

Range extender ICE solutions to accelerate time-to-market for HD BEV trucks

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In different markets, commercial vehicle manufacturers face increasingly stringent CO₂ regulations. Today, there are viable use cases for battery-electric trucks (BEVs), particularly when cost-effective charging at depots is possible. However, operational flexibility remains limited: public charging infrastructure is often unavailable, impractical in dense metropolises such as those in Japan, or expensive in terms of cost per kWh.

This presentation introduces a diesel-based industrial range extender (REX) integrated into a BEV truck as a bridging solution. Diesel offers efficiency, durability, and logistical and infrastructural compatibility for this application. Nevertheless, its role as a range extender requires targeted modifications to achieve highest efficiency across relevant mission profiles while ensuring the most compact packaging. The publication will address the dedicated engine design for REX applications as well as key aspects of vehicle integration.

Introduction

The EU mandates ambitious CO₂ reductions for heavy-duty vehicles: –15% (2025), –45% (2030), –65% (2035), –90% (2040) relative to 2019 levels. Meeting these targets requires rapid adoption of technologies that can scale in the most impactful segments, particularly 4x2 long-haul tractors. BEVs alone cannot scale rapidly enough in this segment as infrastructure bottlenecks are expected.

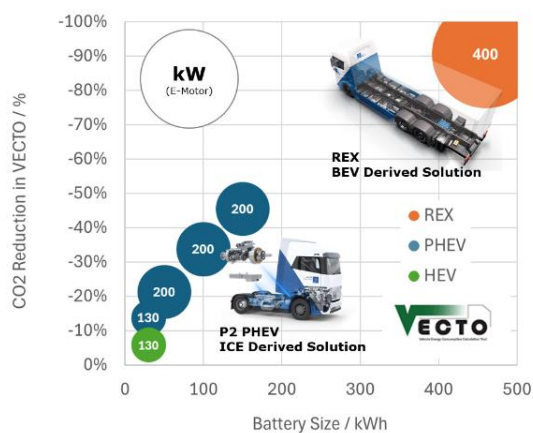


Figure 1: CO₂ reduction of different hybrid configurations in VECTO

Vehicle Integration Study

The REX vehicle integration study was carried out using a European 4x2 BEV tractor equipped with an integrated e-axis and a 600 kWh battery system consisting of nine packs. This platform served as the reference for evaluating two different REX integration concepts, each optimized for specific operational priorities: a last mile-oriented layout (REX last mile) with focus on battery capacity, and one concept with elongated ICE range (REX power pack). Both concepts achieve weight reduction

compared to the full BEV configuration, enabling both improved payload potential and exceptional total range capability.

In the short version of this publication, only the last mile concept shall be described:

Range Extender BEV Concept (REX last mile)

For the last mile-oriented REX concept, only two battery packs were removed to create the necessary installation space. This approach preserves most of the BEV's electric driving capability while allowing integration of the engine, aftertreatment system, diesel tank, and urea tank with minimal impact on the overall vehicle layout.



Figure 2: REX Truck (last mile concept)

The resulting configuration provides a balanced combination of electric range and extended operational flexibility. With approximately 400 km of pure electric range (460kWh battery) and an additional 320 km in REX mode, while maintaining a weight benefit relative to the full BEV baseline of ~180kg. The REX power shall be in a range of 100-140kW.