Combining pickups and deliveries in vehicle routing – An assessment of carbon emission effects

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Abstract

This paper studies the effect on carbon emissions of consolidation of shipments on trucks. By utilizing existing vehicle capacity better, one can reduce distance and thereby carbon emission reductions. Our analysis determines the emission savings obtained by an individual transport provider who receives customer orders for outbound deliveries as well as pickup orders from supply locations. The transport provider can improve the utilization of vehicles by performing the pickups and deliveries jointly on vehicles instead of using separate trucks. We compare a basic set-up, in which pickups and deliveries are segregated and performed with separate vehicles, with two consolidation set-ups, namely mixing (pickups and deliveries may be mixed freely on a single vehicle) and backhauling. In our model we assume that the transport provider minimizes costs by use of a Vehicle Routing tool, where we choose the industrial solver Spider. To compare carbon emissions for the three set-ups, we use a carbon assessment method that uses the distance driven and the average load factor.
We find that emission savings are relatively large in case of small vehicles and for delivery and pickup locations that are relatively far from the depot. However, if a truck visits many demand and supply locations before returning to the depot, we observe negligible carbon emission decreases or even emission increases for consolidation set-ups, meaning that in such cases investing in consolidation through joint pickups and deliveries may not be effective.

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