Speed pedelecs and e-bikes - opportunities for long distance regular commuting by bicycle

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Abstract

This project - undertaken by Bicycle Innovation Lab, Grundejerforeningen Ørestad Universitetskvarter, Gate21, Norda and DR - explores the potential of electric bicycles with focus on the speed pedelec. The research study is based on the experience of 24 employees from 2 different workplaces who tested both types of electric bicycles over a 3 week period. Quantitative and qualitative data were collected through questionnaires and feedback sessions. Our findings show the speed pedelec to be the preferred and ideal form of transport with great potential for commuting middle to long distances, in comparison to all other possible modes of transport including cars, regular e-bikes and public transport. Speed pedelecs were found to be fast enough unlike with the regular e-bike for these longer commutes. On average, commute time was significantly lower by speed pedelec. The most important advantage participants identified with commuting by electric bicycle was the sense of freedom experienced. In relation to safety when commuting by speed pedelec, participants felt in control, alert and overall safe. Feedback for improving safety, that this report recommends, includes widening bike paths and adding a designated section for faster bike path users. The biggest limiting factor to participants owning their own speed pedelec was the high purchase price. Suggested subsidies and promotional campaigns would bring about greater access to speed pedelecs.

Project background and participating organisations

This research project evolved from Grundejerforeningen Ørestad Universitetskvarter (GØU) and Grundejerforeningssekretariatet Ørestad (GFS Ørestad) contacting Bicycle Innovation Lab and Moving People. Their initial aim was to set-up an ambitious initiative to solve car related problems, especially with traffic congestion and the need for car parking space, within the Ørestad region. The plan was to encourage more people to cycle to work with electric bicycles by providing e-bikes to employees at 2 local organisations. If successful this would be scaled to other businesses and organisations in Ørestad.

Bicycle Innovation Lab and Moving People have organised, and been involved with, similar projects in the past and had just completed one at Furesø Kommune. The feedback given by some participants from these projects was that regular e-bikes were too slow for longer daily commuting distances of over 25 km. Speed pedelecs are also a new and relatively unexplored mode of transport. So there was great interest in setting up a trial to test the potential of speed pedelecs. GØU and GFS Ørestad along with DR and Nordea, also agreed to join and host the research project into speed pedelecs with Bicycle Innovation Lab and Moving People.

GØU and GFS Ørestad contributed half of the funding and support with project management, while Gate 21/Moving People sponsored the project with the other half, from their innovative and behavioural change fund. Nordea and DR provided the participants and contributed with project coordination, including communication with participants, as well as hosting feedback sessions and the trial itself, in their workplaces.

This report was written by Joe Storm (Bicycle Innovation Lab) who also designed the overall research plan and administered the practical work of the project. There were significant contributions from Mira Cordsen (GFS Ørestad) - with project management support, coordination between participating organisations, and

facilitation of both feedback sessions. Helle Dahl (Nordea) and Birgitte Kehler Holst (DR) were responsible for coordinating parts of the project at their workplaces and also, afterwards, gave a presentation of the project at the 'Moving People - towards sustainable societies' conference. Special thanks to [other contributors]: Anna Thormann (Moving People), Lene Hartmann (Bicycle Innovation Lab), Andrew Maddock (Bicycle Innovation Lab), David Clark (Bicycle Innovation Lab), Kathrine Storm

Background on participating organisations:

Bicycle Innovation Lab

Bicycle Innovation Lab is an association exploring the great potential of bicycles, and advocates the bike as a viable alternative to the car. Through a variety of activities and collaborations, both locally and internationally, Bicycle Innovation Lab is a catalyst for more involvement and growth in bicycle culture. They operate a bicycle library consisting of cargo bikes, folding bikes and electric bicycles (including speed pedelecs) - for testing - and also sell bicycles from over 30 bicycle suppliers.

Moving People

Moving People aims to make it easy for employees to commute back and forth to work in a smart, effect and greener way through cycling and easier access to a variety of public transport. Moving People was formed by Region Hovedstaden, 17 municipalities, Movia Danmarks Tekniske Universitet and Gate 21. Together with these partners, Moving People aims to create the greatest possible mobility for citizens with the least possible CO2 through municipal planning of mobility and in collaboration with up to 100 large businesses .

Grundejerforeningen Ørestad Universitetskvarter and Grundejerforeningssekretariatet Ørestad

Ørestad Nord is the oldest quarter in Ørestad, where amongst other organisations, DR Byen, The University of Copenhagen - Amager, and Tietgenkollegiet student housing are all situated. The surrounding common area is owned and run by the land owners' association Ørestad Universiterskvarter. In addition to maintenance and supervision, the landowners' association is responsible for the continued development of the area. The landowners association is serviced by the joint secretariat, GFS Ørestad, which manages the day-to-day operations, project management and communication in Ørestad Nord. GFS Ørestad represents Ørestad's landowner associations in all official respects to eg. authorities and collaboration partners.

Ørestad Nord er Ørestads ældste bydel, hvor blandt andet Tietgenkollegiet, DR Byen og Københavns Universitet Amager ligger. Områdets fællesarealer ejes og drives af grundejerforeningen Ørestad Universitetskvarter. Det gælder parker, stiforløb, enkelte vejforløb, træer, bede, boldbaner og byrumsinventaret generelt. Udover vedligehold og tilsynsførelse har grundejerforeningen ansvar for den fortsatte udvikling af området. Grundejerforeningen serviceres af det fælles sekretariat, GFS Ørestad, som administrerer den daglige drift, projektledelse og kommunikation i Ørestad Nord. GFS Ørestad repræsenterer Ørestads grundejerforeninger i alle officielle henseener overfor f.eks. myndigheder og samarbejdspartnere.

DR

Denmark's Radio is a public broadcasting organisation providing challenging and informative content on tv, radio and online. DR aims to create Danish culture and journalism in ways that can bring together collective experiences and provide material for reflection and good conversations.

Nordea

Nordea Bank operates in 20 countries in northern europe with 1400 branches. As the only Nordic bank, Nordea, together with the UN and 27 other banks from around the world, have launched principles for sustainable banking. The principles must ensure that the banking sector contributes to the UN's Sustainability Goals and the Paris Climate Agreement.

Introduction

In a time of climate emergency, traffic congestion and poor health - there is a great need to change the way we commute. More people are realising that e-bikes offer an ideal commuter mode of transport. In 2019 more electric bicycles were sold in Netherlands[1] than normal bikes. In Denmark, electric bikes are slowly becoming more popular.

The two types of pedelec mid-drive electric bicycles referred to in this report are the 's-pedelec' (speed pedelecs) and 'e-bike'. S-pedelecs provide pedal assistance upto 45 km/hr. For e-bikes, pedal assistance reaches upto 25km/h. 'Electric bicycles' refer to both 's-pedelecs' and 'e-bikes'.

The objective of this research project is to test the potential of electric bicycles, specifically s-pedelecs, for commuting longer distances, to and from work. This also, necessarily, includes a comparisons to the regularly used forms of transport (mainly cars and public transport) used by participants selected in this project. An objective of the report is to provide useful information for anyone looking to promote and advance commuting by electric bicycles on different scales locally and internationally.

S-pedelecs are currently in a trial period, in Denmark since July 2018, allowing them to be used on bicycle paths with a helmet and limited liability insurance. Our research offers a unique study of the commuter experience of cycling by s-pedelec, giving valuable insights and feedback to the s-pedelec pilot scheme and the policy makers assessing the value of s-pedelecs.

In relation to the discussion on safety, it is worth establishing a general understanding of how these pedal assist electric bicycles operate. The mid-drive motor provides varying degrees of assistance only when the cyclist pedals. This depends, predominantly, on which (out of usually 4) 'assistance levels' the cyclist has selected, as well as the amount of physical activity or force applied to the pedals by the cyclist. Even at the highest assist level, the cyclist must pedal with a considerable amount of force and energy to reach the maximum assist cut-off point. The cyclist can also limit their top speed by selecting a lower level of

[1] https://www.theguardian.com/world/2019/mar/01/bike-country-n0-1-dutch-electric-record-numbers-e-bikes-netherlands

assistance and monitoring their speed shown on the display. Cycling faster on low levels of assistance is similar to cycling a normal bicycle without motor assistance especially over speeds of 25 km/hr. It is worth noting that, even when in the maximum assistance level, it is physically demanding on a s-pedelec to exceed 35 km/hr for a sustained period. Much more so than exceeding 15 km or even 20 km/hr on a regular e-bike.

With mid-drive motors, pedaling feels natural and very similar to cycling an normal bicycle. A way to picture the 'natural' riding experience of 'pedal assistance' cycling with these types of electric bikes would be to imagine, fast road/racer cyclists. These, commonly seen, cyclists routinely cycle long distances, on very light road bikes, out of town so that their bodies are 'well prepared' and can with 'relatively minimal effort' cycle average speeds of between 30 km/h and 40 km/hr.

Method and Procedures

The trial consisted of 12 mid-drive electric bicycles - 6 s-pedelecs and 6 e-bikes - which were tested over a three week period at each workplace. Participants swapped electric bicycle types midway into the three weeks. Each type of electric bike was tested over a 10 day period at each workplace.

At Nordea in June 2019, 12 participants were selected from over 70 candidates. Candidates signed up through an intranet post and survey, which was ended within 24 hrs due to the high demand. Employees were offered free participation in the project. Afterwards at DR in August 2019, 12 participants were selected from 24 candidates who also signed up through an intranet post with survey. Employees also needed to agree to pay 700 kr. to be eligible for selection.

Participants also agreed to commute regularly to work with the electric bikes. They were also required to provide their average commute time, respond to 2 questionnaires (one midway and the other at the end), and participate in a feedback session at the end of the test period.

The selection process prioritised candidates whose primary commute to work was by car or public transport with a longer commute distance of at least 30 km per day (15 km each way) but not more 70 km (35 km each way). Candidates with commute routes that avoided the city center and were better suited to faster cycling were also prioritised. An equal number of men and women were selected at each workplace.

The average commute distance in one day (distance to and from work) for participants selected from Nordea was 38 km and 28 km at DR. The daily average commute distance for all participants was 33 km (16,5 km each way). At Nordea the longest commuting route by a single participant was 58 km (29 km each way) and the shortest commute route was 24 km (12 km each way). At DR the longest commute route was 52 km (26 km each way) and the shortest commute route was 18 km (9 km each way).

The questionnaires at Nordea were in English. For the DR trial, these questionnaires were translated to Danish and some questions were updated to avoid confusion or irrelevance. For example, instead of asking for the combined commute distance in 1 day, participants in the DR questionnaire were asked two separate questions for the distance to work and another for the distance from work.

Participants were not asked to record or provide their exact commute distance or times each day. They instead provided an estimate commute distance and time for each transport type used to avoid extra unnecessary work for the participants. Several calculations were made from the data to find out

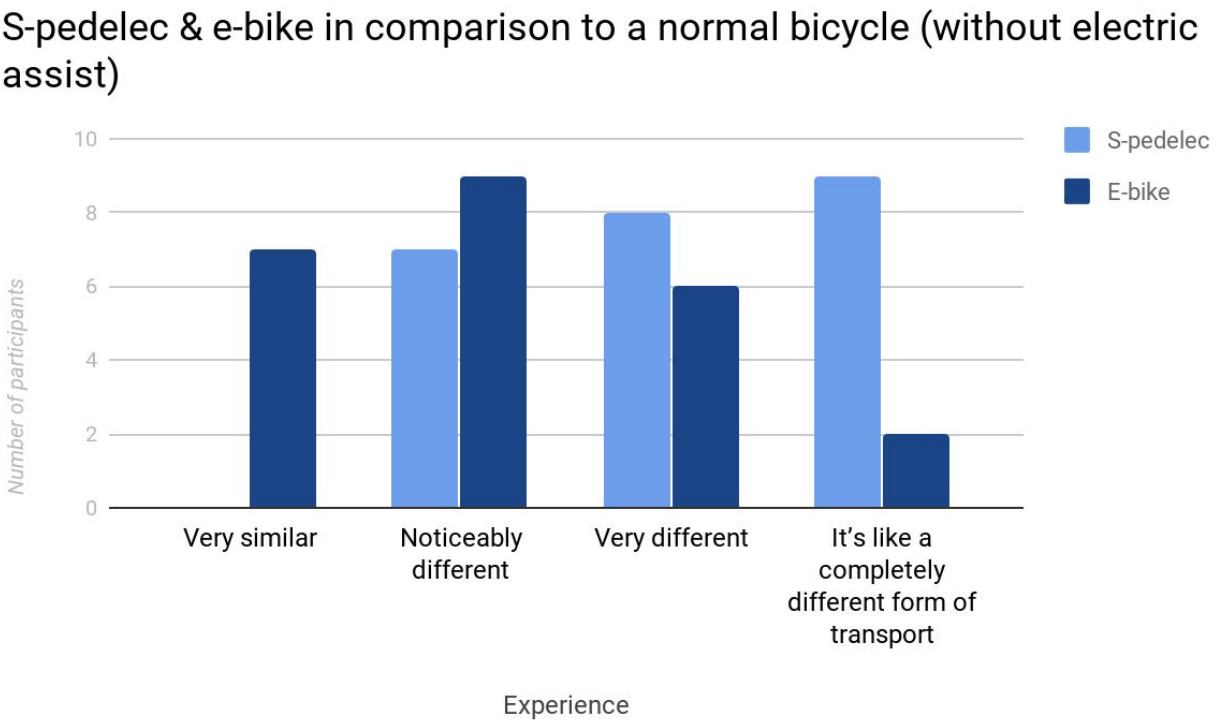
information not directly provided by participants, e.g, total distance travelled with each type of electric bike where commute distance, total number of days commuted, and additional km from partial journeys were provided.

The feedback sessions gathered additional details and clarifications about the participants experience of the different types of electric bikes, their commute, safety and behaviour change. A section dedicated to safety was included (as well as in the questionnaire) so that this area of the project could be explored in more detail. The participants provided significant qualitative feedback formally in these sessions. And less formally through conversations, email and an intranet group where they shared photos and communicated on areas related to the trial.

The collected data has been represented for clear, relevant or legitimate results and comparisons. There were several arbitrary reasons participants did not cycle every day so there was no value in comparing the total distance commuted with each type of electric bike. The data from Nordea and DR has been combined to show results from all 24 participants. Some significant differences between the two groups of participants from each workplace, have also been occasionally represented in the results and evaluation section. For the bar graph showing Participant concern in relation to the disadvantages of owning and commuting long distance by electric bike, the scale definition and data were inverted for clearer visualisation so the longer the bar the more concern it represents.

Results

The electric bicycles compared to a normal bicycle



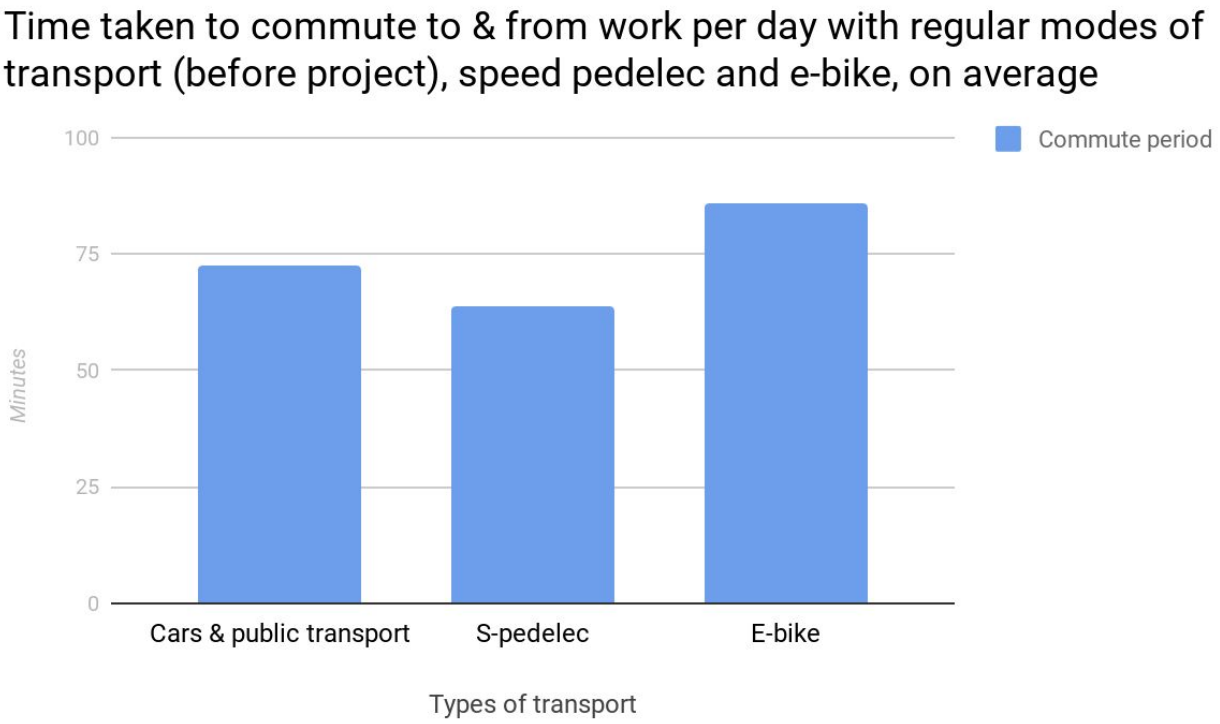
There were 7 participants who experienced the regular e-bike as being very similar to a normal bicycle but none experienced this with the speed-pedelec. However, 9 participants experienced the speed-pedelec as a completely different form of transport in comparison to a normal bicycle whereas only 2 experienced this with the e-bikes.

In relation to commuting after the project, 20 participants thought they would commute more by bicycle than they did before the project compared to only 4 who thought they would not commute more often than previously by bike.

Total commute distance

The 24 participants cycled 8146 km in total with both types of electric bikes over the test period of 6 weeks.

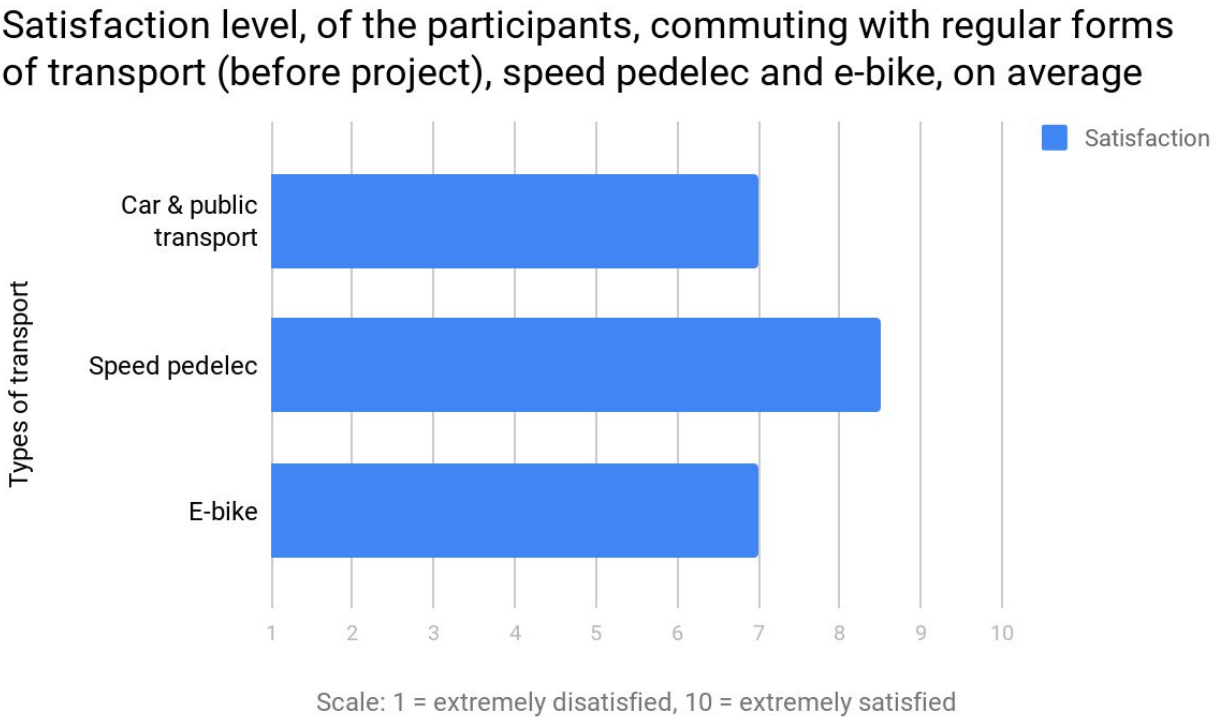
Daily commute time



On average, the commute by speed-pedelec saved participants using this mode of transport 22 minutes per day compared to their commute by e-bike and saved 9 minutes per day in comparison to their regular modes of transport. Regular e-bikes, on average, took 13 minutes more than the participants usual form of transport.

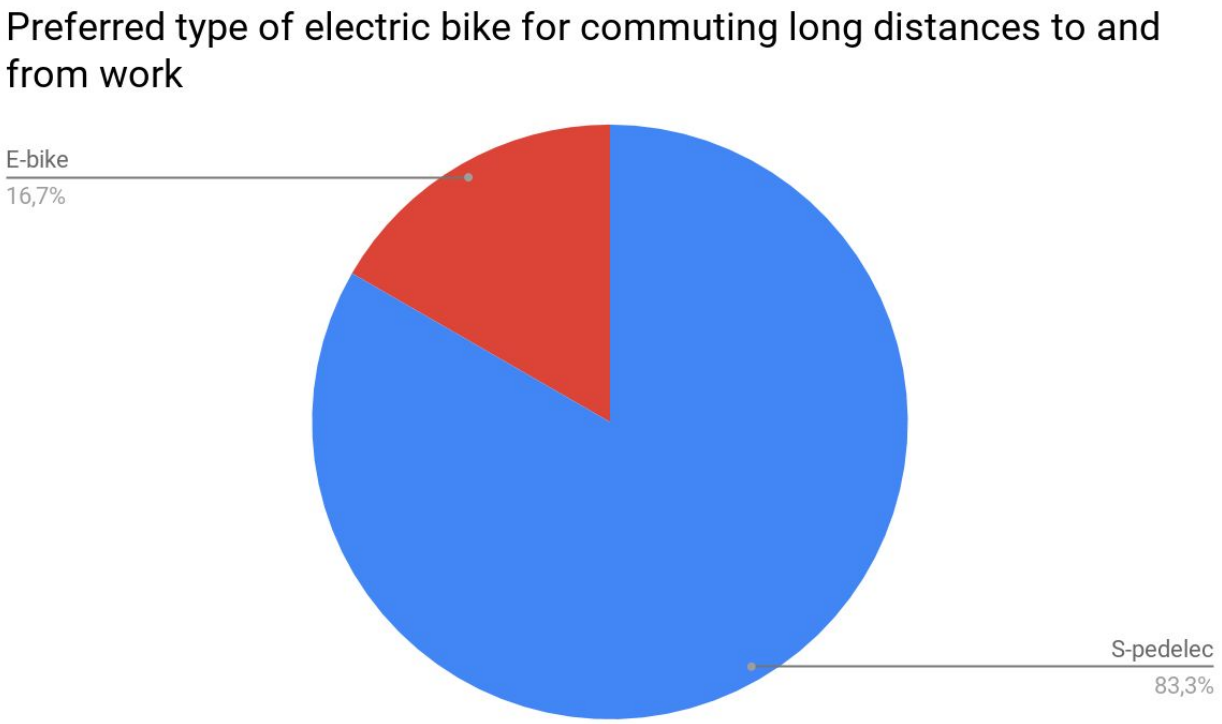
An average saving of 9 minutes by s-pedelec compared to commuting with regular forms of transport, accumulated over a longer period is a significant saving of time. For example, 200 days of daily commuting by s-pedelec would reduce the average commute time compared with regular forms of transport by approximately 30 hours. However, commuting by e-bike for 200 days, in this case, would take up an extra 43 hours, and add an extra 73 hours compared to s-pedelecs.

Commuter satisfaction



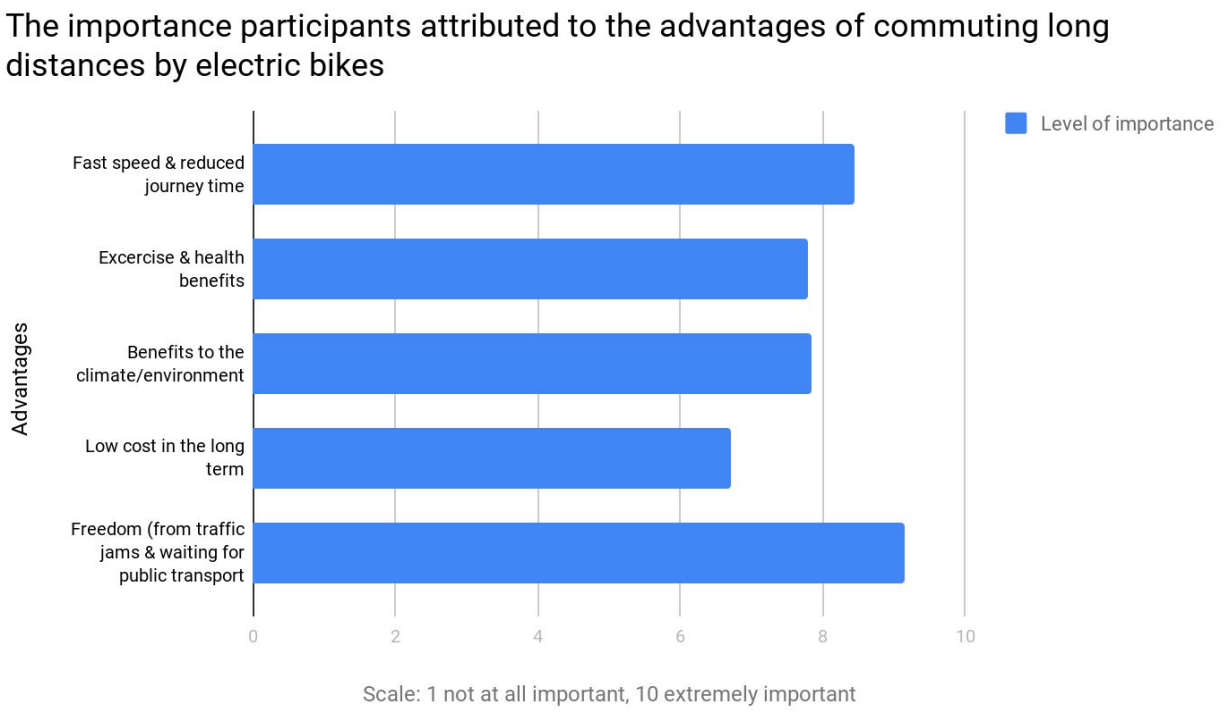
Participants were most satisfied with their commute by s-pedelec rating it 8.5 out of 10 as opposed to 7 for both regular e-bikes and their usual forms of transport. The majority of participants, before the trial, commuted by car. The rest took public transport (train, bus, metro) or a mix of public transport, car and bicycle. There were 4 participants, from DR, who often commuted 25 km or less per day by bicycle (including one by e-bike) before the project. None of the participants from Nordea commuted to work by bicycle.

S-pedelec or e-bike



There were 20 participants (83,3%) who preferred the speed-pedelecs compared to only 4 (16,7%) who preferred the regular e-bikes.

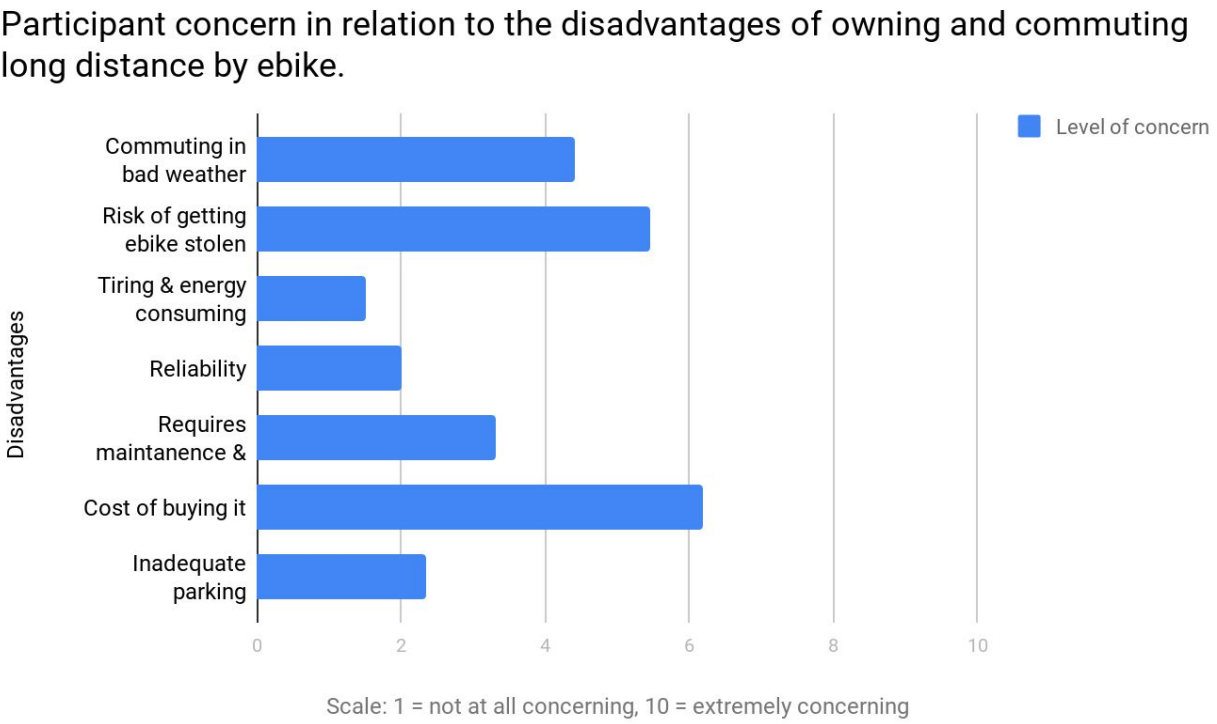
The advantages of electric bicycles



The most important advantage, on average, of commuting by electric bike for the participants was gaining freedom from traffic jams and not having to wait for public transport - this was rated 9,2 out of 10 on a scale of importance with 10 being extremely important. The next most important advantage was the fast speed and reduced journey time - rated at 8,5.

Benefits to the climate/environment were also identified by participants as a very important advantage (7,9) as were the exercise and health benefits (7.8) from commuting by electric bike. Participants at DR valued benefits to the climate/environment (9) as their second most important advantage. Whereas participants from Nordea valued it as their least important advantage (6,7). All advantages were identified as significantly important - above 6,5 out of 10.

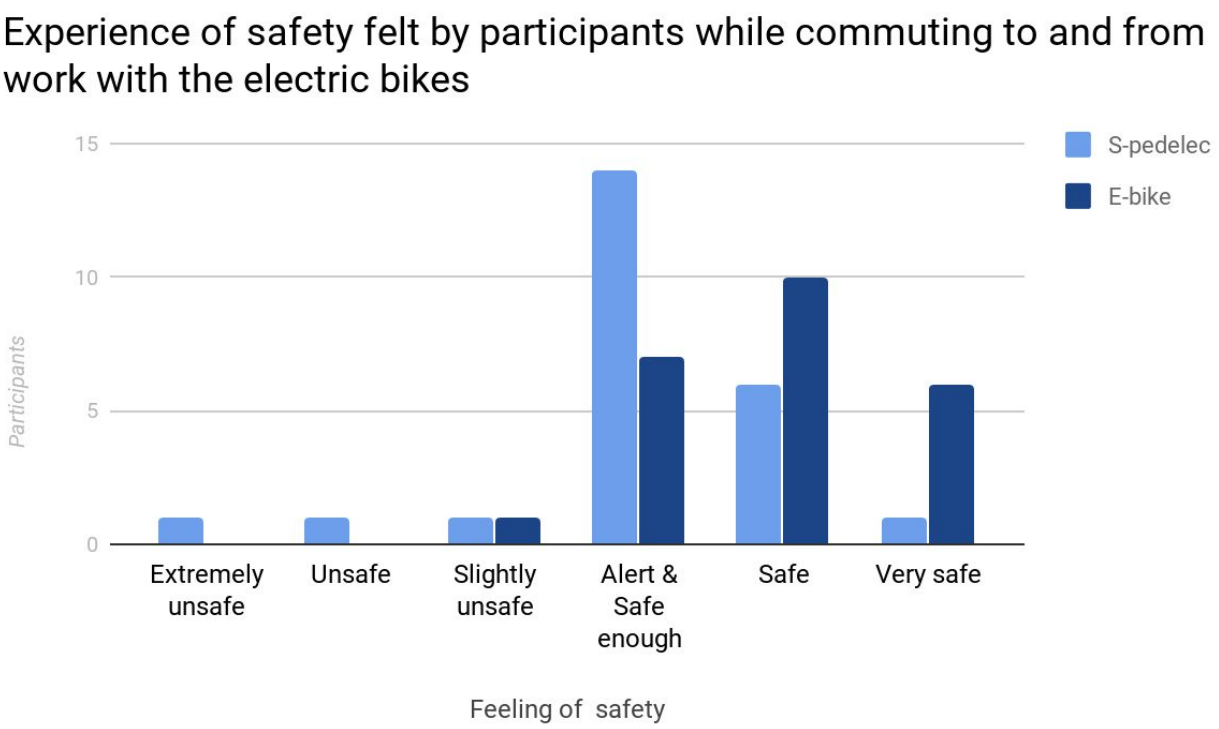
The disadvantages of electric bicycles



The biggest concern, on average, for participants commuting regularly by electric bicycle and owning one themselves was the high initial cost of purchasing one (rating it 6,2 on a scale of 1 to 10 - with 10 being extremely concerning). Their second biggest concern was the risk that it could get stolen (5,5). Participants were slightly concerned with commuting in bad weather (4.4). And even less concerned with the fact that the electric bicycle would require maintenance and repairs (3.3). Or that there was inadequate parking (2.4) for it. Participants were not concerned about reliability (2) when commuting by electric bicycle. They were least of all concerned about it being a tiring and energy consuming (1.5) form of transport.

There was also feedback from 2 participants who decided that the law prohibiting them from attaching a child seat, for transporting their children, is a significant disadvantage stopping them from purchasing a s-pedelec.

Safety



In total there were 21 participants who felt adequately safe when commuting by s-pedelec. Of the 21, 14 of these felt alert & safe enough, 6 felt safe and 1 felt very safe. Commuting by regular e-bike, there were 7 who felt alert & safe, while 10 people felt safe, and 6 felt very safe.

Alert and safe was the most common ¨±¢f zk ¦Ykf¨± felt by the participants during their commute (with both types of electric bikes). In total, 21 identified as feeling alert and safe, 16 felt safe and 7 felt very safe. Altogether these 44 represent types or degrees of feeling safe whereas only 4 commuting experiences with the electric bicycles were identified as unsafe.

The few participants who did register that they felt unsafe (1) and slightly unsafe (2) also identified that they felt more in control and safe as they got more used to the electric bikes during the project. The single participant who felt extremely unsafe, however, did not identify feeling more in control and safe the more he got used to the s-pedelec.

None of the participants experienced collisions or accidents with other road users. There was one participant commuting with the regular e-bike who mistakenly cycled into a curb.

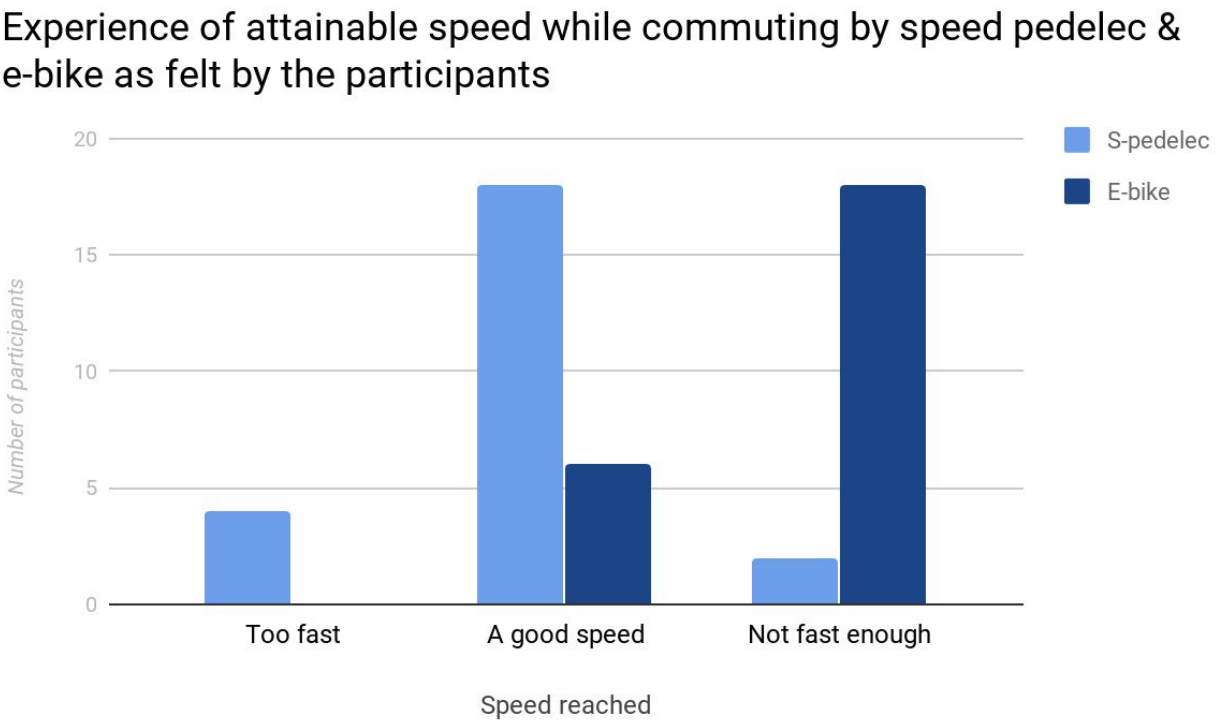
Participants provided decisive feedback on s-pedelecs in relation to safety. One commented that “the top speed of 30 - 45 km/hr definitely cannot be used in the city because there are too many other cyclists”. Another stated that “as long as you are extra aware, then they are safe, but that goes for both types [of electric bikes]”. Some participants identified that commuting by speed-pedelec “requires a lot more awareness of other road users compared with a normal bicycle”. Similarly, one participant “experienced that the s-pedelec is definitely too fast or a form of transport requiring that all road users become familiar with them [s-pedelecs]. It is difficult for others to judge the distance [if you are cycling fast] and they get surprised when you overtake them.” There was broad agreement on the value of being able to reach upto

“45 km/hr [which] is pretty fast on a bike, but also the speed you need to be a real alternative to a car”. A few participants reported that a small number of other cyclists were annoyed with people cycling fast with electric bicycles. One of these cyclists even accused a participant of having tampered or ‘tuned’ their electric bicycle to go faster. A few cyclists were also irritated by the electric horns on s-pedelecs which some participants attributed to its loud artificial sound that is not familiar or associated to cyclists.

There was one participant who reported feeling extremely unsafe commuting by speed-pedelec and experienced that it was also too fast. He “really liked the speed-pedelec but also felt it was relatively unsafe cycling +40 km/hr in the city...[and that the regular e-bike] was pleasant to cycle but with this bike, I [he] experienced that 25km/hr is too slow. So an electric bicycle with 35km/hr would be perfect”.

The most support shown for ideas to increase safety, was for the suggestion to widen bicycle paths and add a section allocated only to fast cyclists and those commuting by electric bicycle. As well as identifying the need to further develop bicycle infrastructure, participants were also in favour of information campaigns to improve awareness for different types of bike path users. There was also a suggestion to add a normal bell for use in the city. Another participant recommended that a helmet partially covering the face or a Hövding be mandatory when commuting by s-pedelec.

Speed



There were 18 participants who felt that they could reach an optimal speed commuting by speed-pedelec compared to just 6 participants who felt the same with e-bikes.

There were 18 participants who felt that the regular e-bike was not fast enough whereas only 2 participants felt the same with speed-pedelecs .

There were 4 participants, from DR, who thought the speed-pedelec was too fast with none identifying this with the e-bike, or from Nordea.

After the project

The main reasons for participants joining the trial and testing the electric bikes was to find out if they could be used for commuting to work and if it was worth investing in one for themselves. Of the 24 participants 17 thought they would go on to buy their own electric bicycle within the next year.

Already at the end of the project, 2 participants have purchased their own electric bicycle (1 s-pedelec and 1 e-bike). Another 5 participants have requested, by email, more details for purchasing electric bikes.

Discussion & evaluation of results

Electric bicycles are very similar to normal bicycles in many ways, however the vast majority of participants - 17 out of 24 - experienced that s-pedelecs, in particular, were very different or even a completely different form of transport. None felt that this type of electric bicycle (the s-pedelec) was very similar at all to a normal bicycle. The regular e-bike, though, was experienced by 7 participants as being very similar. Nearly half of all participants (9) experienced the e-bike as noticeably different to a normal bicycle. However, the same number of participants (9) found the speed-pedelec to be a completely different form of transport - while just 2 identified the e-bike in this way.

In the final questionnaire, after trying both types of electric bicycles, 20 participants thought they would commute more often to work by bike (using their regular bicycles). Where they had been able to easily and naturally achieve this throughout the project using electric bicycles, it was reasonable to expect the same commute could be done with a regular bike. From the first feedback session held at Nordea almost a week after returning the electric bikes, it became clear that this was an unrealistic expectation. Some motivated participants did try to commute to and from work, as well as cycle other long distances, with their normal bicycles. They soon realised this was extremely difficult to do on a normal bicycle and could not be done regularly. Or as one participant put it: “afterwards, I tried my own one - it’s never going to happen again!”. This participant’s daily commute to Nordea from Albertslund was approximately 30 km (15 km each way). She joined the project in order to challenge herself to cycle to & from work and found the s-pedelec “very interesting” because it was quick, worked for her, she was not sweaty when she got to work and “really enjoyed it”[2].

Participants were able to cycle considerably long distances and were much more physically active due to commuting with the electric bicycles over the 3 week period. They cycled long distances regularly to and from work instead of commuting by car or public transport. For example, the participant referred to in the previous paragraph was able to, with the electric bicycle, cycle 300 km in total instead of commuting by train. While another participant, whose average daily commute was 50 km, cycled a total of 600 km with the electric bicycle instead of taking his car. Collectively, the 24 participants cycled more than 8000 km in 3 weeks.

[2] Feedback session held at Nordea on 27th June 2019. Audio recording, reference from 16 mins 06 secs.

Electric bicycles offer great potential for exercise despite widely held beliefs. In general, the electric bicycle is often perceived as being best suited for elderly people who *xffd f°¨¥Y Y¦¦ñ¦¨Yxbf* because they are unable or too weak to cycle normal bicycles. Similarly, another common misunderstanding is that cycling with an electric bicycle is cheating and offers very little, if any, health benefits. However, extensive research from one recent study, examining the "Physical activity of electric bicycle users compared to conventional bicycle users and non-cyclists" from 7 European cities, shows significant health and mobility advantages. They found that "e-bike use leads to substantial increases in physical activity in ebikers switching from private motorized vehicles and public transport" because they cycle much longer distances and more often[3] .

Almost all of the participants - 20 out of 24 - preferred the s-pedelec to the regular e-bike. They were also most satisfied with their commute by s-pedelec. This very high satisfaction level for commuting by s-pedelec was significantly higher compared to their commute by e-bike and even in comparison with their commute by regular transport, on average. They were able to save considerable time with their commute by speed-pedelec compared to commuting by e-bike or with their usual forms of transport, on average. The participants' usual modes of transport (mainly car, train, bus, and metro) for commuting to work was restricted by traffic congestion, accessing and waiting for public transport. Avoiding these restrictions as well as commuting with a sense of freedom and autonomy was the *wz¦¨ñw¢z¥¨Yx¨* advantage they experienced commuting with the electric bicycles. This was even more important than, although still related to, their reduced journey time. With the s-pedelecs, the large majority of participants felt they could reach a good speed when commuting their long distance to and from work unlike with the e-bike.

Overall the feedback received for the commute by s-pedelec was very positive and often enthusiastic - especially concerning important factors like journey time, speed and the sense of freedom & satisfaction they experienced. These are significant indicators which suggest that commuting medium to long distances regularly to and from work by s-pedelec could very likely be sustained in the long term and would be the preferred or ideal form of transport for many commuting in similar circumstances.

There were temporary aspects of the project that may have affected participant satisfaction commuting with the electric bicycles. Encountering new forms of transport and the novelty or excitement of participating in the project itself could have increased satisfaction. There was, however, some feedback to suggest that control and satisfaction increases the more participants got used to cycling with the electric bikes. Commuting in winter or bad weather by electric bike was, a concern for participants and, something they did not directly experience as the project took place in warm summer months. Avoiding the very worst weather, by using other forms of transport, and embracing it with appropriate protective clothing, could most probably limit a significant drop in the overall satisfaction level of commuting by electric bicycle. Especially for those commuting by s-pedelec where there are a range of significant advantages that should offset this concern overall.

The large majority of participants who commuted with the regular e-bike (which they often referred to as the slow bike/version), experienced that it was not fast enough. This was shown, quantitatively in the questionnaire, where 18 participants identified that it was not fast enough. It was also reflected in the

[3] Alberto Castro et al., 2019. Physical activity of electric bicycle users compared to conventional bicycle users and non-cyclists: Insights based on health and transport data from an online survey in seven European cities. (Transportation Research: Interdisciplinary Perspectives). pg 3. https://www.sciencedirect.com/science/article/pii/S259019821930017X

general qualitative feedback for the regular e-bike by participants in the questionnaire comments section, feedback sessions and informal discussions. The assist limit frustrated them when cycling and made their commute time too long. One participant, for example, commented that “the 25 km/h bike is too slow and doesn't give much added value compared to a light race bike, but the 45 km/h was the real deal - and an interesting alternative to my car”. Another stating that “the 'slow' version was too slow/annoying to cycle for my daily commute”. There were a few participants with longer commute distances who reported that the maximum speed assist limit of 25 km/hr and the longer commute time experienced with the regular e-bike stopped them from commuting as often as they could have - and had agreed to at the start of the project.

The high price of electric bicycles and the risk of getting them stolen were the most concerning disadvantage for participants when considering owning one themselves and commuting regularly to work. Speed pedelecs, with very high quality parts and extra accessories, can easily cost anywhere from around 30.000 kr. (4000 euros) upwards while a good quality mid-drive e-bike costs in access of around 15.000 kr. (2000 euros). They can easily be stolen if not locked securely in safe parking areas. This report recommends subsidies and other campaigns to reduce the price of s-pedelecs so as to increase the accessibility to them. Access to secure parking and locking expensive electric bicycles to fixed points would also likely contribute to an increase in the number of electric bicycle owners.

Concern for safety has become a ¨z¢mbYv Yxd ®f¥±vfIn¨nwY¨f kzb©¦ when discussing or examining electric bicycles, especially s-pedelecs. The same could be said for climate/sustainability solutions and commuter mobility when evaluating the potential of s-pedelecs for long distance commuting. Employees from DR who participated in the project exhibited more awareness of these ‘narratives’ compared to participants from Nordea who were more focussed on direct advantages and their immediate experiences with the electric bicycles. DR participants are, most likely, through their type of work more exposed to and engaged in these ¨z¢mb¦. They therefore, on average, highly valued the abstract and indirect advantages that the s-pedelec provided them in relation to sustainability and responding to the climate emergency. This advantage, on average for DR participants, was the second most important advantage of commuting long distances by electric bicycle. It outweighed most other benefits, including direct noticeable advantages like reduced journey time. This makes perfect sense considering the science, threat and urgency connected to the ‘climate narrative’. However the idea that s-pedelecs are unsafe or dangerous is not so clear cut and in fact did not hold up with experience of participants from both Nordea and DR who commuted regularly with them.

There was one participant from DR who reiterated the potential dangers on several occasions including in the questionnaires and feedback sessions. This single participant often pointed out the problems that can arise from excessive speed. Yet also claimed himself to have commuted over 40 km/hr in the city centre and felt extremely unsafe. Either this participant unlike others was going too fast in the city centre and therefore felt extremely unsafe or - for someone so aware of the dangers associated with speeding, it was unlikely he would have put himself in such an unsafe position. Instead, he provided feedback from the hypothetical perspective of someone dangerously speeding and misusing the s-pedelec to warn others of the dangers of ¨mn¦. The same participant also experienced that the regular e-bike was too slow and proposed that the ideal electric bike would have a maximum assist speed of 35 km/hr - in other words a s-pedelec in a lower selected level of assistance or a higher maximum assist speed on a regular e-bike (as in some other counties eg. USA).

Speed pedelec bicycles are designed for safe faster cycling with high quality parts and extra accessories and are considerably safer than most other bicycles cycled at similar speeds. They are significantly safer

compared to road bicycles which often do not have disc brakes, have much thinner smooth tires with poor grip and very low narrow handlebars.

The vast majority of participants felt alert and safe, safe or very safe when commuting by electric bicycle. All these types and degrees of safety also indicate that they were in control and aware of the risks involved with commuting by electric bike. Participants were asked to identify the feeling they experienced in relation to safety when commuting with these electric bikes (from the given options: extremely unsafe, unsafe, slightly unsafe, alert & safe, and lastly very safe). It should not be interpreted, necessarily, that there was a prescribed clear hierarchy of safety. Feeling alert and safe was the most identified type of safety experienced and was felt most with the s-pedelec. Alert and safe was positioned in the middle of the range of options participants could select from for this question on safety. Considering the level of agency, potential speed and concentration needed for commuting over long distances and for long periods of times, the safest and least complacent feeling / experience is best represented or described as alert and safe even more so than very safe. This is not to imply that participants who identified their commute as very safe were not cautious enough or even complacent. Alertness and cautiousness are important conditions contributing to feeling very safe, in this case.

On the whole, participants assessed the safety of s-pedelecs based on their experience commuting with them. Their main focus related to commuting at speed with other regular cyclists, and restrictive factors that limited the use of s-pedelecs. They identified large sections of their route that limited them from exceeding 30 km/hr - this mainly included most areas in the city. The feedback and discussions around safety were very constructive. Participants tried to identify real areas of potential danger and provide sensible solutions for safer integration of kY¦¨f¥ amuf ¢Y¨m ©¦f¥¦. This applies to all faster bike path users including exercise cyclists or road bike cyclists and moped drivers who to a much larger extent, currently, often use bike paths at speeds in excess of 25 km/hr. Most bicycle paths were not designed with faster road users in mind. For example, regular slower cyclists can cycle side-by-side taking up the full width of the bike path, or cars can park alongside bike paths and can unexpectedly obstruct bike path users when the drivers exit or accesses their parked cars.

Significant suggestions for improving safety were proposed by participants. This included widening bicycle paths and adding a clearly marked section for fast moving bike path users - who could also be clearly identified by high visibility vests or clothing. Information campaigns would also likely help with some of the identified problems. Both aimed at alerting faster bike path users to the potential risks but also introducing these faster bike path users to regular cyclists. This report recommends that s-pedelec users continue to cycle on the bike paths without requiring number plates or licensing.

Conclusion

Based on the findings in this study, it can be concluded that the s-pedelec has great potential and a range of advantages for regular long distance commuting. It was, on average, the preferred form of transport over the car, public transport and regular ebike but also significantly faster and offered a number of other highly valued advantages. Most importantly, it gave long distance commuters a sense of independence and freedom - especially from traffic congestion and waiting for public transport. Significantly, it also allows commuters to more adequately respond to the climate threat while also exercising and improving health.

Unlike with a regular bicycle, the s-pedelec makes cycling long distances frequently to and from work possible - without feeling exhausted and sweaty. Users of the s-pedelec feel safe and in control when cycling this type of bicycle. This is not surprising given the safety oriented parts, additional accessories and design which provide significant extra safety and control to make it, potentially, one of the safest bicycles available.

There are a number of obstacles restricting the take up of s-pedelecs on a large scale. The high purchase price and risk of theft associated with electric bicycles are the most concerning restrictions stopping more people gaining access and using them. Subsidies to lower the price, campaigns for introducing and testing the s-pedelec as well as more secure parking could likely contribute to more people owning and commuting by s-pedelec. Through discussions on safety, in relation to participant experience commuting by s-pedelec, a number of recommendations have been put forward to improve safety and the integration of faster bike path users. This includes widening bike paths and adding a designated section for faster users. And safety information campaigns providing guidance for commuting with or as faster bike path users. These developments would benefit all bike path users especially the growing number of users, most commonly on road bikes, who often cycle or commute much faster than regular cyclists.