Institute of Transport Economics
Norwegian Centre for Transport Research

Summary

The Climate Effect of E-bikes

Documentation of which factors drive and hinder use of e-bikes in Norway and e-bikes' contribution to reduction of greenhouse gas emissions in Norwegian municipalities

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Increased use of e-bikes (pedelecs) may contribute to the attainment of important targets in transport, climate and health policy. This study investigates what promotes and hinders the use of e-bikes in Norway, in addition to the effect of e-bike use on the reduction of greenhouse gas (GHG) emissions. The results show that important promoting factors are: economic parameters (e.g. price), smart transport planning, climate- and environmental motivations, time savings and practicality, and health motivations. Important barriers to increased use are: insufficient planning and infrastructure for biking, the weather, economic barriers, conflict situations between different road users, and insecurity and lack of knowledge. The study provides an economic analysis of two support measures for buying private e-bikes, and finds that they have contributed to reduction of GHG emissions from daily transport. Results show that whilst one support measure yielded larger reductions, the other measure yielded better economic results for society. Since we lack good data about the use of e-bikes among municipal employees and lenders of e-bikes, it is hard to calculate the climate effect of use of e-bikes among these groups. The most important positive climate effect of municipal investments in e-bikes (both directly for their employees as well as contributing to loaning facilities) seems to be that those who try an e-bike may subsequently buy an e-bike privately. These private e-bikes have a net positive effect on the reduction of GHG emissions because they substitute private car use to a substantial extent. What is the most important climate effect may, however, change over time.

Background

The transport sector in Norway emits around 30% of the total net greenhouse gas (GHG) emissions in Norway (Miljødirektoratet, 2018b). In order for the domestic target of a 40% reduction of GHG emissions by 2030 to be attained, GHG emissions in all sectors must be reduced, and particularly in the transport sector. Since Norwegian municipalities employ a large number of persons and are major procurers of various goods and services, they have an important role in achieving targets to reduce national GHG emissions, as well as being role models.

Many strategies may be implemented to reduce the GHG emissions in the transport sector, including to encourage citizens to bike and walk more instead of using polluting means of transport like a personal car. There seems to be a large improvement potential in the Norwegian population for increasing this behavior. For example, 59% of all travels between 1 and 2,9 kilometers are made by car, and 69% of all travels between 3 and 4,9 kilometers are made by car according to the last published national survey about Norwegians travelling habits (Hjorthol, Uteng, & Engebretsen, 2014, side II og 27).

Increased use of biking and walking will also contribute to attainment of the target of reducing physical inactivity by 10% by 2025, which is pertinent in a time where around seven out of ten Norwegians have a weight that is classified in the categories "overweight" and "obesity." At the same time, increased use of biking and walking will contribute to lower local pollution and

nicer city environments. By opting for these strategies, municipalities may reduce their carbon foot print and also contribute to employees and others getting in better physical shape and lower rates of sick leave absences.

Electric bikes, also called e-bikes and pedelecs, which are classified as Electric Pedal Assisted Cycle (EPAC), are bikes with an electric motor that makes it less strenuous to bike when the biker has the motor assistance turned on, and where this motor will no longer provide assistance in speeds over 25 kilometers per hour. An electric cargo bike (e-cargo bike) is an e-bike that have facilities for carrying goods and/or people in the front and/or in the rear of the e-bike. E-cargo bikes are larger and heavier, and are intended to carry heavier loads than conventional e-bikes. Therefore, they also have stronger batteries.

E-bikes and e-cargo bikes are useful for several types of tasks, including: a) that persons who want to bike, but are afraid of becoming tired and sweaty, can do it without having to have a shower afterwards, b) to transport children and bulk in a convenient way, c) to get faster from A to B, and d) to take biking trips that otherwise would be too long and tiresome, for example in the mountains. People with various physical limitations, for example knee problems, asthma, and arthritis will likely benefit from e-bikes because they may make biking more available for them.

A number of studies about e-bikes with data from Norway have been published the last years. There is, however, several features about this phenomenon that we know little about. The program Klimasats from the Norwegian Environment Agency have supported various projects in a number of municipalities in recent years. We know relatively little about the climate effect of these support measures, or the socioeconomic effects of for example support for acquisition of e-bikes. The present study seeks to fill some of these "gaps" by asking and answering the following research questions:

a) To what extent does the support from Klimasats to e-bikes help the municipalities reduce their own emissions of greenhouse gases?
b) What promotes and what hinders use of e-bikes in Norway in general and in Norwegian municipalities in particular?
c) What is the climate effect of economic support measures to buy e-bikes for citizens, and what is the net socioeconomic effect of these support measures?
d) How large is the sale of e-bikes in Norway today? How many e-bikes is there in Norway today?
e) Which means have been implemented that may support the acquisition and use of e-bikes that have been instigated by the Norwegian Environment Agency and other actors?
f) What are the experiences of municipal employees that use e-bikes during their service, the users of so-called e-bike libraries, businesses that use e-bikes in their daily operation, and persons with e-bikes that are using so-called bike hotels?

To answer the research questions, we have performed various methods to collect several types of data, including the following:

1) 12 semi-structured interviews with representatives from Norwegian municipalities who work with topics related to biking, four semi-structured interviews with representatives from businesses that use e-bikes and two semi-structured interviews with persons who are experts on e-bikes.

2) Two group interviews with employees in Oslo municipality that use e-bikes in their service and users of the e-bike library in Drammen.
3) Six e-mail interviews with users of e-bikes that are using bike hotels.
4) Quantitative data from two before-after studies about use of e-bikes before and after citizens have received support to buy e-bikes for private use.
5) Review of relevant documents, including research literature, the municipalities' climate and energy plans, and online newspaper articles.

The sale of e-bikes has risen rapidly the last years

The sale of e-bikes has risen rapidly the recent years. Our data, which build on data from the Norwegian Electric Vehicle Association (Elbilforeningen) from 2014-2016 and on the import statistics from Statistics Norway, show that in 2014, 13 969 e-bikes were sold in Norway. Subsequently, in 2015, 22 383 e-bikes were sold, and in 2015, 36 337 e-bikes were sold. In 2017, 42 684 e-bikes were registered imported and in 2018, the number of imported e-bikes was 61 185. We do not know exactly how many of these e-bikes that in the meantime have been disposed of, smuggled in or exported. We also do not know how many persons have constructed an e-bike of their conventional bike by adding an electric motor. If we add up these numbers, we may however make a rough estimate of the total number of e-bikes in Norway, and find that it probably totals at least 176 600 e-bikes.

Various strategies that contribute to increased use of e-bikes

The support program Klimasats from the Norwegian Environment Agency, as well as direct actions from municipalities and other actors have contributed to increased use of e-bikes in Norway. These strategies include buying e-bikes for municipal employees, establishment of loaning facilities where private citizens and businesses can borrow e-bikes, building bike hotels, establishing e-bike and e-car pools, buying e-bikes for city e-bike rental facilities, and establishing a leasing facility where people first lease and then may buy the e-bike at an affordable price. In addition, so-called combines strategies have been made where people for example receive support to buy and e-bike, a bike carrier, and a public transport ticket.

The climate effect of the municipalities' push for e-bikes

Use of e-bikes may have both positive direct effects and indirect positive effects in contributing to a net reduction of GHG emissions. Various studies show that at the population level, those that possess an e-bike use this bike instead of all other means of travel, but that the travel most often replaces the use of a car. The data that we collected about the use of the municipal e-bikes for the municipal employees and for lending out were very sparse. Therefore, it is hard to say anything concrete and general about the direct climate effect of these e-bikes.

Various surveys to the lenders of the e-bikes and also other data show that a significant number of those that have lent e-bikes via various borrowing facilities, buy an e-bike privately afterwards, and that the borrowing often is often instrumental for this decision. This may be understood as an indirect positive climate effect of a strategy targeted at e-bike use. A survey of municipal employees showed that also a significant number of these persons acquired an e-bike in the aftermath of using it at work. The previous groups, e.g. the lenders of e-bikes and the municipal employees will, if they behave similarly to the

persons participating in the abovementioned studies, substitute all types of travels with using an e-bike, but the travels with a personal car most importantly. Therefore, it seems that the most important positive climate effect of economic support measures to the municipalities to acquire e-bikes for employees and for lending out is this positive indirect effect when a significant number of persons later acquire a private e-bike.

Strategies targeted towards e-bikes also have other indirect positive effects, including that those affected may tell family, friends, colleagues and acquaintances about it, which may subsequently motivate others to privately purchase (and use) e-bikes. On the whole, this may help e-bikes to become more visible in the city scape, which may in turn motivate other people to use them.

The special needs of persons with an e-bike

This study shows that persons with an e-bike have some special needs that may be important to keep in mind for policy makers that plan to encourage their use in Norway. First, e-bikes are dependent on step-less transition zones between, for example, the bike road and the pavement. Although this is also the case for conventional bikes, it is particularly the case for e-bikes due to their extra weight. Second, it is important to enable safe passing in a bike lane and in bike fields in the road because e-bikes are on average faster than conventional bikes. Third, due to this extra speed, bikers on an e-bike may also benefit from separate bike roads to an even larger extent than bikers with conventional bikes. Fourth, since the e-bikes generally are significantly more expensive, and e-cargo bikes are significantly larger than conventional bikes, it is important to provide practical and safe bike parking (optimally under a roof and in a heated room). Fifth, these aforementioned factors underline the importance of easy access to the bike parking, and that it is easy to park the bike there. Sixth, charging facilities at the bike parking or in the bike hotel may additionally be necessary.

The socioeconomic effects of two support measures to buy e-bikes among private users

Studies with data before and after a strategy has been implemented provide the opportunity to estimate the change in the travel behavior in the daily travels, and thus also change in greenhouse gas emissions. At the Institute of Transport Economics, there has previously been studies of two support measures: «Elsykkel for et bevegelig liv» ("E-bikes for a physically active life") (Framtiden i våre hender – FIVH, Oslo/Tromsø, i 2014) and «Tilskudd til kjøp av elsykkel» ("Economic support for buying an e-bike") (Oslo kommune, 2016-2017). In both studies, private citizens were recipients of monetary support to buy e-bikes. The analyses of socioeconomic effects are based on comparison of marginal external costs in the modes of travelling (caused by local pollution, noise, wearing of public infrastructure, delay/congestion and accidents/injuries), before and after the citizens acquired the e-bikes. In addition, external health effects from active transport are included.

The analyses of the numbers in these two studies point in the same direction: Both strategies lead to the reduction of GHG emissions, primarily because people used e-bikes instead of personal cars, to an even larger extent than they did instead of walking and using public transport. The estimated yearly reduction of CO_2-equivalents from transport in the groups of recipients was in the range of 50-100 kilos per person who received support from Oslo municipality and a little more than 200 kilos per person who received support from FIVH. These estimates are close to the estimates from other Nordic countries if one

adjusts for various lengths of the biking seasons. Future and larger support measures combines with research projects that follow them up will indicate to what extent the results from these studies may be generalized.

The socioeconomic net cost, which means the cost of the support measure minus the reduction of marginal external costs, per ton CO_2-equivalents among the recipients, is calculated to be below zero for the one support measure from Oslo municipality and a little more than 2 500 kroner for the other from FIVH. Negative socioeconomic net costs means that the reduction in the marginal external costs (except for the CO_2-emsisions), because of increased bike share and reduced care share, is higher than the costs of the support measure.

Positive health effects from active transport are, together with the reduced delay/queue, the largest contributor to reduced marginal external costs. In other words: the most important socioeconomic effects of supporting buying e-bikes for private citizens are that they become more physically active and contribute to reducing the amounts of cars standing in a queue.

Here, we have used conservative (in other words low) estimates for estimation of the marginal external health costs. Alternative assumptions about the valuation of health effects switch the ranking of the two e-bike support measures in terms of the economic assessment. The alternative assumptions implied higher valuations but also considerably higher relative valuation of walking, thus decreasing the benefit estimate for the Oslo municipal support measure where walking was more common among beneficiaries at the outset (before implementing the measure). For estimation and socioeconomic analyses, it is also decisive what the real health effect of using an e-bike compared to biking a conventional bike and walking. All these factors indicate that the abovementioned estimates are uncertain.

Further, we have reduced information about the costs of the support measures, in particular for the one implemented by FIVH, which in addition included a low number of participants. Finally, it must be underlined that the socioeconomic calculations have been made with a time horizon of one year. That means that we have not included the usefulness the e-bike support measures may have over several years. The limited number of persons in the sub-groups of monetary support for buying e-bikes in Oslo municipality had an enhanced level of biking with an e-bike and lower CO_2-emissions compared to a control group. When the long-term effect of a support measure is included in the calculations, the socioeconomic beneficial effects will increase.

Existing data on the effects of support measures where private citizens receive support for buying an e-bike show that these support measured are influencing the daily travelling modes of the recipients and may contribute to reduction of CO_2-equivalents in the range from 50-250 kilo per recipient per year. The climate effect will likely largely depend on the recipients' travelling modes *before* they have received this economic support. Larger efforts for identification and selection of recipients that have low percentages of walking and biking (and potentially also physical activity in general) will give larger effects in CO_2-reduction and potentially also increased positive health effect of the support measure. But, these types of efforts will also increase the costs of the support measure so that it will not necessarily become better in socioeconomic evaluations. Anyway, it must be underlined when assessing that various support measures for e-bikes, one should keep in mind both effects on GHG-emissions, improvement of the local environment and improvement of public health.