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A cost analysis of decarbonizing the heavy-duty road transport sector

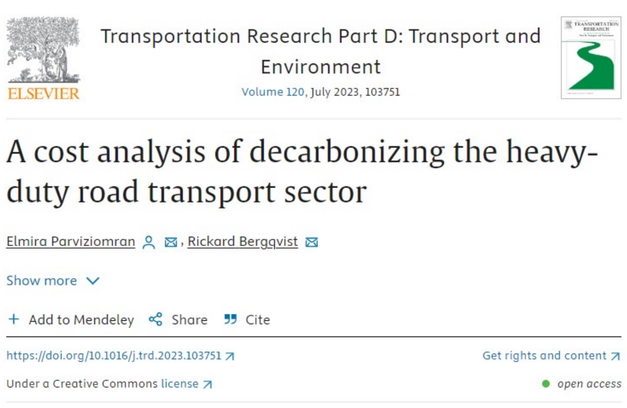
Introduction

In the last decade, research has mainly focused on understanding sustainability transitions and their costs, such as initial investments, fuel, and maintenance.

However, it often overlooks tech-related factors like reduced loading capacity in green powertrains and charging strategies, affecting both fuel costs and charging time for BEVs, a topic explored in this paper.

This paper also highlights the underexplored impact of financing policies, such as green financing, on transition costs.

The study uses an ambitious scenario involving the Swedish heavy-duty fleet from 2020 to 2050, with a 48% share for both BEVs and FCVs, alongside 4% occupied by diesel ICEs in 2050 and 42% increase in total transportation demand by 2050 . It includes sensitivity analyses on charging strategiesand interest rates.

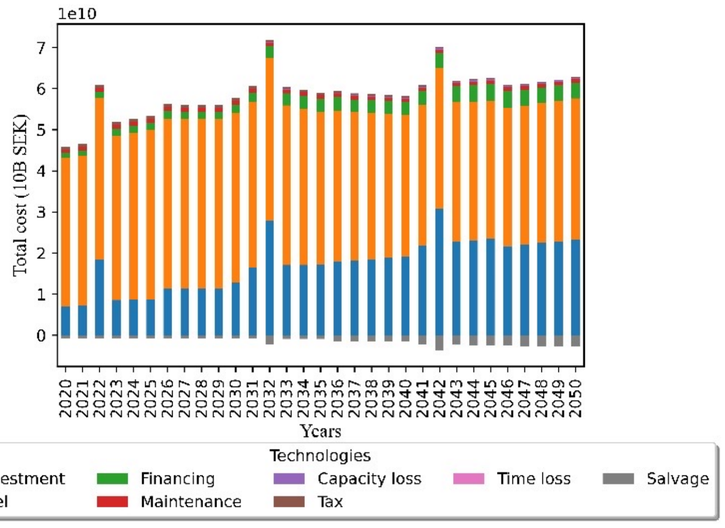


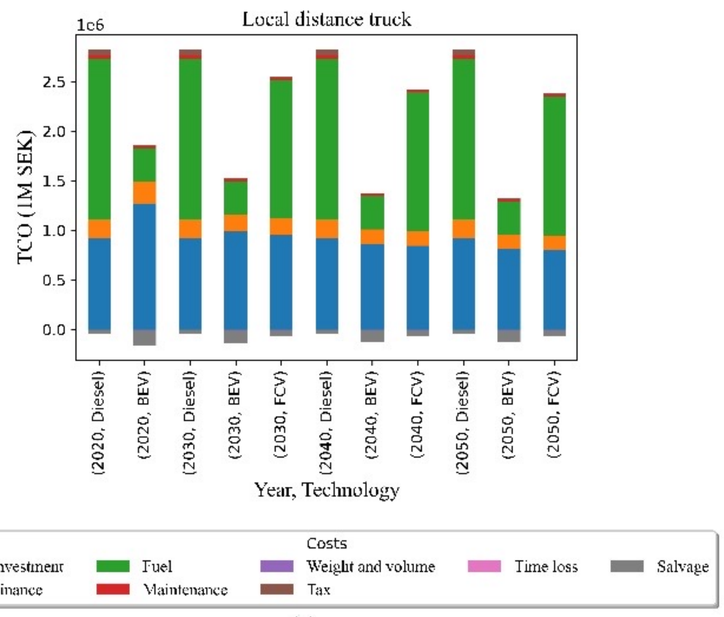
Method

Aanalytical modeling of system cost and total cost of ownership (TCO) for powertrains using Python.

Results

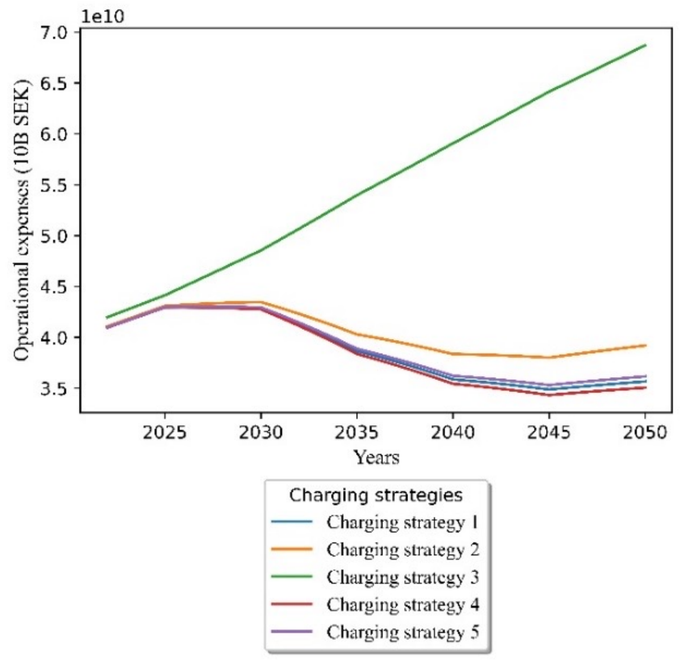
- Fuel costs are a significant portion of total costs
- Fuel costs depend on charging strategies influenced by electricity prices, including location, time, power effect, and electricity source.
- The cost of lost loading capacity and time loss is negligible
- TCO for BEVs is competitive with ICEs, especially with overnight depot charging using low-power chargers



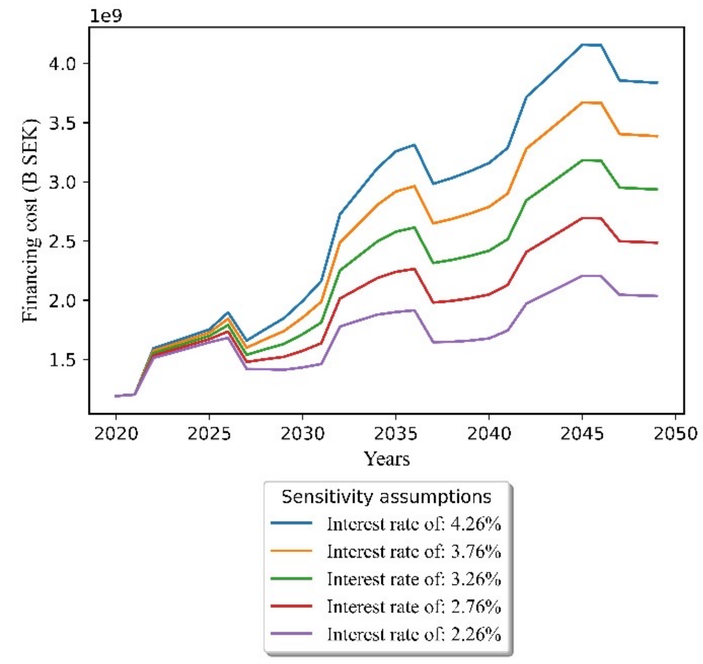


Sensitivity test

- Operational cost sensitivity to charging strategies
- Transition from 100% overnight depot charging to 100% daytime public charging results in a 92.5% operational cost increase by 2050
- Financing cost sensitivity to discounting interest rates for green powertrains



Charging strategies	Assumptions
Charging strategy 1	100% depot charging overnight with low power supplied electricity
Charging strategy 2	80% depot overnight charging low-power, 5% fast charging in public, and 15% semi-public charging with medium-power supplied electricity
Charging strategy 3	100% fast public charging in the daytime with supplied electricity
Charging strategy 4	Similar to the first strategy but with self-consumed electricity
Charging strategy 5	Similar to the second strategy but with self-consumed electricity



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