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E-bike use in Sweden – CO_2 effects due to modal change and municipal promotion strategies

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ABSTRACT

There is a strong political desire to reduce the use of fossil fuels in road transport. In this paper, the use of e-bikes (of the pedelec type) in Sweden is analysed by focusing on changes in travel behaviour and their corresponding effects on CO_2 emissions. The aim is to analyse the effect on CO_2 emissions due to the use of e-bikes. The analysis is carried out on the possible differences in changed travel behaviour between areas dominated by either urban or rural environments. It is based on a combination of responses to a questionnaire distributed to e-bike users and a survey of local transport planners in Swedish municipalities. The results indicate that there are large gains to be made from e-bike usage in terms of decreased CO_2 emissions through a reduction in car mileage. Furthermore, the results indicate that the potential for e-bikes to replace car trips is as great in rural areas as it is in urban areas. At the same time, the results indicate that the Swedish municipalities carrying out e-bike campaigns target trips in both urban and rural areas, therefore representing an effective promotion strategy to achieve the full CO_2 emissions reducing potential of e-bike use. This study also shows that, depending on the type of errand being carried out, more respondents living in urban areas than in rural areas replace their conventional bicycle trips with e-bike trips. Thus, the use of e-bikes produces some less than desirable effects, such as reduced physical activity.

1. Introduction

Transportation has become a worldwide environmental and social issue due to concerns about traffic safety, pollution (both air and noise), and health (Banister, 2005; Van Wee, 2007). On a global scale, the transport sector contributes about 13% of all greenhouse gas emissions (IPCC, 2007), much of which are emitted in cities and urban areas. In Sweden, road transport accounts for about 25% of all energy consumption and about 30% of all CO_2 emissions (Swedish Energy Agency, 2012), implying that it is responsible for a substantial part of Sweden's climate emissions as well as other environmental problems.

Electrically assisted bicycles, along with electric cars, have important roles to play in solving the issue of air pollution and noise by providing for climate-smart transport needs in the future (Pierce et al., 2013; MacArthur et al., 2014; Popovich et al., 2014). Indeed, electrically assisted bicycles have become a fairly common mode of transport in the Netherlands and Germany and are deemed to have great potential on a global scale. About 70% of the e-bikes in the EU are sold in Germany and the Netherlands. Around 20% of all new bicycles sold in the Netherlands are e-bikes, and these represent a third of the total revenue from bicycle sales (RAI Vereniging, 2013). In Germany, 310,000 electrically assisted bicycles were sold in 2011, corresponding to 8% of all bicycles sold in the country (Gehlert et al., 2012). The general prediction is that the number of electrically assisted bicycles sold in Germany will increase to 600,000 per year, which will constitute a market share of 10–15% (Gehlert et al., 2012; ZIV, 2013). While there are no precise figures for the distribution between electrically assisted bikes with motor assistance up to 25 km/h (pedelecs) and electrically assisted bikes with motor assistance up to 45 km/h, the consensus is that between 95% and 98% of the electrically assisted bicycles sold are of the pedelec type (ZIV, 2012).

Unlike Germany and the Netherlands, the figures for Sweden show that only a small fraction of the roughly 500,000 new bicycles sold every year are electrically assisted. A travel survey carried out in southeast Sweden (Swedish Transport Administration, 2012) revealed that only about 1.3% of the surveyed households had access to an electrically assisted bicycle; however, sales are raising (Bike Europe, 2011; Bike Europe, 2012). The electric bikes sold in Sweden are almost exclusively pedelecs in which the electric motor is engaged only when pressure on the pedals is increased (the

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motor disengages when the cyclist stops pedalling). The motor only adds to the force of the pedals, does not provide any power at speeds over 25 km/h, and the motor's net power does not exceed 250 W. By law, these bikes are considered bicycles and may thus be used on bike paths.

General studies (as opposed to demonstration projects) have been conducted in countries with larger numbers of and more experience with e-bikes, such as the Netherlands (Hendriksen et al., 2008; Engelmoer, 2012) and China (Cherry and Cervero, 2007), in order to acquire more information on who buys e-bikes, how they are used, and what modes of transport they replace. Despite the great amount of interest expressed in conducting such studies, some researchers, like Roetynck (2010), for example, maintain that there is still too little research carried out on e-bike users.

In Roetynck's (2010) study that was published as part of the EU project, PRESTO, reference is made to data showing that e-bike users consist of two main groups: older people ≥65 years of age and commuters. It appears, however, that the average age of those who buy such bicycles has begun to fall as more people are becoming aware of the advantages of e-bikes as a mode of commuter transport. Engelmoer (2012) and Fietsberaad (2013) confirm this trend. There are also studies suggesting that younger people acquire such bicycles in order to transport heavier loads than they would be able to manage with a conventional bicycle, for instance, by attaching a trailer (Dill and Rose, 2012).

Studies show that it is mostly conventional bicycle journeys that are being replaced by e-bikes (Kairos, 2010; Go Pedelec, 2011), especially trips for the purposes of commuting (Engelmoer, 2012). In the Netherlands, Hendriksen et al. (2008) carried out a survey on the use of electric bikes among commuters and retirees. Among the commuters, one-third had switched from a conventional bike, 16% from a car and 6% from the bus. The remaining shares were split between several different modes, with many people having used a combination of transport modes that were now replaced by their use of electric bikes. In the group of retirees, 45% replaced their conventional bike and 20% replaced their car. The remaining retirees used a combination of different transport modes.

An online survey study done in Switzerland targeting people who had, or wanted to have, an electric bike, showed that more men (67%) than women had either purchased or were interested in buying an electric bicycle (Hasher, 2012). In a German web- and paper-based survey, 70% of the respondents were men also when considering different age groups. The respondents were found primarily within corporations and organizations that subsidized the purchase of electric bicycles (Hacke 2013). Though the data is not representative of the entire German population, it should be noted that the gendered result is reversed when compared to the share of conventional bike users in countries such as in Germany, the Netherlands and Denmark, where the share of male cyclists is equal to or lower than the share of female cyclists (Pucher and Buehler, 2008).

The net carbon effect of an increased use of electrically assisted bicycles depends on the context of the trips, their frequency and length but also on the type of transport mode being replaced (Kairos, 2010; Pierce et al., 2013). In Sweden, 80% of all car trips in urban areas cover distances of less than 3–4 km (Transport Analysis, 2011), hence indicating a great potential for e-bikes to replace cars in these journeys. Kairos (2010) suggests that e-bikes might substitute for middle-range trips in rural areas that would otherwise be undertaken with a car. Even though there is significant interest in analysing the effects of e-bike usage on greenhouse gas emissions, very few studies have so far calculated its energy saving potential (Cherry et al., 2009; Pierce et al., 2013). From the studies that do exist, there are indications that the energy saving potential and corresponding reduction in CO_2 emissions is not minor. For instance, in Pierce et al. (2013), the switch to an electric bicycle for UK National Health Service staff for the purposes of commuting and home visits resulted in an annual decrease in CO_2 emissions of 748 kg (34.3%) per person.

The research reveals that there is a growing consensus that both technological solutions and behavioural changes are needed in order to achieve the stated climate goals for the transport sector (Robinson, 2004; Litman and Burwell, 2006; Nilsson and Khan, 2013). Various transport policy measures have been enacted to reduce people's car use and/or to increase the use of more sustainable modes of transport. Such actions are sometimes referred to as “transportation demand management measures” (Kitamura et al., 1997; Meyer and Miller, 2001) or “mobility management measures” (Kristensen and Marshall, 1999; Rye, 2002).

Demonstration projects on the use of e-bikes have been carried out in Sweden, many with local authorities playing an active part, e.g., “E-mobility” (Gudjonsson and Johansson, 2012) and the ongoing EU project “Electric Mobility in Smaller Cities” (ELMOS). These projects generally report very positive opinions reflecting an increased interest in the personal purchase of an e-bike (e.g., Gudjonsson and Johansson, 2012). The demonstration projects are often focused on smaller groups of people that can borrow or hire an e-bike for private, business, and/or commuting purposes for a limited period. Until now, no Swedish study has been directed at users that have bought an e-bike privately and not as participants in an e-bike campaign.

Travel surveys conducted in Sweden have revealed that an individual's travel behaviour varies depending on their area of residence. People living in urban areas tend to travel shorter distances and more commonly by bicycle and public transport, whereas people in rural areas tend to travel longer distances and more often by car (Trivector, 2007; Transport Analysis, 2011). This result indicates that when analysing the effects of increased e-bike use, the mode of transport that is replaced might differ depending on where the respondent lives. It may also be the case that e-bikes do not attract the same type of users in each area due to differences in transport demand; this may lead to different results in terms of changed travel behaviours.

The aim of this study is to analyse the CO_2 reducing effects resulting from e-bike usage. The data set is based on a web survey sent to e-bike users (of the pedelec type) through an e-bike retailer in Sweden with outlets in several locations and a website. This is the first empirical study in Sweden addressing privately owned e-bike users on a national scale. The geographical distribution of the data set enables an analysis of the differences in changed travel behaviours (mainly replacement of car trips) between urban and rural areas leading to differences in the CO_2 reduction. A survey of local planners in the 60 largest municipalities in Sweden was also carried out in order to investigate the geographical areas of focus when launching e-bike campaigns. This was done in order to investigate whether the geographical impact areas coincide with the areas demonstrating significant emission reducing potential due to e-bike usage.

2. Method

2.1. Survey of e-bike users

The use of electrically assisted bicycles was surveyed through a web-based questionnaire sent to users of e-bikes of the pedelec type. The e-bike users were identified using the customer register of one of the major e-bike retailers in Sweden. The retailer markets various standard models of an own and store-brand e-bikes, although none of its models are specially designed for disabled people.