
THE POTENTIAL OF ELECTRIC AND NON-ELECTRIC BICYCLES TO REDUCE ENERGY CONSUMPTION AND EMISSIONS IN PRIVATE TRANSPORT

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ECEEE Summer Study 2013
06.06.2013

Need for reduction of greenhouse gas emissions in the transport sector



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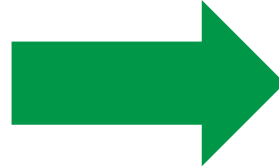
Need for reduction of greenhouse gas emissions in the transport sector



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or



Research question

What is the potential to reduce transportation related emissions when (electric) bicycles are used for short trips instead of the car ?

Structure

1. Framework
2. Dataset
3. Methodology
4. Results
5. Discussion

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Potentials for an increased bicycle usage - possible drivers

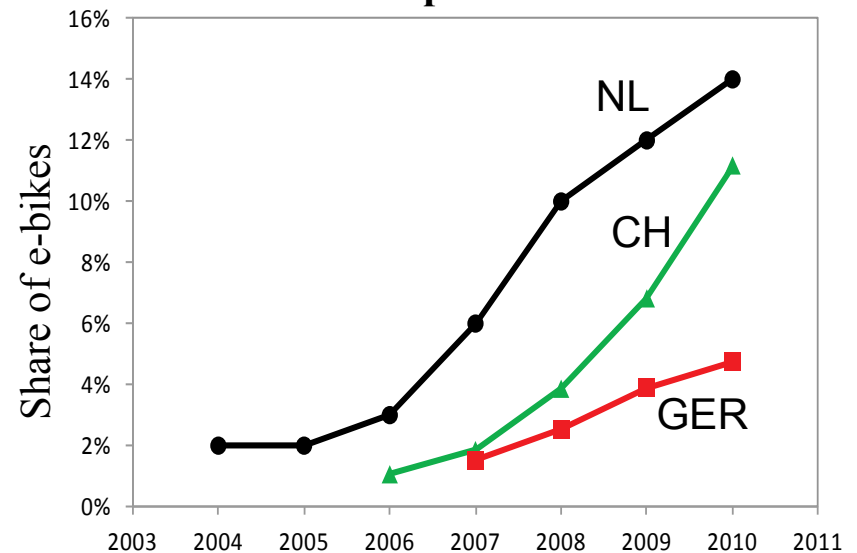
1. Electric Bicycles:

- Affordable for „everyone“
- Rising share (see figure)
- Support the driver while pedaling
 - Higher comfort , also for older people
 - Higher driving ranges possible

2. Bicycle fast lanes

- Usually 3-15 km long
- Potential to shorten bicycle travel time
- Higher safety for cyclers (better road conditions, separation from car lanes)
- Most important reasons not to take the bicycle are safety reasons, see (Sinus 2011)
- Bergström and Magnusson (2003) report that 38 to 43 % of the interviewed commuters would cycle more during winter, if maintenance of roads was improved

Sales shares of electric bicycles (pedelecs) in different European countries



Assumptions

To understand the substitution potential of car trips due to a higher bicycle share, we study German mobility patterns

Assumptions:

- Only trips to work are considered
 - The substitution potential should not be overestimated
 - These trips are made regularly, their reduction potential is therefore promising
- (electric) bicycles are used for shorter trips (< 25 km)
- Only bikes and pedelecs are considered to be a substitute
- All bicycles are zero emission vehicles
- Higher bicycle use is possible due to political actions
- Longer trips are still made by car
- All vehicles of motorised individual traffic are conventional fossil fuel based vehicles

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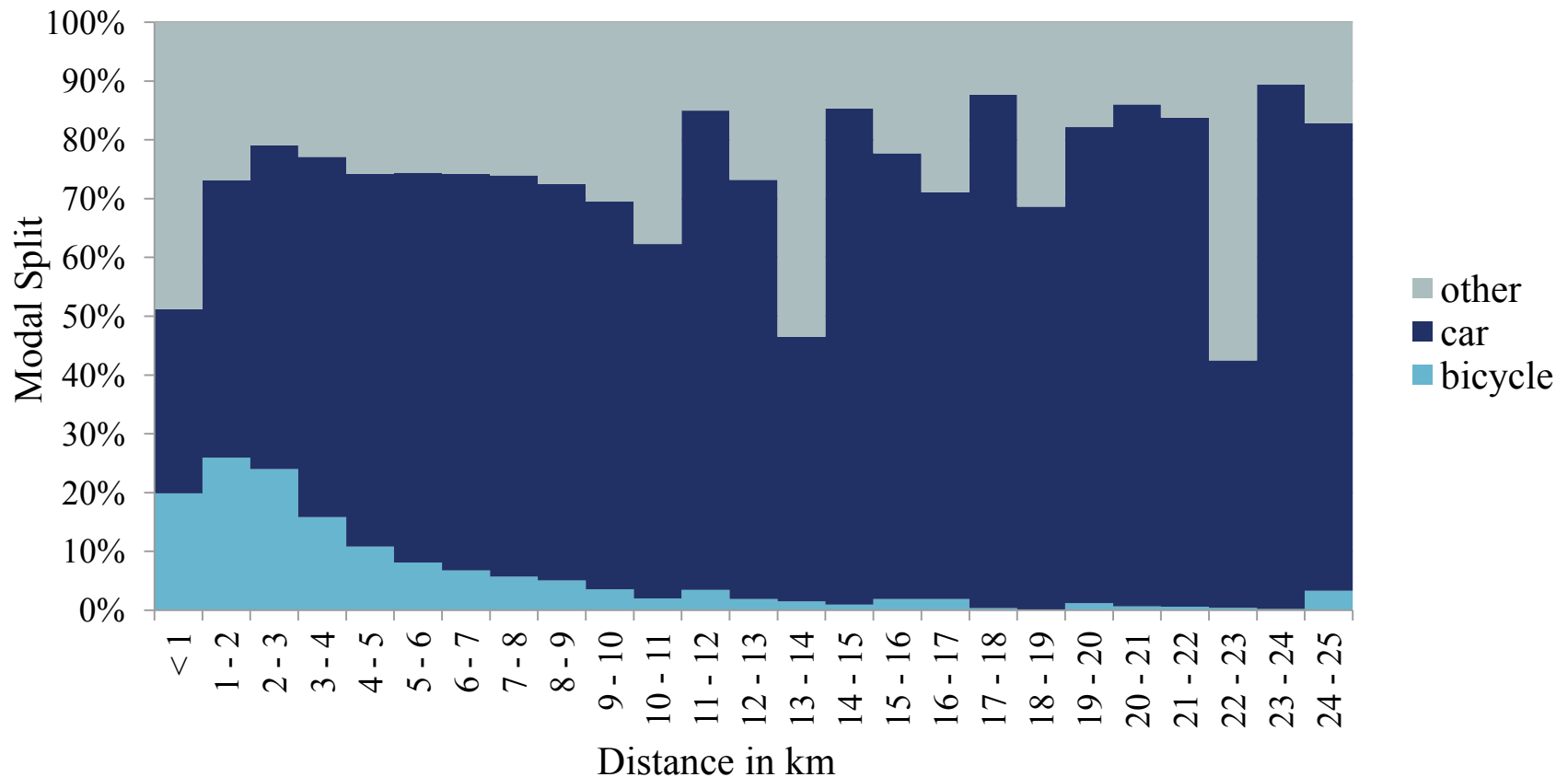
Mobilität in Deutschland (MiD) 2008

Mobility in Germany

- The dataset stems from a representative nation-wide survey on private mobility
 - The households kept record of all their **daily trips** with the corresponding **distances, durations, the modal choice** and much more
- 25,922 households (with 60,713 individuals and 34,601 cars)
 - Over 190,000 trips
 - Ca. 2.1 million kilometres of trips
 - 1 qualifying day
- As the focus of this work is to evaluate the potential of replacing car trips by bicycle trips, our analysis focuses on these aspects

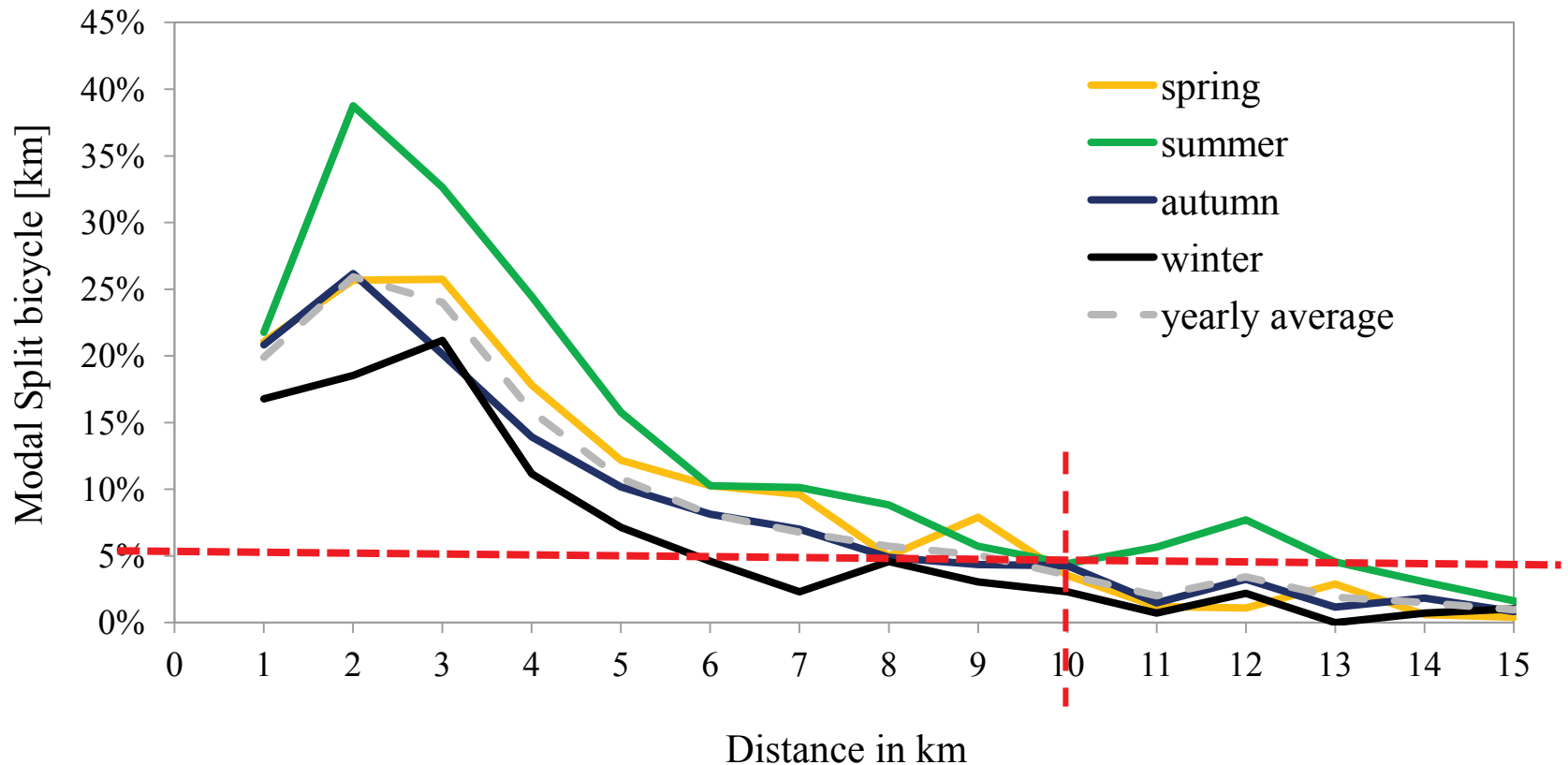
The car is the most important vehicle for almost all trip length

Modal split of trips to work as a function of distance (kilometre dependent shares)



For distances above 10 kms, the bicycle is almost not relevant – neither in summer

Modal split of bicycle trips to work as a function of distance and season



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Methodology

- Recall: Only trips to work shorter than 25 kms are considered in this paper
- **Differences in seasonal mobility patterns** are regarded as a **good possible measure** to determine the share of car drivers that could transfer to the bike if the overall conditions for bicycle driving were improved
- We **compare the modal shares of bicycle driving for the different seasons** and in dependence of the weather conditions to deduct a potentially higher modal split for bicycle use
- In our analysis we distinguish between
 1. **The substitution potential** (shift in modal split)
 2. **The reduction potential** (CO2 savings)

Calculation of the substitution potential

- 2 scenarios:
 - **Maximum scenario:** bicycle modal share for work trips in summer is estimated to be the maximum possible bicycle share or, in other words: it is supposed that the summer mobility pattern for bicycle riding is also valid for all other seasons
 - **Conservative Scenario:** we consider certain variability in mobility behavior as an indicator for a potential shift towards a higher bicycle share. This variability could be seen as indicated by the difference between spring and autumn mobility patterns

Calculation of the reduction potential

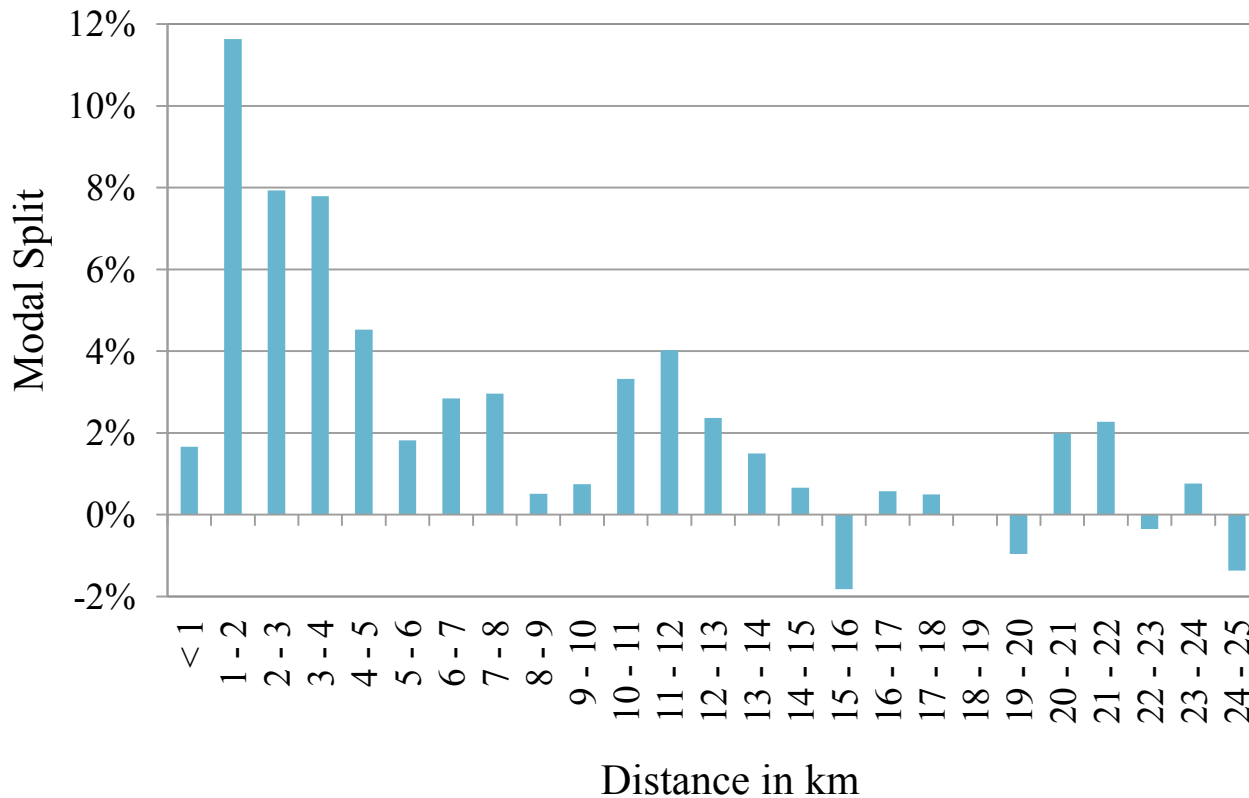
- 2 different approaches:
 - **Rough Estimate**
 - By comparing the average trip lengths of bicycle trips to work under different conditions we can estimate the potential change of average kilometers driven to work by bicycles and their corresponding share in the overall passenger kilometers travelled
 - We assume that all these new bicycle trips replace existing car trips
 - Accordingly the total passenger kilometers travelled by bike should increase by the same share as the average bicycle trip length, reducing in turn the total passenger kilometers travelled by car
 - **Kilometer specific estimate**
 - Savings are calculated as a result of the changes in modal split for each kilometer

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Great substitution potential for short trips

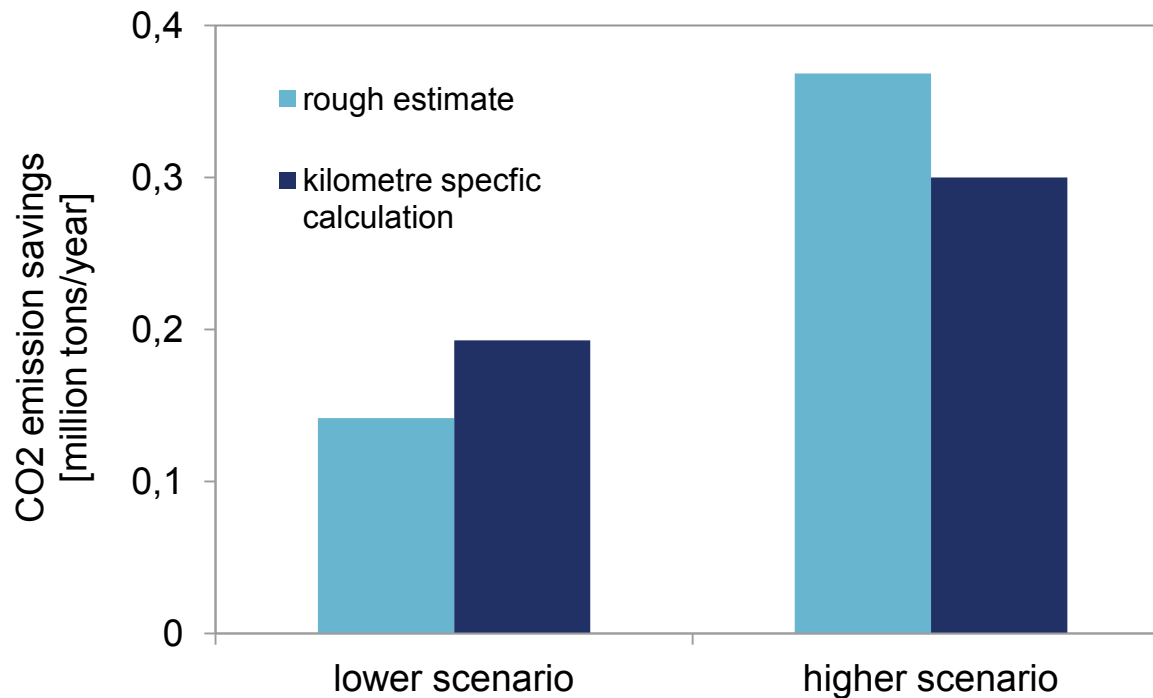
Maximum substitution potential as a function of distance



- For the **maximum scenario**:
 - Additional Modal split for bicycles up to 12 %
 - Up to 2% for the other distances seems possible
- For the **conservative scenario**
 - The potential is up to 2 – 4 %

The CO2 saving potential sums up to 0.4 million tons per year

Comparison of CO2 savings estimates



- This is up to 0.25 % of the annual transport related emissions in Germany

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Discussion

Methodology

- Only work related trips are analyzed
→ The potential might be much higher

Results

- Especially for short distances a big substitution potential seems possible
- BUT: Possible Savings seem rather small (up to 0.4 million tons CO₂/year)

Implications

- Building infrastructure for bicycles is a long-term investment, so this aspects has to be taken into account
- Circumstances to favour the switch from car to bike use could be improved by political actions
- Need for a change of habits or mobility culture

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