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Is the speed pedelec the light electric vehicle that will achieve a modal shift?

Bram Rotthier[1], Guylian Stevens, Bart Huyck, Emilia Motoasca, Jan Cappelle
KU Leuven Technology campus Ghent, Gebroeders De Smetstraat 1, 9000 Ghent, Belgium
[1]bram.rotthier@kuleuven.be

Abstract

Giving space to people and nature is a main goal in the development of liveable, sustainable cities. To achieve this, a modal shift is key. The current modal split shows that a transition to the bicycle may be difficult. Previous research lists the drawbacks for bicycle commuting, such as infrastructure, weather conditions, amount of time and effort to cover larger distances, sweating, etc. The speed pedelec, with its higher assistance speed and power, overcomes some of these obstacles. An analysis of speed pedelec user data shows that this vehicle offers travel times comparable to those of cars and public transport. Both the EU and Belgian legislators have created a regulatory framework for this new vehicle, enabling a future market uptake. Still, the authors believe that a further development of the speed pedelec is needed to really induce a modal shift.

Keywords: speed pedelec, modal shift, legal aspects, benefits

1 Introduction

Many car-congested cities all over the world are searching solutions to turn into green, sustainable communities. A possible solution would be a modal shift to cycling. However, experience shows that it is hard to convince car drivers to become cyclists. Traditional EPACs already meet more of the commuter's needs. This is reflected in sales numbers: in 2016, already 39% of the bicycles sold in Belgium had an electric motor [1]. Due to the limited speed (25 km/h) of these EPACs, they have a limited range for comfortable commuting and little added value for the sporty commuter. The more recently introduced speed pedelecs, which are more powerful and have an assistance speed up to 45 km/h, are extending the range of the commuting cyclist.

In this abstract, the potential of the speed pedelec to achieve a modal shift is discussed based on existing legislation and on the results from a user measurement campaign and a user survey.

2 Unveiling legislative clarity for speed pedelecs

Today's speed pedelecs are two-wheelers with pedal assistance up to 45 km/h and a motor with a maximum continuous rated power of 350W or 500W. This means the speed pedelec is faster and

more powerful than the classic pedelec (EPAC). This new vehicle type has challenged both European and Belgian legislators. At this moment, both legislative levels have decided on a regulatory framework for these vehicles.
According to EU regulations [2], speed pedelecs are subject to type approval. The EU classified this vehicle in category "L1e-B: two-wheel mopeds*"*. The European legislator has imposed extra requirements on L1e-B vehicles *designed to pedal*, such as a maximum mass of 35 kg, an adjustable rider positioning and a maximum assistance factor of four [3]. The latter is a strong limitation for the vehicle design options and it is scientifically not proven that it is improving the structural integrity of the vehicle [4]. In the European legislation it is included that this limitation may be changed in a future revision of the type approval legislation. For these vehicles designed to pedal, requirements for type approval are adapted, such as extra requirements for front forks and frames and exemption for electric range tests. [3] [5]
The classification of speed pedelecs as L1e-B vehicle implies that a driver's license AM is required. [6]
According to the current Belgian traffic law [7], the speed pedelec is a "moped type speed pedelec", a dedicated category. In zones where traffic is limited to a maximum speed of 50 km/h, speed pedelec users may choose between bicycle lane and the roadway. In zones with higher speed limits, speed pedelec users must use bicycle lanes, if available. Of course, the road authority has the opportunity to derogate from these rules, by using traffic signs. At the time of writing, speed pedelec users are not eligible for any tax benefits, but the government has decided on making speed pedelec users eligible for the tax free "bicycle commuting allowance" of maximum €0.23/km. This measure is still awaiting final approval from the parliament.

Hence, both European and Belgian legislators have worked on an adapted, clear regulatory framework for speed pedelecs. These regulations can still use some fine-tuning, but there is a clear legal base for manufacturing and using speed pedelecs in Belgium.

3 Benefits for commuting

In Belgium, the hours lost in traffic jams have doubled between 2011 and 2016 [8]. This emphasises the need for a modal shift to different modes of transport, that are compacter, lighter, hence more on a human scale.
A lot of research has been carried out to investigate the potential of bicycles to replace cars. This seems very logic for the Flanders region *(Belgium)* since about 61% of the Flemish commuters works at maximum 15 kilometres away from home [9]. Modal split figures, however, show that only about 15% of the commuting population is using a bicycle for commuting [9]. Research [10] [11] has shown that the major drawbacks for more uptake of bicycle commuting are:

- Lack of infrastructure,
- Weather conditions (wind & rain),
- Lack of bicycle parking,
- Longer distances to cover,
- Presence of slopes,
- Feeling unsafe in traffic,
- Fear of bike theft/vandalism,
- Bad air quality,
- Sweating,
- Lack of more luggage (and persons) carrying capacity.

Many new light electric vehicle designs are emerging to achieve this modal shift, taking into account and trying to overcome the above mentioned drawbacks. The authors believe there are great technical developments, but it will be challenging for these LEVs to gain a significant market share due to the current traffic situation *(culture, legislation and infrastructure)*. For new vehicle designs, it is important to "fit in" this traffic situation. Because of the speed pedelec's resemblance to bicycles and mopeds, it was easier to find their place on the road and to issue suitable legislation, as mentioned in the paragraph above. This resemblance is also expected to lead to a higher user acceptance.

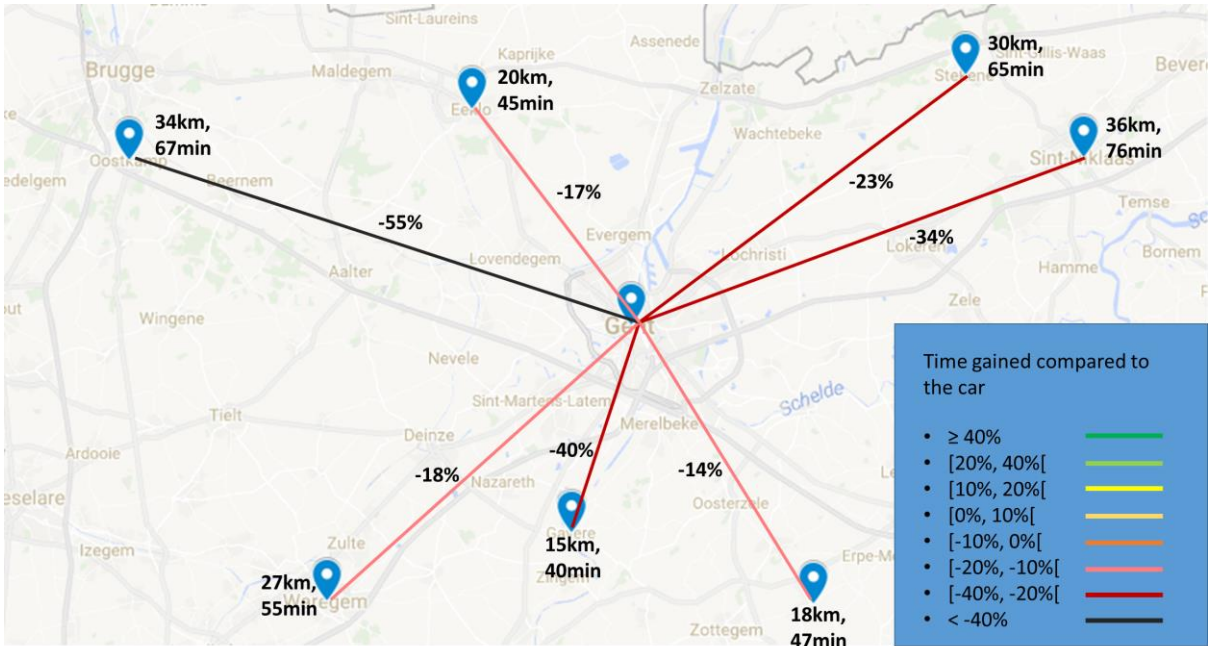

*Figure 1: Relative time gained by speed pedelec commuting compared to car commuting (Ghent)**

The use of speed pedelecs limits the sweating and the influence of environmental factors as wind and slopes compared to using the traditional non-motorized bicycle. Moreover, user loggings show that this vehicle is increasing the active commuting distance to about 40 kilometres one-way. To be able to objectively assess how speed pedelecs are being used in the typical Belgian traffic situation, the riding behaviour of different speed pedelec users has been logged. From this data we derived the average speed pedelec commuting time for different test persons. In this paper, the travel times of test persons commuting to Ghent and Brussels are discussed, as typical examples of commuting behaviour related to Flemish cities of two types: one (Ghent) with little and the other (Brussels) with many traffic jams on highways.

In Figure 1, the average time gain of speed pedelec commuting is compared to car commuting for 7 speed pedelec commuters to the less congested city of Ghent. The result shows that the commuting trip for these test persons by speed pedelecs takes about 14% to 55% more time than when using a car. It can be seen that the value of 55% is an outlier that can be related to the highway (without

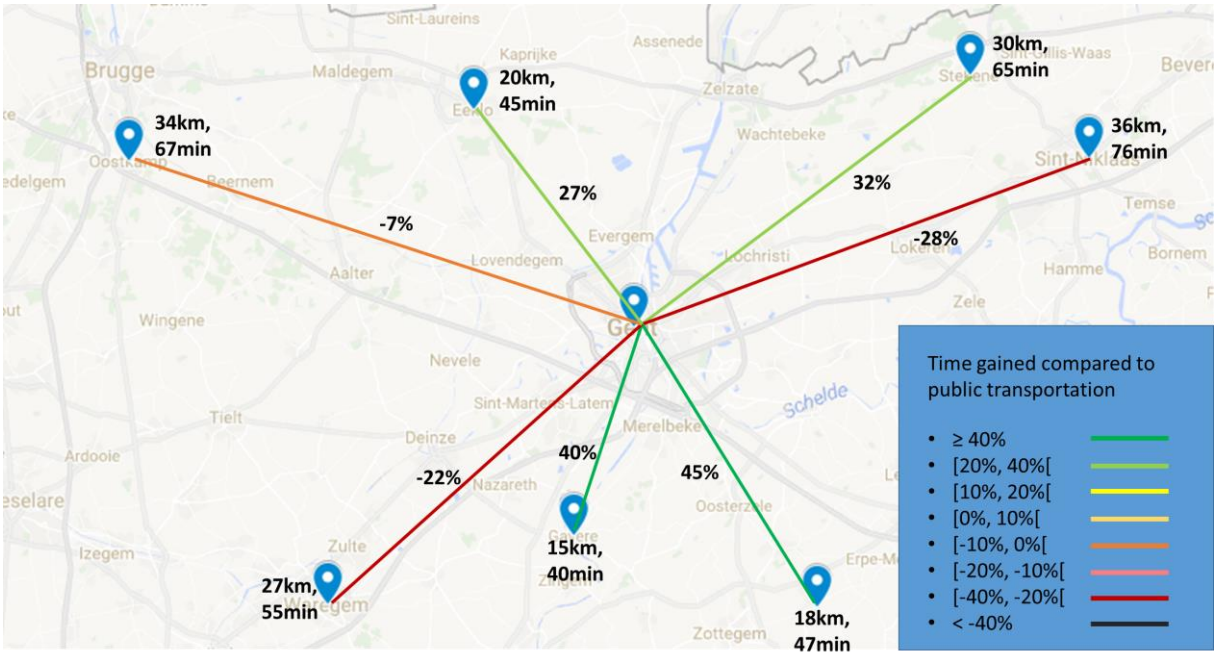

*Figure 2: Relative time gained by speed pedelec commuting compared to commuting by public transport (Ghent)**

*distances are in bird's eye view

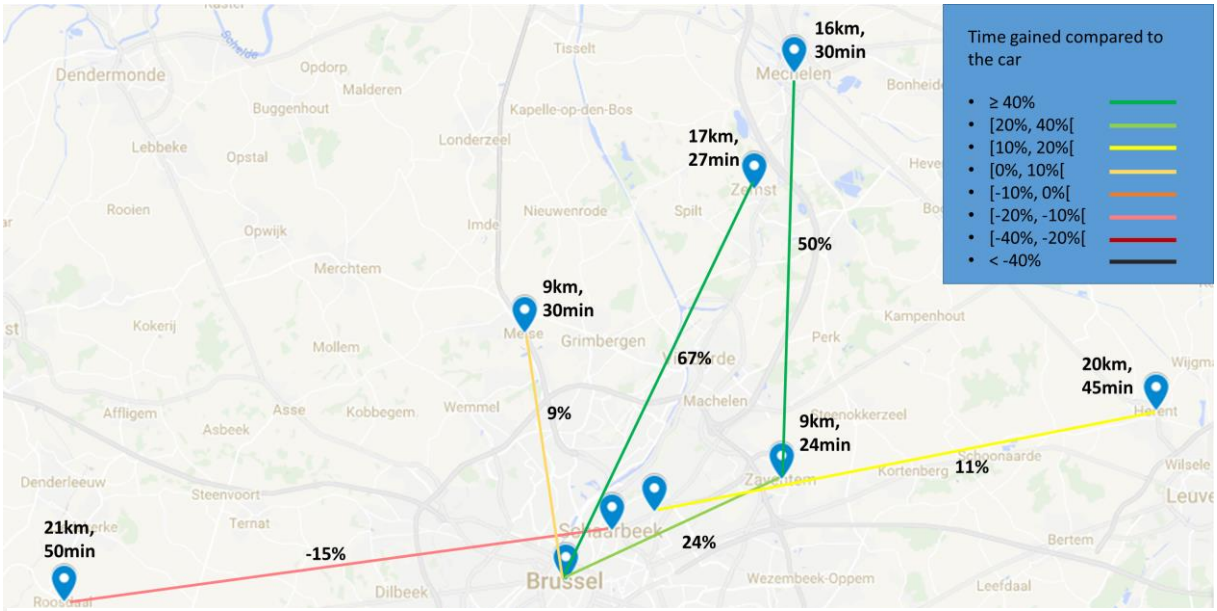

*Figure 3: Relative time gained by speed pedelec commuting compared to car commuting (Brussels)**

many traffic jams) close to both start and end of the commuting trajectory for this test person.
In *Figure 2*, the same speed pedelec data is compared to the average public transport commuting time for these users. It can be observed that, even though the Flanders region has a fine maze of public transport, for only 3 test persons public transport would be a faster option for commuting to Ghent.

In Figure 3 and Figure 4, the same comparison is made for 6 test persons commuting to the heavily congested city of Brussels [12]. From these figures can be concluded that for most of these test persons, commuting by speed pedelec is a faster option than both by car and by public transport. Hence, due to the higher speed of the speed pedelec, this vehicle allows for larger active commuting distances, with travel times comparable to public transport and the car.

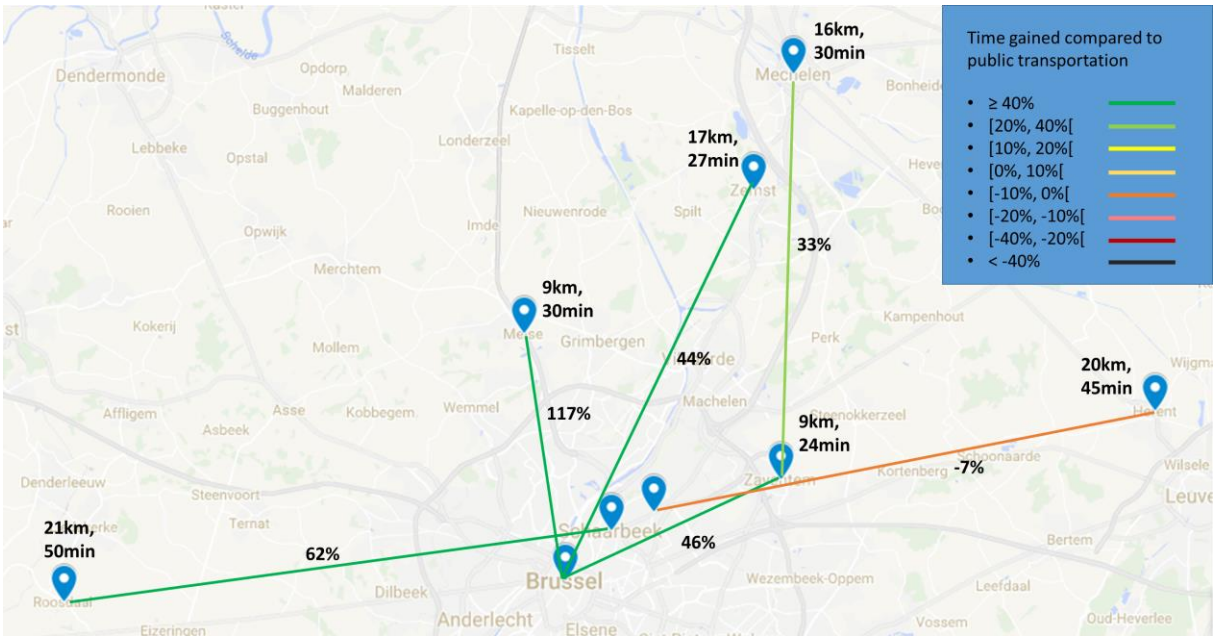

*Figure 4: Relative time gained by speed pedelec commuting compared to commuting by public transport (Brussels)**

*distances are in bird's eye view

Interviews with commuters showed that people are often scared by the relative high purchase prices of speed pedelecs. Prices in bike shops currently vary between €2799 and €9490. To gain insight in the purchase price that users really spend, traditional pedelec and speed pedelec users were questioned in 2017. The purchase price of the vehicles they bought is shown in Figure 5. It can be observed that most pedelec users spend €1000 to €3000, while for speed pedelec users this range is wider: €3000 - €7000. The annual costs (mainly maintenance) was also surveyed, as depicted in Figure 6. In these annual costs no clear gap between pedelec and speed pedelec users can be observed, even though it is expected that the speed pedelec users cover larger distances.
These economical figures show that the expected bicycle commuting allowance (or any other fiscal support) can be an important measure to stimulate the modal shift from cars to speed pedelecs.

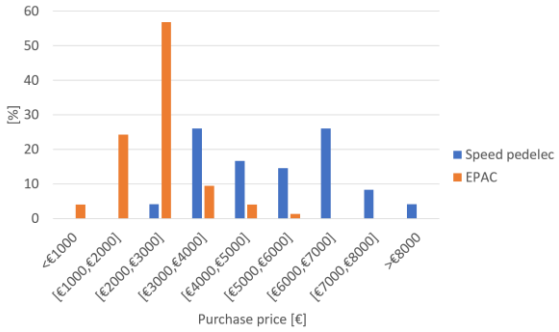

Figure 5: Results of user survey on (speed) pedelec purchase price

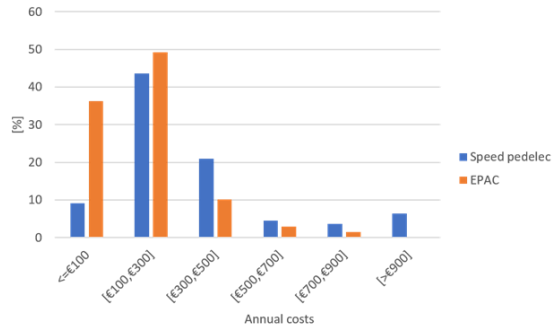

Figure 6: Results of user survey on annual costs for (speed) pedelec commuting

Speed pedelecs are not solving all the above mentioned reasons why commuters are not easily convinced of replacing their car by a bicycle for commuting. The current speed pedelec should be further developed into a '365-days' vehicle, allowing for daily commuting without too much hassle *(luggage, clothing, locking, etc.)*. The design of such a '365-days speed pedelec' will be further elaborated during the oral presentation.

As a sign to the government, it is important to communicate that the bicycle commuting allowance is a great first step, but that it is not enough. Major obstacles for bicycle commuting were related to cycle/parking infrastructure and safety, meaning that governments on all levels need to invest in safe bicycle infrastructure.

4 Conclusion

Many car-congest cities are aiming for a modal shift. A transition to bicycle commuting would be a possible solution, but the current modal split shows that this is difficult to effectuate. Previous research showed the primary obstacles for commuters to opt for the bicycle. Currently, many light electric vehicle designs are emerging to meet more user requirements, but the authors believe that it is also important to fit into the current traffic situation (culture, legislation, infrastructure). The recently introduced speed pedelec gives an answer to many drawbacks of the traditional bicycle and fits into the current traffic situation. Due to its higher assistance speed and motor power, it allows for longer commuting distances, with travel times comparable to the public transport and the car. But to really induce a modal shift, there is still a need to further develop a '365-days bicycle'.

Acknowledgments

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Authors

Bram Rotthier graduated in 2012 as master in energy engineering at the University College KAHO Sint-Lieven. Afterwards he directly joined the E&A research group of KU Leuven, where he started as researcher in a project about home charging of EVs. Currently he is working on the Interreg project SEEV4-City and preparing a PhD in light electric mobility.

Guylian Stevens graduated in 2016 at KU Leuven as master in energy engineering. After joining the research group E&A he worked for a project on electromobility and light electric vehicles. At the moment he is working on the Tetra-project ULiVE, focused on the development of an universal e-bike charger.

Bart Huyck obtained a PhD-degree in electrical engineering from KU Leuven in 2013. Since then he's postdoctoral researcher in the KU Leuven research group E&A (Energy and Automation). His research interests are control engineering and reliability of energy systems applied in photovoltaic systems and light mobility.

Emilia Motoasca obtained a PhD-degree in electrical engineering from Delft University of Technology in 2003. In 2015 she joined the KU Leuven research group E&A (Energy and Automation) as assistant professor with research interests in design of energy systems and electric motors and drives applied to robotics, e-mobility, assistive devices, industrial processes, energy harvesting, etc.

Jan Cappelle (°1976) is professor at KU Leuven in the faculty of engineering technology in Ghent, Belgium. He is leading the E&A research group specialized in stand-alone power systems and light electric mobility. He initiated several national and international projects about electric mobility. He built test facilities for electric bicycles and has expertise in the performance analysis of electric two-wheelers.