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Vehicle & charging requirements for an electrified road freight system demonstrator in the UK

INTRODUCTION

In 2021, the UK government commissioned a feasibility study in preparation for a trial of an 'Electric Road System' (ERS, see Fig. 1) to support future electric Heavy Goods Vehicles (HGVs). As part of this, a team of academics and industry partners identified for the trial a section of the M180 in the North of England (see Fig. 2) and investigated the vehicle specifications and charging requirements needed for the trial.

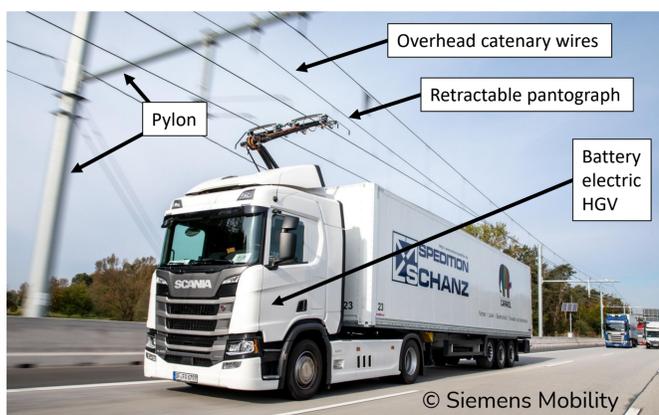


Fig. 1: Siemens 'eHighway' electric road system

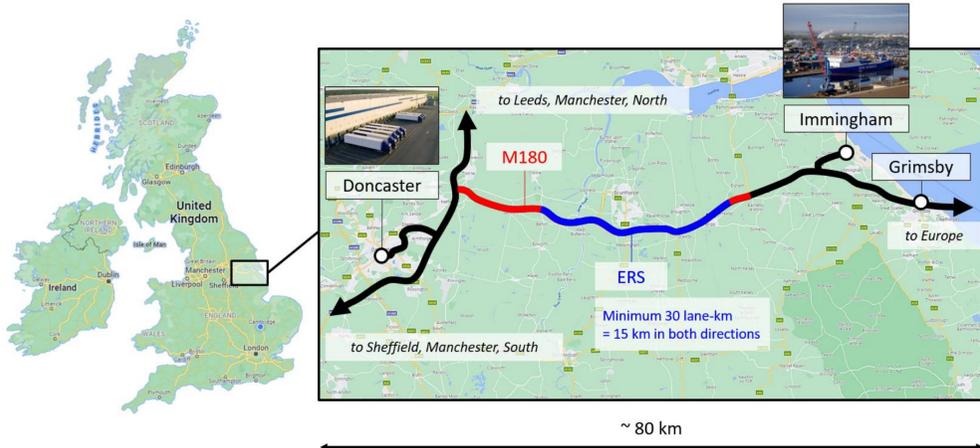


Fig. 2: Proposed ERS demonstrator site

RESULTS

The simulated journeys are shown in Fig. 4, and the calculated battery capacities are shown in Tab. 1. These range from a 'small' 150 kWh pack to an impractical 1,100 kWh pack. Realistically, a range-extended electric HGV with a smaller battery pack would be used in the latter case. Maximum and steady cruising power demands of 300 kW and 150 kW were calculated. Assuming ERS battery charging at 150 kW, this gives typical power ratings of both electric motor and pantograph at 300 kW. Three proposed vehicle types for the trial are summarized in Fig. 5. Assuming a 1C charge rate, power capacities of 150-500 kW would be required for on-route static charging.

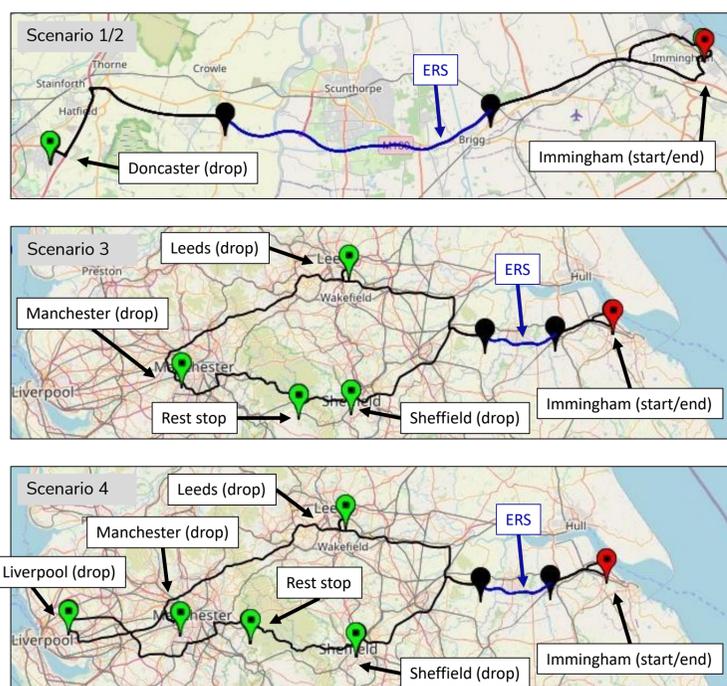


Fig. 4: Journey scenarios considered (1-4)

SIMULATION MODEL

A simulation model (Fig. 3) was developed comprising a drive cycle generator and a vehicle-driver model. It was used to simulate edge-case journey scenarios on the M180 demonstrator and calculate the necessary vehicle battery and power requirements for a 44 t HGV. These included warehouse-to-warehouse journeys (with and without on-route static charging), a multi-drop journey (with on-route charging), and a longer multi-drop with significant off-ERS km and no on-route charging.

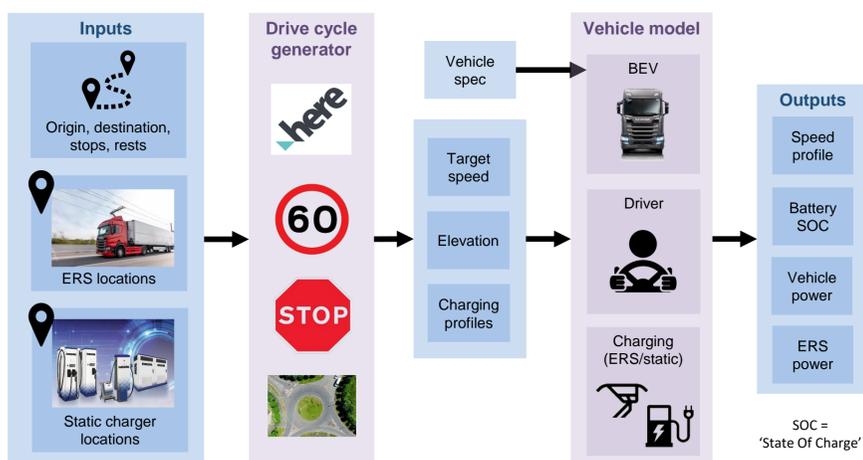


Fig. 3: Simulation model

Tab. 1: Calculated battery sizes

Journey type	Battery (kWh)
1/2: Warehouse-to-Warehouse (with/without on-route charging)	150/450
3: Multi-Drop, on-route charging	300
4: Multi-Drop (long), no on-route charging	1100

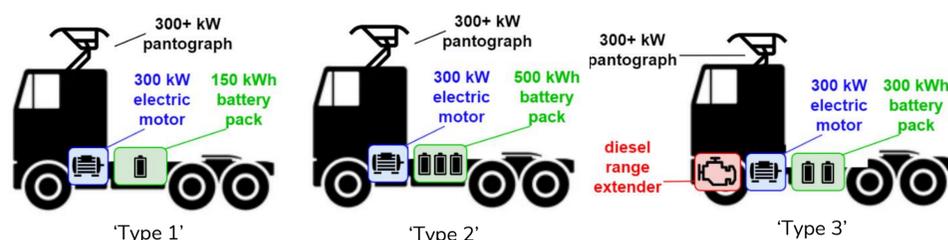


Fig. 5: Vehicle configurations proposed for the trial