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The electrification of road freight

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The decarbonisation of the road freight sector is challenging, so alternative approaches need to be investigated. This study proposes a framework for the electrification of road freight operations. Using four case studies in the UK, it demonstrates that electrification of road freight is a viable option that should form part of a low-carbon transport system.

The road freight sector is considered to be more difficult to decarbonise than personal transport. Road freight decarbonisation strategies have included a range of measures including:

- Improvements to aerodynamics and rolling resistance of lorries.
- Lighter weight vehicles.
- Improvements to propulsion efficiency.
- Alternative fuels.
- Higher capacity vehicles.
- Operational factors such as reduced empty returns and improved routing.

This study considers potential beneficial approaches for the electrification of the freight sector. Although the necessary infrastructure for delivering electricity is sufficiently mature, a significant upgrade is required to accommodate the additional power demand of electrifying transport. The adoption of electric freight transport offers opportunities for zero emission at the point of use, which is beneficial for urban air quality. Yet, there is still substantial emissions of carbon dioxide (CO_2) from power plants. Consequently, shifting to electric freight vehicles will only deliver significant CO_2 reductions if the electricity supply network is decarbonised.

This study proposes a comprehensive framework for the electrification of the road freight sector based on case studies of road freight in the UK. It demonstrates that the electrification of the road freight system is feasible and will require a charge-on-the-move network. This could be achieved with either overhead cables or inductive power transfer (IPT).

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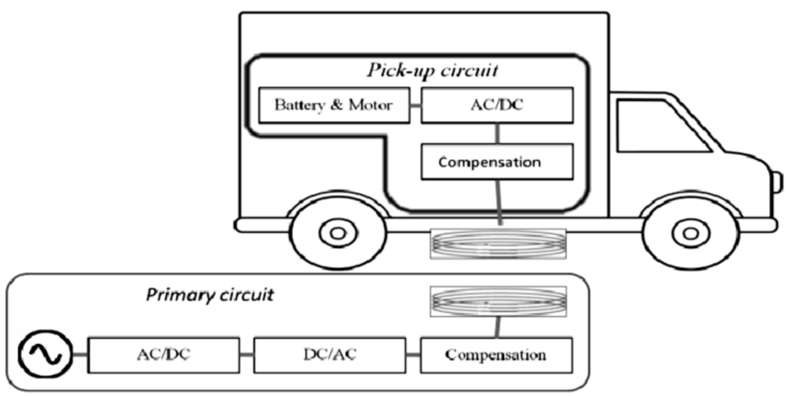
The electrification of road freight

IPT involves contactless energy transfer between two LC circuits (two circuits consisting of an inductor and a capacitor connected together), that are in proximity to each other. A typical IPT system for electric vehicle (EV) power delivery applications in shown in Figure 1. It comprises two major sub-systems – the road-charging unit (primary circuit) and the vehicle-charging unit (pick-up or secondary circuit). The transmitting coil is energised and the resulting magnetic flux is captured by the vehicle charging unit providing a stable power source.

Figure 1: A typical inductive power transfer system for electric freight vehicle power delivery



Developing IPT devices could enable charge on the move (also known as dynamic charging) to be implemented. In such a system, the road infrastructure would transfer energy wirelessly to road vehicles while they are moving.

The study proposes a logistic concept that could provide a framework for the electrification of most road freight operations. The concept is divided into four operations – 'long-haul trucking', 'urban delivery', 'transportation of goods from local distribution centres to consumers' and 'auxiliary services' such as urban refuse collection.

Three vehicle models were developed using an advanced vehicle simulator including electric light goods vehicles and electric heavy goods vehicles (up to 10 tonnes and 38 tonnes respectively). The power requirement of each vehicle model was calculated over appropriate driving cycles. The outcomes were then combined with UK traffic data to set a baseline for required power demand across the country. It was shown that an additional electrical load of 9.4 GW would be added to the power demand during peak hours of commuting due to the electrifications of road freight transportation.

Four case studies were used to assess the feasibility of electric road freight. The assessment showed that shifting towards electric freight vehicles appears to be technically and financially feasible since large and expensive on-board batteries are not required. A 73 % reduction in CO_2 emissions could be achieved by 2030 for all case studies examined. An even higher reduction of 91 % of CO_2 emissions by 2040 is feasible, provided the current projections for decarbonisation of electricity generation are achieved.

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D I G E S T

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