

Summary

Velocipedes, better known as velomobiles, have been around for some time. They were often known under a variety of names like pedalcars, cyclecars and velocars. From the first true velomobile in 1925, the velomobiles have endured the automotive boom after the Second World War and flourished in the oil crisis of the 1970s. Today there are about nine commercial new generation velomobiles available, in various countries.

To prevent the work of comparing various, significantly different, velomobiles the focus of this report is set on one specific velomobile, the Dutch built Aerorider. The Aerorider was developed in 1997 and is a state-of-the-art hybrid velomobile, combining physical and electrical power to overcome slopes and produce speeds up to 45 km/hr. Furthermore, as velomobile use can be seen as a indicator of a strong cycling culture, the Netherlands is chosen as a research location. The Dutch cycling culture, the predominantly flat country and the suitable infrastructure make the Netherlands a suitable platform for fostering velomobile use.

In this report, the present use of transport commodities in the Netherlands is presented in an overview of the use, motives, ranges, perception and future trends of the transport commodities.

In the Netherlands, 75% of the kilometers traveled by the population is done using a car (incl. 24% as passenger), followed by the bicycle and train, each accounting for 8% of the total. The daily commute accounts for 29% of traveled kilometers, followed by the trips made as visits and with social/recreational motives, both strongly related to multi-person travel.

When the ranges of use of the different transport commodities are compared, a gap emerges between the ranges of moped and bicycle use and the ranges of car and train use. This gap harbours large potential for the Aerorider, especially within the upper ranges of bicycle use and the lower ranges of train use.

The Dutch population perceives the car as the most attractive mode of transport (67%), followed by the bicycle (27%). Public transport is perceived as rather negative, only 4% rates this mode of transport as attractive and 75% of the Dutch population specify public transport as an unsuitable form of transport. These ratings could provide an indication of a possible modal shift towards velomobiles.

After discussing the Aerorider acceptance within the transport spectrum of the Netherlands, the Aerorider is compared to the different modalities using the following criteria:

- Travel speeds and times
- Energy consumption
- Emissions
- Fixed and Variable costs

The train and moped emerge as the fastest modes when the travel time is assessed over a preset distance of 10 km. The car and Aerorider make up a steady third and fourth place. The travel times are however difficult to assess as the ranges and average speeds differ strongly among the different modalities and traveling conditions.

The energy consumption of the modalities is assessed in primary energy sources, presented in MegaJoules of energy per passenger-km and vehicle-km. The electric alternatives consume only a fraction of their gasoline and diesel variants. The Aerorider merely consumes 0.036 MJ/pkm of energy, only about 2% of what a car consumes.

The Emissions overview is divided into the *direct emissions* (pollution from the tailpipe) and *indirect emissions* (pollution related to the extraction and production of the fuel source). Once again, the electric alternatives emerge as the best option, with no tailpipe emissions, only the *indirect emissions* of these modes are considered.

Finally, fixed and variable costs are examined for the different transport commodities. The bicycle is, by a considerable margin, the cheapest of the transport modes. The train and tram/bus follow shortly after, as these do not have any fixed expenses and are partly subsidized by the government. The Aerorider is the fourth cheapest, taking in account series production of the Aerorider, cost per passenger-km estimates to about €0.20.

Concluding the report, the transport commodities are compared on the 4 criteria noted. For the ease of comparing them, the commodities are given a score on the last three criteria (energy consumption, emissions and cost) as these are preferably kept as low as possible. From these scores the bicycle emerges as the best option, closely followed by the Aerorider. The car is the least of the modalities, as it has the highest consumption, emissions and cost.

The Aerorider has potential to be a sustainable, cost efficient alternative for both car and public transport use. Especially the lower range of the, negatively evaluated, train should harbour market potential for the Aerorider. With the large share of commuting kilometers, it is recommended to investigate the perception of electric vehicles within this motive as well as the role of government and companies in promoting them. Within the near future, when the costs of producing the Aerorider have dropped, it is recommended to examine if the cost are truly the only obstacle in large-scale use of the Aerorider. Ultimately, with growing popularity of electric powered vehicles and the surge away from the dependence on fossil fuels, velomobiles await a bright future.