Evaluating the Performance and Costs of an Electric Road System for Decarbonising the UK's Long-Haul Road Freight

Daniel Ainalis*, Christopher Thorne, Christopher de Saxe, John Miles, Phil Greening, & David Cebon

Email: dta32@cam.ac.uk

Abstract

The UK Government revised the Climate Change Act [1] in July 2019 to mandate net-zero greenhouse gas (GHG) emissions by 2050. In August 2021, it announced that it expected to mandate that diesel trucks would not be sold in the UK after 2040. These announcements will require profound change with robust and cost-effective decarbonisation solutions across electricity generation, heat, industry, transport, and agriculture. In transport, surface freight provides an essential service that is vital to the UK, however, it is a significant source of GHG (and noxious) emissions. Within domestic freight, Heavy Goods Vehicles (HGVs) carry 90% of the UK's goods lifted [2], but are a 'difficult to decarbonise' sector. Finding a viable zero-emission alternative to the traditional diesel-powered HGV is vital if the UK is to achieve its net-zero carbon ambition. To meet the 2040 target for diesel lorries, there is a need for technologies that will be ready for implementation from the early-mid 2020s onward.

For the UK's long-haul fleet, one candidate to deliver the required net-zero solution is an 'Electric Road System' (ERS), based on the 'eHighway' overhead catenary system developed by Siemens [3]. Initial studies suggest that a national ERS is the lowest cost, lowest energy, lowest carbon solution available to achieve net zero HGVs by 2050 [4]. This ERS would deploy roadside electrification infrastructure enabling the most efficient and direct use of zero-carbon electricity, and therefore the lowest societal cost. This approach uses established and widely available technologies, is scalable, and can be rapidly deployed. There are numerous existing national bodies to deliver the project and create significant employment in doing so (e.g. UK's construction industry, Highways England, National Grid, etc.). Truck manufacturers such as Scania have demonstrated a willingness to produce the required vehicles and have a track record for delivering suitable test vehicles for eHighway demonstration trials around Europe.

This paper will present an analysis of various potential UK-wide configurations of ERS that could be rolled-out across the country by the late 2030s. It will extend the research presented in [4]. The analysis will use national logistics data for truck journeys across the UK to define the system requirements and 'edge cases'. It will examine the trade-off between ERS network size, on-board battery capacities and stationary charging infrastructure in terms of performance, total cost (to all stakeholders: infrastructure owner, vehicle operators, and HM Treasury), and carbon emissions.

References

[1] Climate Change Act (2008), UK Parliament, London.
[2] DfT (2018) Freight Statistics, TSGB0401: 'Domestic freight transport by mode', https://www.gov.uk/government/statistical-data-sets/tsgb04-freight.
[3] Siemens (2020). "Ehighway – Electrification Of Road Freight Transport", [online] available at: https://www.mobility.siemens.com/global/en/portfolio/road/ehighway.html, Siemens Mobility Global.
[4] Ainalis, D.T., Thorne, C., & Cebon, D. (2020). "Decarbonising the UK's Long-Haul Road Freight at Minimum Economic Cost", Technical Report CUED/C-SRF/TR17, Centre for Sustainable Road Freight, Cambridge, UK.