

Vahid Aryanpur & Fionn Rogan

INTRODUCTION

The Irish road freight sector faces decarbonisation challenges due to growing activity, increasing energy demand, and limited availability of low-emission fuels and commercialised zero-emission trucks. This policy brief describes future pathways for the decarbonisation of light, medium and heavy trucks. The analysis incorporates all capital and operational costs for advanced electric and hydrogen-powered trucks as well as intangible costs associated with increased recharging time, cargo capacity limitations, and buyer reluctance towards emerging technologies. A whole-systems modelling approach is employed, incorporating inter-sectoral dynamics and ensuring compliance with Ireland's carbon budgets and net-zero target.

KEY TRENDS

- The number of trucks in Ireland has risen by more than 70% from 2015 to 2022. They are almost entirely reliant on diesel fuel.
- The Irish road freight fleet in 2022 comprised approximately 128k small (2-5 tonnes), 11k medium-sized (5-10 tonnes), and 26k large (over 10 tonnes) trucks. The average daily mileage ranges from 136 to 163 km. Most drivers may manage recharging requirements.
- Total annual road freight activity involved driving approximately 5 billion kilometres, moving 12 billion tonne-kilometres. Freight activity doubled between 1995 and 2018. Projections suggest that total freight demand is expected to double by 2050 compared to 2018 level.
- Trucks comprise just 5% of Irish road vehicles yet contribute to a disproportionate 21% of total transportation CO₂ emissions, and an even higher share of local air pollution, highlighting the need for rapid sustained decarbonisation.

COMMENTARY

- Intangible costs for trucks, often underestimated, significantly impact freight transport operations. These include increased recharging time, cargo capacity limitations, and buyer hesitancy toward emerging technologies.
- These intangible costs can increase the capital cost of zero emission trucks by up to 40% making them at least 27% less cost-competitive.
- Many truck operators, who are often small family businesses with limited resources, require a targeted decarbonisation strategy to facilitate a minimally disruptive energy transition.
- This analysis generates future pathways for decarbonisation of freight based on least-cost optimisation modelling with the TIMES-Ireland Model.
- Full details: Aryanpur, V. and Rogan, F., 2024. Decarbonising road freight transport: The role of zero-emission trucks and intangible costs. Scientific Reports, 14(1), p.2113 (link)

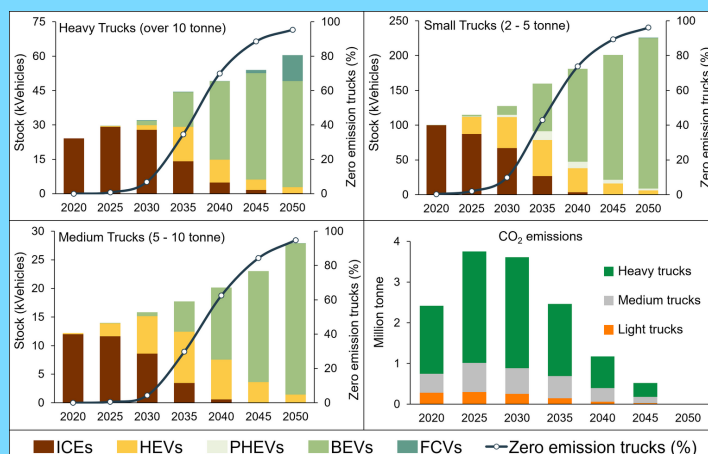
COST-OPTIMAL MITIGATION PATHWAY

Short-term (pre-2030)

- Conventional trucks are gradually being substituted by more efficient hybrid counterparts, which reflects the cost-optimising preferences of the modelling framework.

Long-term (2030-2050)

- Electric trucks dominate the market for all weight categories. The inclusion of intangible costs leads to some heavy trucks switching to fuel cell vehicles representing 20% of the market share.
- During the study period (2020-2050), despite doubling freight demand, the successful adoption of zero emission trucks leads to a reduction of total fuel consumption by at least one-third. This is primarily attributed to the higher fuel efficiency of hybrid and fully electric trucks. Compared to 2020, the average fuel economy improves by 85%.



POLICY RECOMMENDATION

Purchase price incentives serve to encourage early adopters and can contribute to boosting the adoption rates of zero emission trucks. However, policies focusing on operational expenditures are more likely to enhance the competitiveness of these trucks compared to traditional purchase price incentives. Such policies would provide dual benefits by supporting truck owners and directing incentives more precisely toward achieving measurable CO₂ emission reductions in line with legally-binding carbon budget targets.