Decarbonising Road Freight Transport:

Estimating The UK truck fleet dynamic and fuel use

Extended abstract for 10th International Workshop on Sustainable Road Freight Transport

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1. Introduction

The UK's road freight system provides at least £13.6 billion to the economy each year (GOV.UK, 2022). Heavy Goods Vehicles (HGVs) contribute to less than 6% of road traffic but release 18% of the total UK road transport emissions (National Grid, 2022). The UK Government released its standing point and policy for HGVs to decarbonise road freight. According to that, by 2035 new HGVs up to 26 tonnes to be added to the fleet will be zero-carbon technology, and for new HGVs larger than 26 tonnes deadline is by 2040. (GOV.UK, 2022)

The aim of the project is understanding UK's truck fleet dynamics until the net-zero goal years and beyond, in order to see how policies on road transport and related technology evolution will affect the road freight transport and its effect on the environment. For adoption of available net-zero truck technologies and timely investments, immediate actions and decisions are needed from stakeholders. And introduction of net-zero trucks will not happen suddenly, rather it will be gradual. Considering the average lifetime of trucks, there still will be trucks on the road that are using diesel. That will change the current demand of fuels and energy usage of the fleet. There are studies that investigate HGV technologies however, there are no studies that investigate how HGV fleet dynamic of UK will change, including different technology mixes.

To reach the aim, the project focuses on the following steps:

1. Estimating fuel use of the truck fleet and fuel prioritisation between different modes of transport since fuels such as renewable diesel and biofuels will be freed up as light weight vehicles rapidly become net-zero.

2. Comparing trucks that are Battery Electric Vehicles (BEVs), Fuel Cells, Electric Road Systems (ERS) and Alternative Fuels in terms of cost, materials and greenhouse gas (GHG) emissions.

3. Quantifying life cycle GHG emissions of HGV fleet and comparing techno economic and GHG implications of alternative low carbon technology deployment scenarios.

2. Methodology

To estimate number and type of vehicles using different technologies through the years a model needs to be developed. A former study conducted by Milovanof et. al (2019) came up with a fleet-based life cycle model for the U.S. light-duty vehicle fleet, called the FLAME model. The fleet module of this model is used as a lead example in the project to come up with the fleet turnover for heavy duty vehicle fleet in the UK.

Objectives of the FLAME fleet module:

- Simulates the annual fleet sales and stock
- Estimate the fleet kilometers traveled by vehicle type and age, and the associated fleet fuel use

Inputs:

- Survival rates (cumulative and annual)
- Historical values and prospective scenarios of technology market shares

Fleet turnover equation:

$$Stock_{y,t} = Stock_{y-1,t} + In_{y,t} - Out_{y,t}$$

$$Out_{y,t} = \sum_{a=age} Out_{y,t,a}$$

$$Out_{y,t,a} = \left(1 - SR_{y,a}\right) * Stock_{y-1,t,a}$$

$Stock_{y,t}$ the on-road stock of vehicles of technology "t" in year "y",

$In_{y,t}$ the new sales,

$Out_{y,t}$ the outgoing vehicles (scrapped vehicles),

$SR_{y,a}$ the survival rate of age "a"

Survival rate represents the probability for a vehicle to stay operational in the fleet knowing it was operational in the previous year.

Outputs:

- Annual vintage stocks by vehicle type
- Annual fuel use

Once the model would be adapted and developed according to the HGVs in the UK, annual sales would enable us to estimate what demand will be for low carbon technologies into future.

3. Results

To put as an input to the model, cumulative and annual survival rates of the existing UK truck fleet are calculated and can be seen below in Figure 1. It can be seen that at year 8, cumulative survival rate of a truck in the UK fleet is halved.

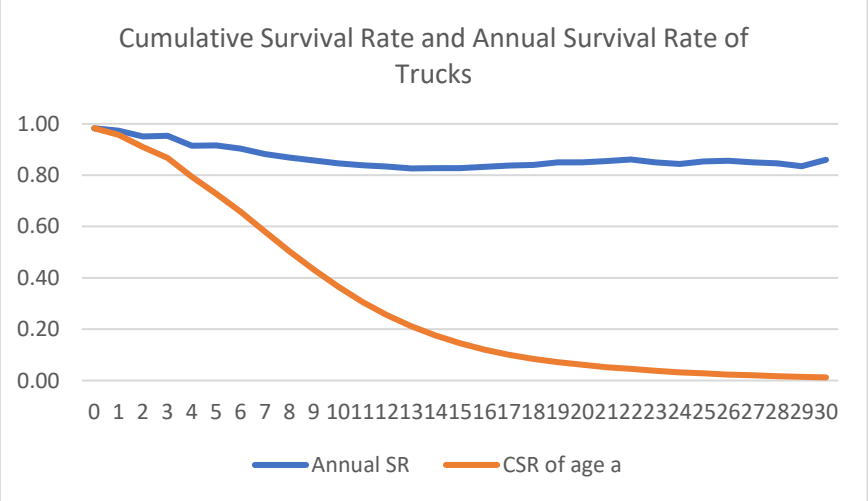

Figure 1. Annual and Cumulative Survival Rates of UK truck fleet based on historical data from 1994 to 2021

For HGV Fleet Turnover, model is updated according to the current fleet. Future demand estimations that are used are based on “UK Transport Vision 2050: investing in the future of mobility” by UKRI (2021) and “National Road Traffic Projections” by DfT (2022), which estimate demand of and traffic due to HGVs will increase by 12% by 2050.

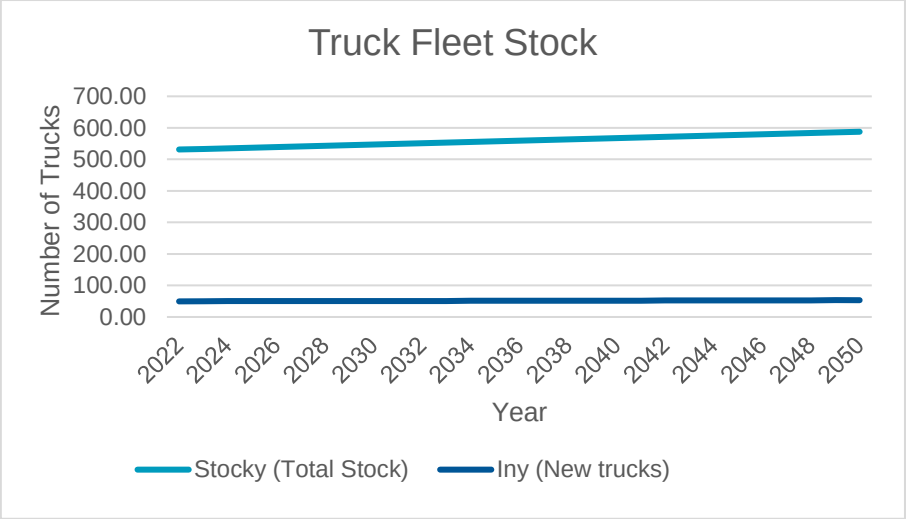

Figure 2. Estimation of total UK HGV fleet stock and the newly added trucks for each year

4. Discussion

Proper estimation of road freight dynamics is significant to decrease GHG emissions, since investing in unnecessarily high number of trucks and fuels, putting out infrastructure that would not be used are not desired. Understanding possible technology mix scenarios can help all the stakeholders such as truck companies, fuel traders, infrastructure providers and people who live in the country that demand cleaner environment. In the following stages of the study, fuel use estimates for the following years will be calculated and model will be developed to include different technologies being considered. Moreover, Life Cycle Assessment (LCA) and Techno-economic Analysis (TEA) will be applied on different technology mix scenarios.

5. References

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