrified or only partially electrified lines, bringing it closer to the goal of 100% climate-friendly mobility.

Non-electrified subsections especially in rural areas

100% energy availability even under extreme conditions

Reduction of pollutants through modern mobility

Competitive advantage to conventional diesel trains



"The use of a lithium-ion battery system enabled the customer to achieve a sustainable and 100% climate-neutral mobility turnaround on rail."

Hans-Peter Czernietzki
HOPPECKE Rail

Carbon-neutral
when bridging
subsections of line

Flexibility
throughout the
entire rail network

185 km
battery-electric range

140 km/h
maximum speed

2 | Solution: Customized, high-performance lithium-ion energy storage system

With the development of the rail traction battery system, HOPPECKE offers a powerful as well as a climate-friendly solution for bridging non-electrified subsections of local rail passenger services.

The innovative drive concept allows batteries to be charged flexibly during the journey under overhead contact lines or at non-electrified terminal stops. In addition, braking energy can be partially recovered via recuperation and stored in the traction battery. Thus, non-electrified rural areas can also be connected to the rail network in a carbon-neutral manner. The vehicle-specific challenges in operation are to ensure the availability of sufficient energy - even at extreme temperatures and operational disruptions that lead to long downtimes.

Above all, this is made possible by the powerful lithium-ion energy storage system from HOPPECKE. The installed battery concept includes four high-power battery systems.

HOPPECKE was able to contribute significantly to the success of the project through the innovative design of the battery system tailored to the test vehicle. The system is characterized by its high energy content, which enables a record battery-electric range of up to 185 km. The system is technically realized by a serial and parallel connection of a total of 100 high-power modules. On subsections with overhead lines, the battery system can be recharged in a very short time thanks to its fast-charging capability. By doing this, the subsequent non-electrified subsection can be successfully completed without restrictions.

Compared to conventionally powered regional trains, the Stadler FLIRT³ achieves with 140 km/h a competitive top speed. At the same time, HOPPECKE's battery management system always ensures an optimum temperature window for cell operation by controlling the temperature control system as required. This maximises the service life of the battery system.

Accordingly, the FLIRT³ makes the sustainable and climate-neutral mobility turnaround on rail possible. Even without the expansion of the supply infrastructure, which is uneconomical for low-frequency routes.

Key Benefits

- Flexible charging of the battery while driving or at non-electrified terminal stops
- Short recharging times due to fast charging capability
- Recuperation of braking energy enables carbon-neutral connection of non-electrified rail network
- Reduced emissions and noise pollution
- High energy content enables up to 185 km range
- Faster travelling by train - even on secondary lines with many stops
- Improved timetable quality for passengers
- Battery management system maximises battery system lifetime

3 | Products :

- ▶ Lithium energy and performance for all rail applications
- ▶ Full-service contracts for lifetime optimisation
- ▶ Real-time online monitoring portal
- ▶ Individual consulting for optimal battery utilisation



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