

## Abstract

As part of a research project at the chair of freight transport and transport logistics at the university of Wuppertal, potential logistics locations in the metropolitan region of the Rhineland were identified and evaluated with regard to their usability for various logistic functions. In previous work, it was found that there is a migration of commercial areas from the inner cities to the outskirts of the metropolitan area. In order to counteract the resulting increase in mileage in the metropolitan area, this work examined whether savings in kilometers traveled could be achieved by using the potential locations identified in the Rhineland metropolitan region. This was done exemplarily for the two areas food retail as representative of regional supply and for parcel service providers as representative of network locations.

At the beginning of the paper, an insight into the current state of research on this topic is given and the research project of the Wuppertal chair including the developed evaluation scheme for the potential locations is presented. Afterwards, the typical logistics processes of the segments food retail and parcel service providers to be considered are described before the daily delivery tours are determined under different scenarios using the routing tool VROOM (Vehicle Routing Open-source Optimization Machine). The boundary conditions for the tours were previously determined via literature research and expert interviews.

For the food retail sector, the daily delivery trips from the regional warehouses to the individual stores are calculated for the four largest companies represented on the German market. As a representative of the parcel sector, a similar analysis of the tours from its own hubs to all private and commercial customers in the study area is made for the company DHL. First, only the existing locations are considered for this purpose. Then, using a heuristic, logistics areas are determined from the sum of the existing and potential locations that would presumably represent an optimization with regard to the daily kilometers driven.

For the food retail sector, it was indeed possible to determine mileage savings using this method, with potential savings ranging from a few percentage points to almost 50%, depending on the company. For the DHL company, on the other hand, no mileage reductions could be determined, reflecting the good hub network already in place. With a different heuristic, however, there should still be some potential for optimization.

From the results, including an estimate of the potential use of battery electric vehicles, the annual CO<sub>2</sub> emissions were calculated for each scenario and segment. The use of electric vehicles in particular could save enormous amounts of greenhouse gas.

However, the reduction potentials through optimized site selection of logistics centers do not seem to be exhausted at all. By adjusting the criteria for pre-selecting potential locations, even higher mileages could be saved. This applies above all to rural areas, such as the northern Lower Rhine region.