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Potentials for reducing greenhouse gas emissions by inducing modal shift in long-distance passenger travel

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The scene

- Climate change is a threat for the quality of life; GHG emissions should be reduced.
- Long-distance travelling contributes considerably to the GHG emissions of person transport.
- There are large differences in energy efficiency of different travel modes.
- A target of the EU is >50% market share of the train in 2050 on medium distances (current share is 12-13%).

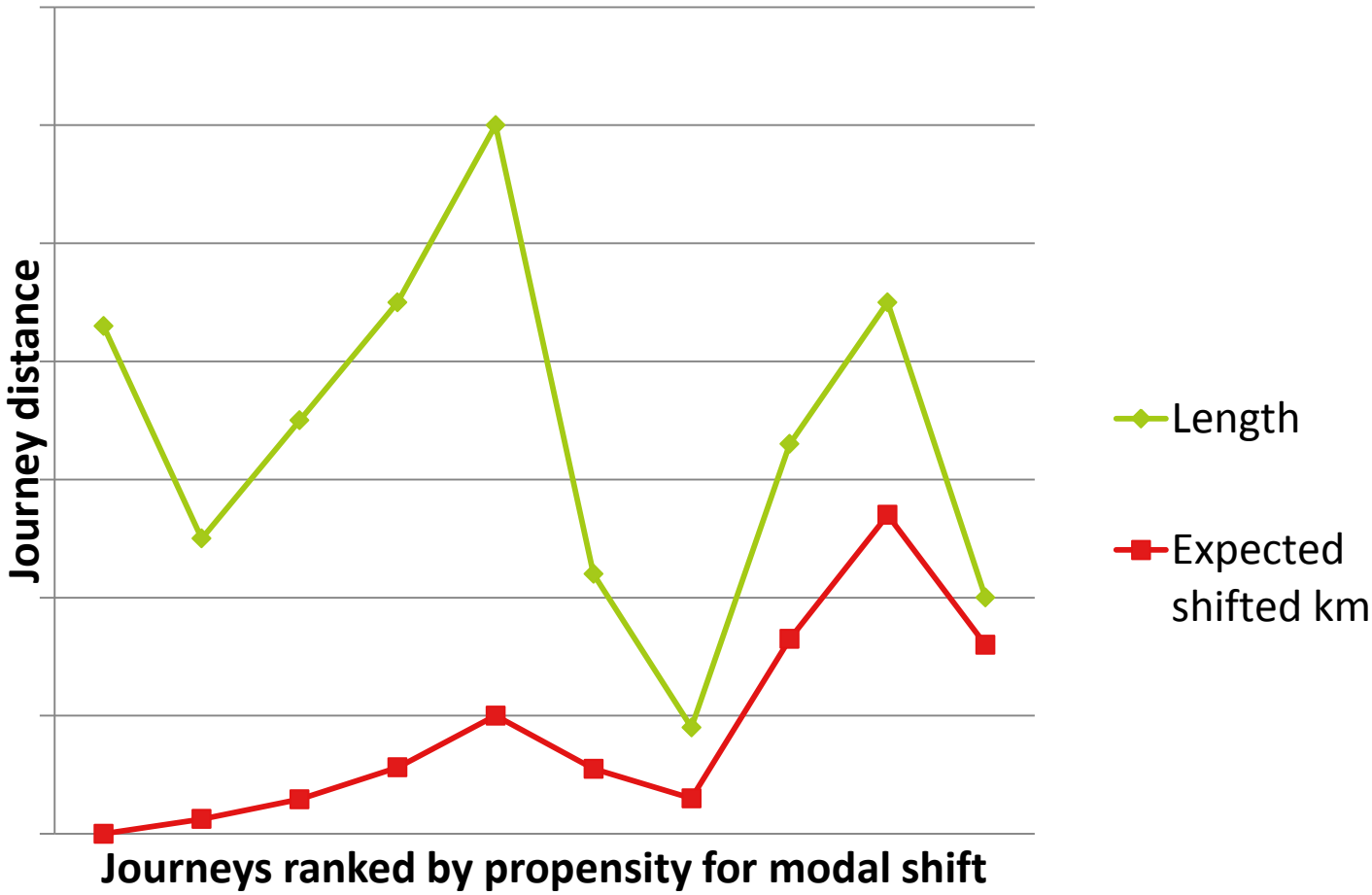
Research question

- Which reduction of GHG emissions by long distance transport can be achieved by modal shifts to the train?
- The analysis is limited to Europe.
- The question how considerable modal shifts can be achieved is no subject of the paper.

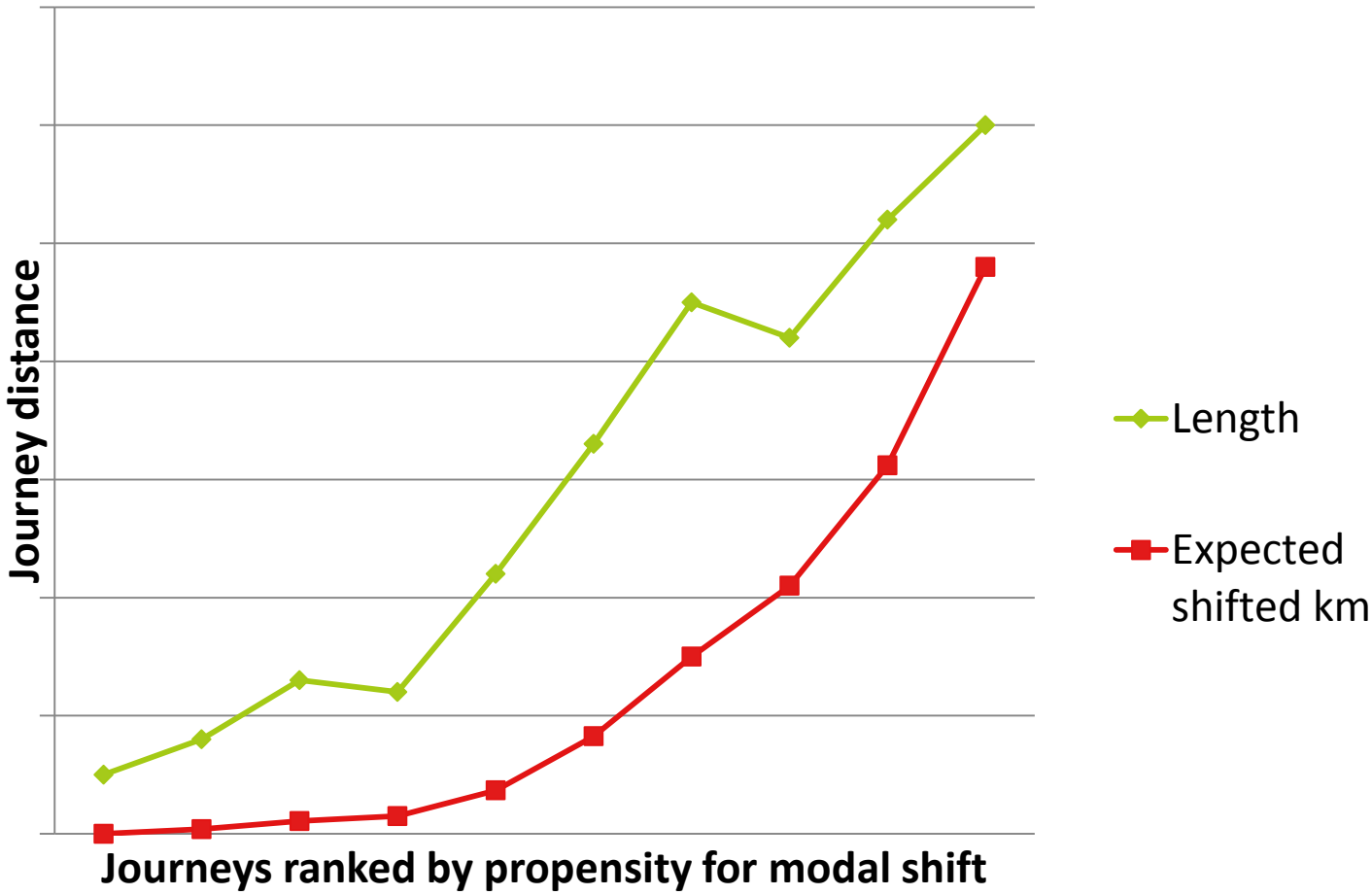
Simple calculation?

- Simple: multiply the mileage by train by 4, assume a proportional decrease of the mileage by the alternative modes, and calculate the corresponding emission changes.
- No, the shift process is more complex. The potential for shifted kilometres from a certain mode depends on the association between sensitivity to modal change and journey distance.

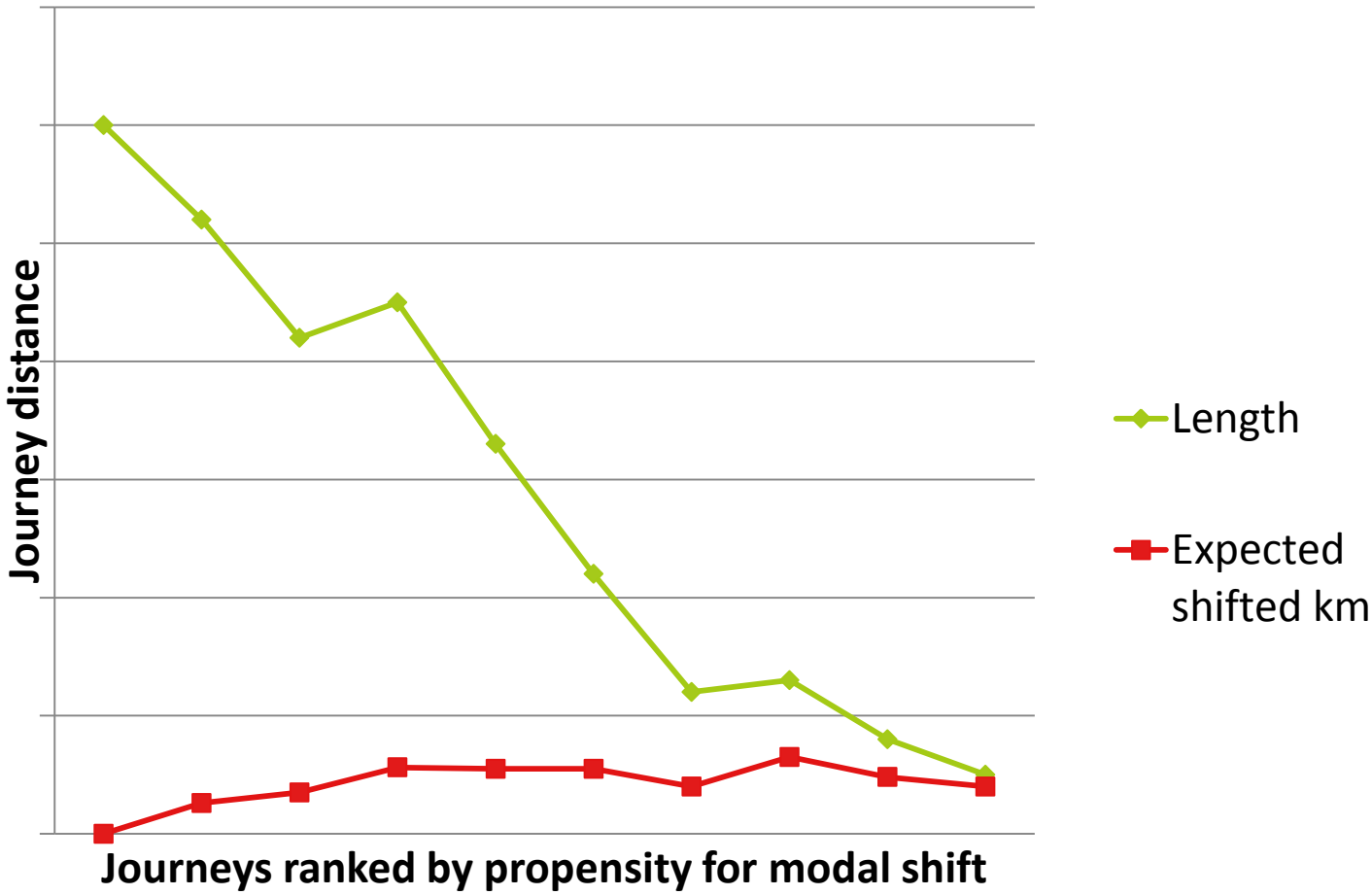
Potential for shifting kilometres



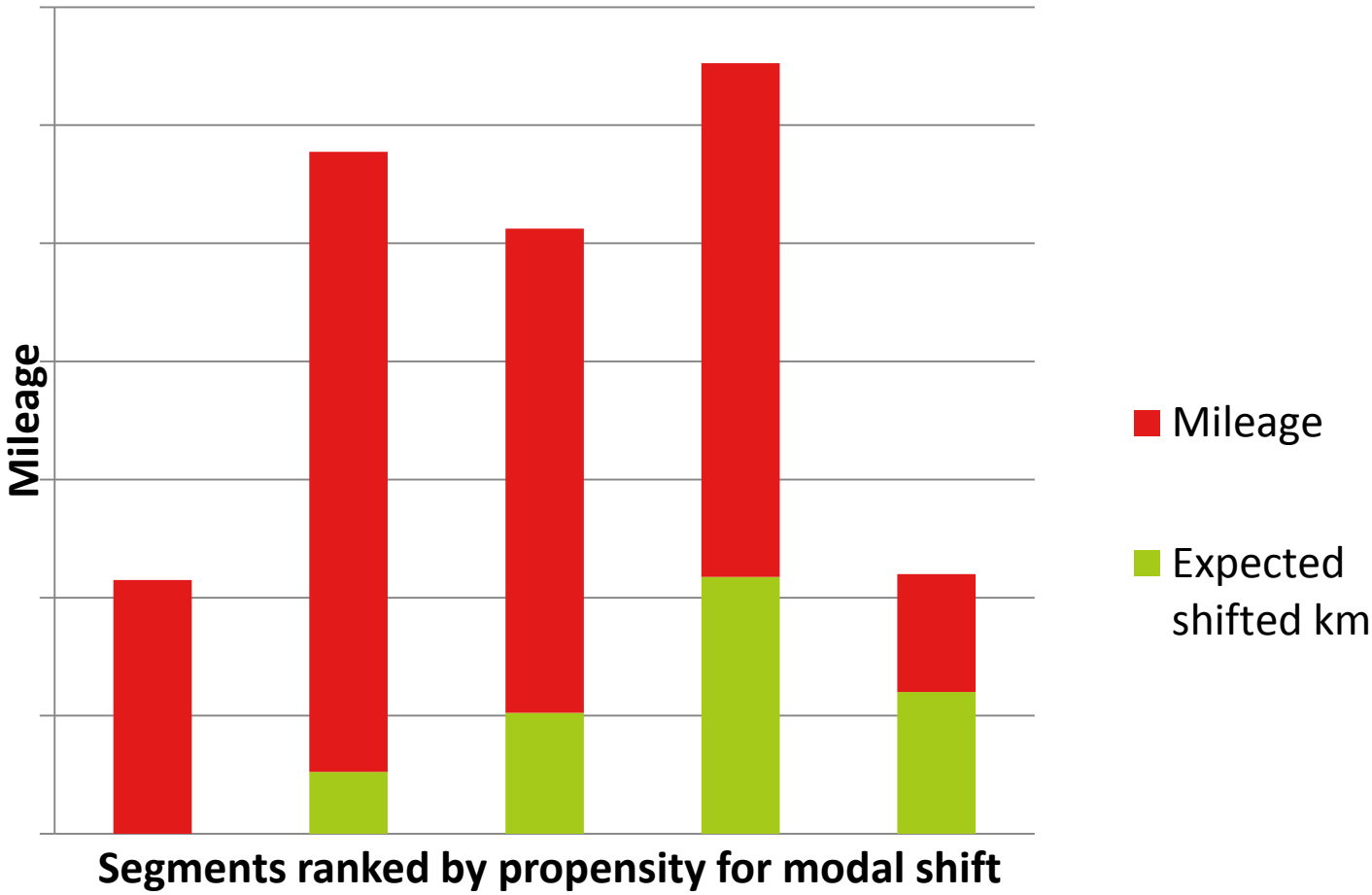
High potential when length and propensity are positively correlated



Low potential when length and propensity are negatively correlated



Segments with comparable expected modal shifts



Method

- Breakdown long-distance travel market into segments with comparable sensitiveness to modal shift.
- Assessing volumes of mileage (by mode) and emissions per segment.
- Predicting volumes and emissions in 2025 according to different scenarios that differ regarding assumed shifts to the train.

Defining segments

Basic assumption: the propensity/sensitivity to modal shift to the train correlates to the relative appropriateness of the train.

- Define the general appropriateness of the train compared to the most important alternative long-distance modes.
- Identify the variables that affect the appropriateness significantly and define the most discriminating categories.
- Cross the variables, estimate the appropriateness for each cell and cluster cells with comparable appropriateness.

Relative appropriateness of the train

Variable	Component	Airplane	Bus public	Bus private	Car
Time	Normal speed	++	0/-	0/-	0/-
	Leaving/approaching	--	0/-	0/-	0/-
	Space accessibility	-	+/-	+	++
	Time availability	+/-	+/-	+	++/--
	Alternative time use	-	-	-	--
Time/comfort	Transfer	0	0	+	++
Comfort	Space	-	-	-	-
Price		+/-	+	+	+/-

Variables with significant influence on the relative appropriateness

- Travel distance
- Car availability
- Number of travellers
- Crossing important sea barrier
- Location of origin or destination
- Other less important but still significant variables (transport of luggage; crossing national border; age, gender, employment, income of traveller; country of residence)

Variables, categories, and segments

			Car availability				No car availability			
			Number of travellers				Number of travellers			
Distance	**Destination location**	**Origin location**	**One**	**Two**	**3-14**	**≥15**	**One**	**Two**	**3-14**	**≥15**
Short	Core city	Core city	4	3	3	3	5	5	5	3
		Suburb	4	3	3	3	5	5	5	3
		Rural	4	3	3	2	5	5	5	2
	Suburb	Core city	3	3	3	3	5	5	5	3
		Suburb	3	3	3	3	5	5	5	3
		Rural	3	3	2	2	5	5	5	2
	Rural	Core city	3	3	2	2	5	5	5	2
		Suburb	3	2	2	2	5	5	5	2
		Rural	3	2	2	2	5	5	5	2
	Sea barrier		2	2	2	**2**	2	2	2	2
Medium	Core city	Core city	3	3	3	3	3	3	3	3
		Suburb	3	3	3	3	3	3	3	3
		Rural	3	3	3	3	3	3	3	3
	Suburb	Core city	3	3	3	3	3	3	3	3
		Suburb	3	3	3	3	3	3	3	3
		Rural	3	3	3	3	3	3	3	3
	Rural	Core city	3	3	2	2	3	3	3	2
		Suburb	3	3	2	2	3	3	3	2
		Rural	3	2	2	2	3	3	3	2
	Sea barrier		1	1	1	1	1	1	1	1
Long	All	All	1	1	1	1	1	1	1	1

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Five defined segments

1: Train is inferior (no propensity to modal shift).

2: Train quality is poor.

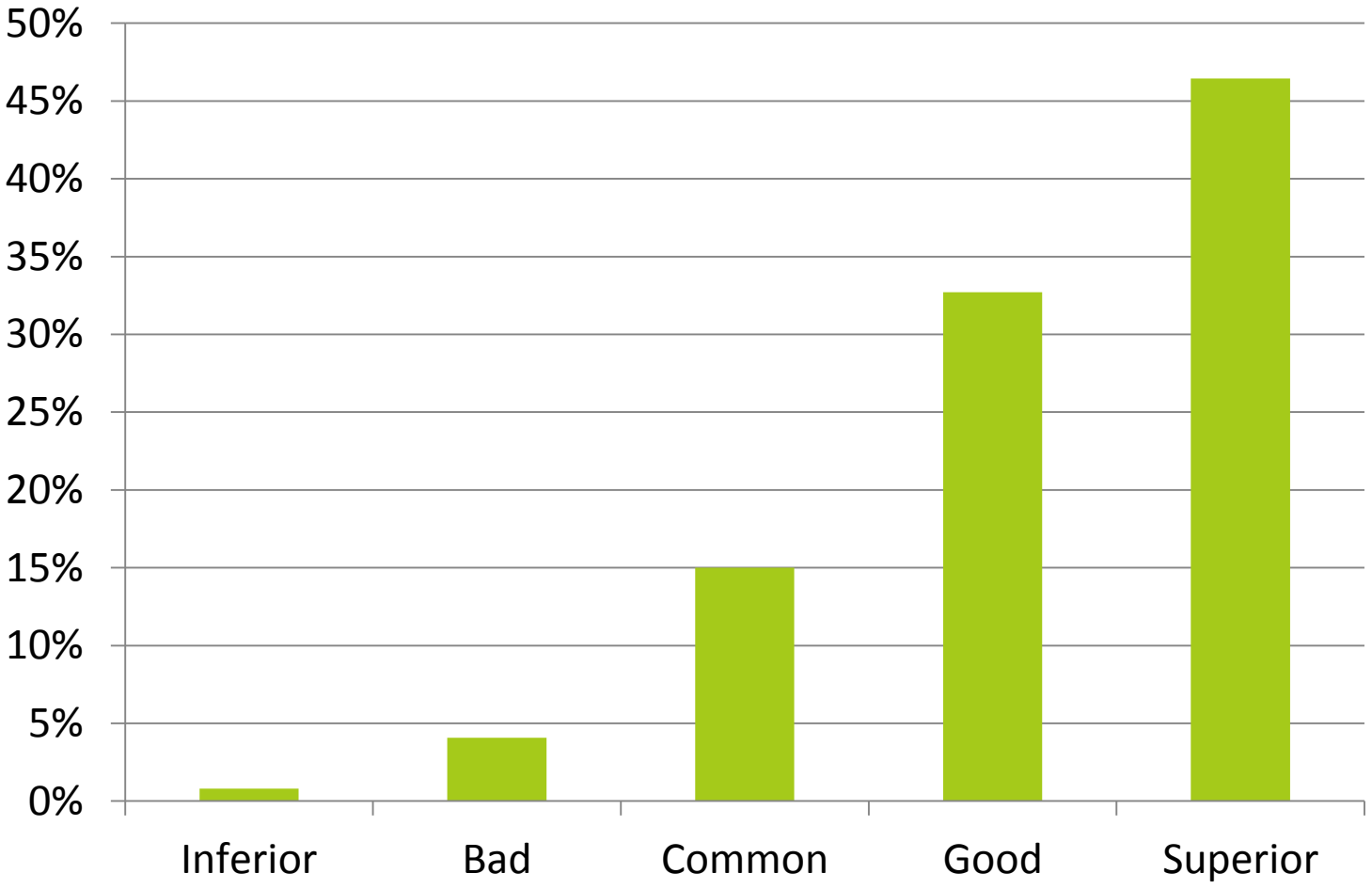
3: Train quality is common.

4: Train quality is good.

5: Train is superior.

The train is compared to the best performing alternative mode.

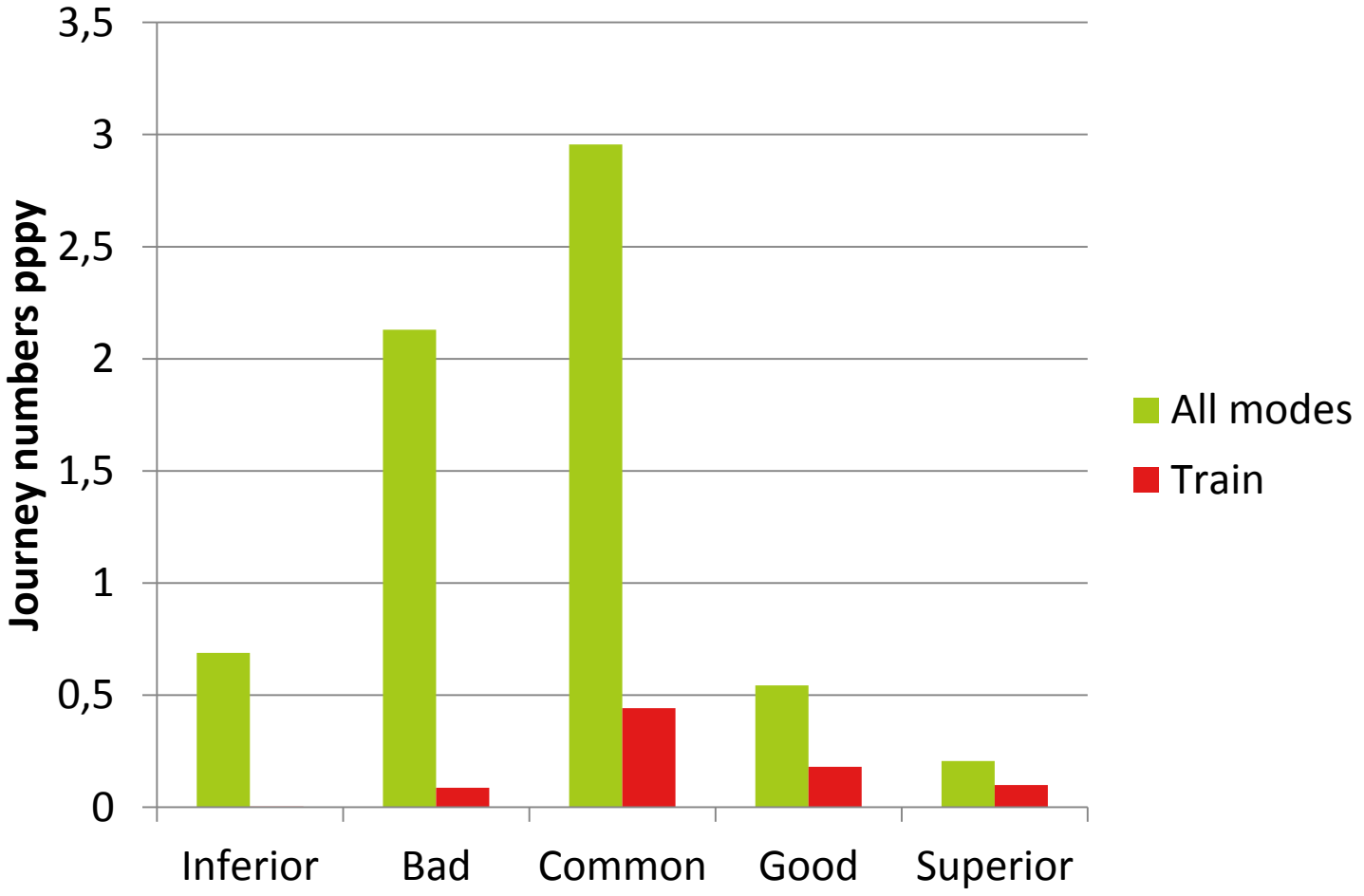
Current market share of the train by segment



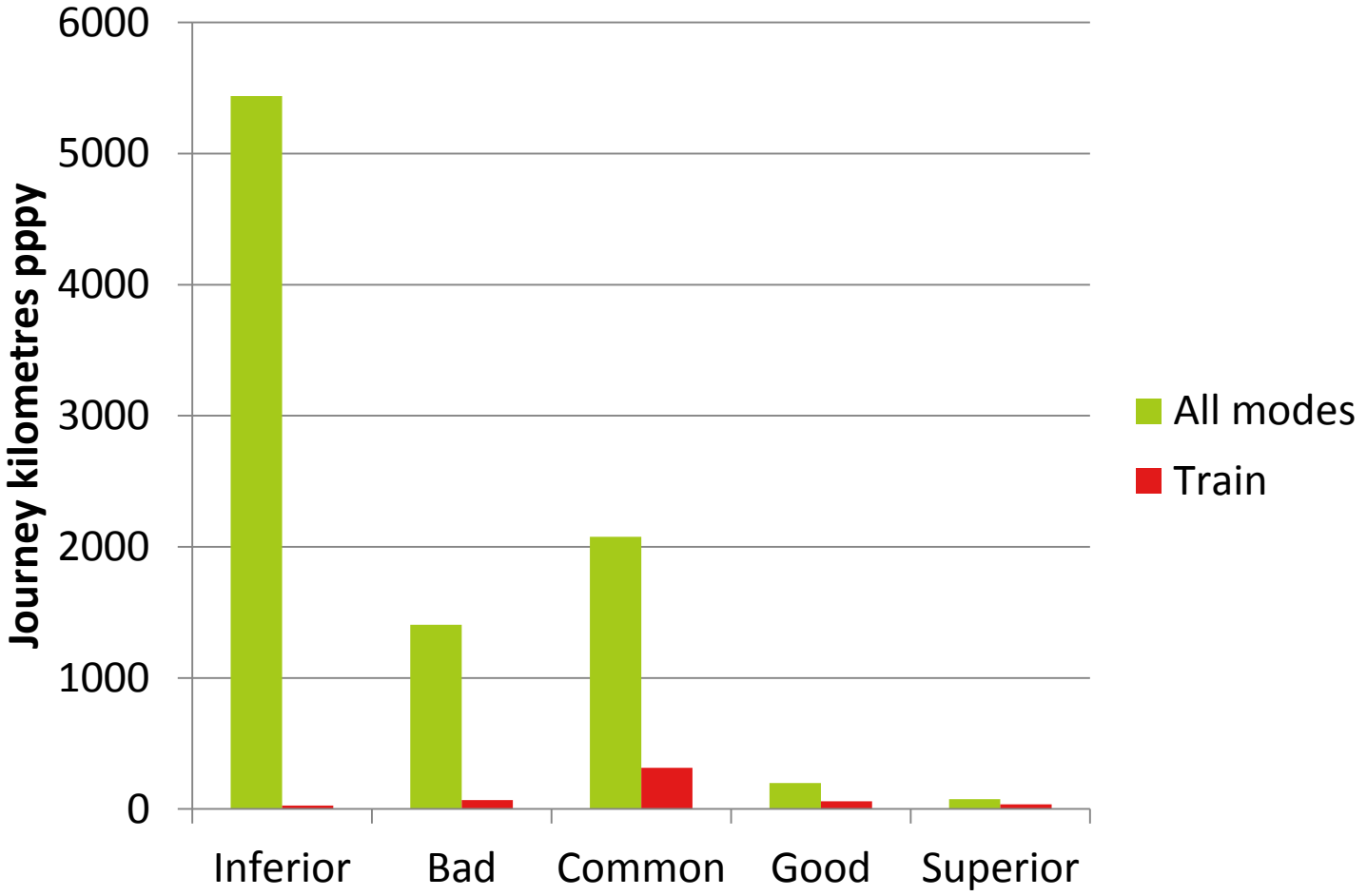
Data

- Dateline survey: the only available European long-distance travel survey that covers all long-distance travelling; it was conducted in 2001/2002.
- Update to 2013 based on statistics on modal use and on tourism (mainly from Eurostat).
- Prediction for 2025 of autonomous changes by (mainly) extrapolating trends.

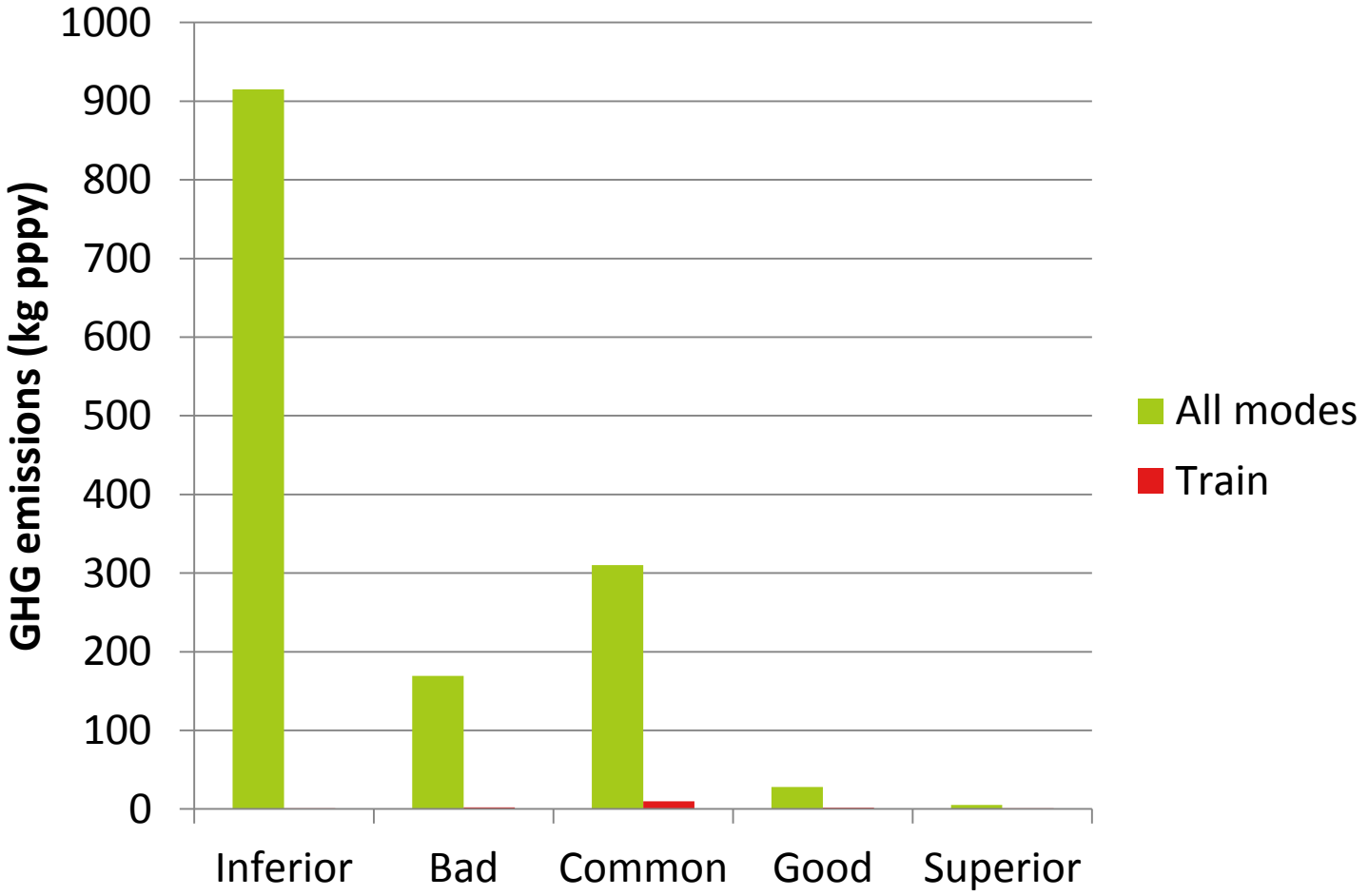
Volume by segment (journey numbers)



Volume by segment (mileage)



Volume by segment (GHG emissions)

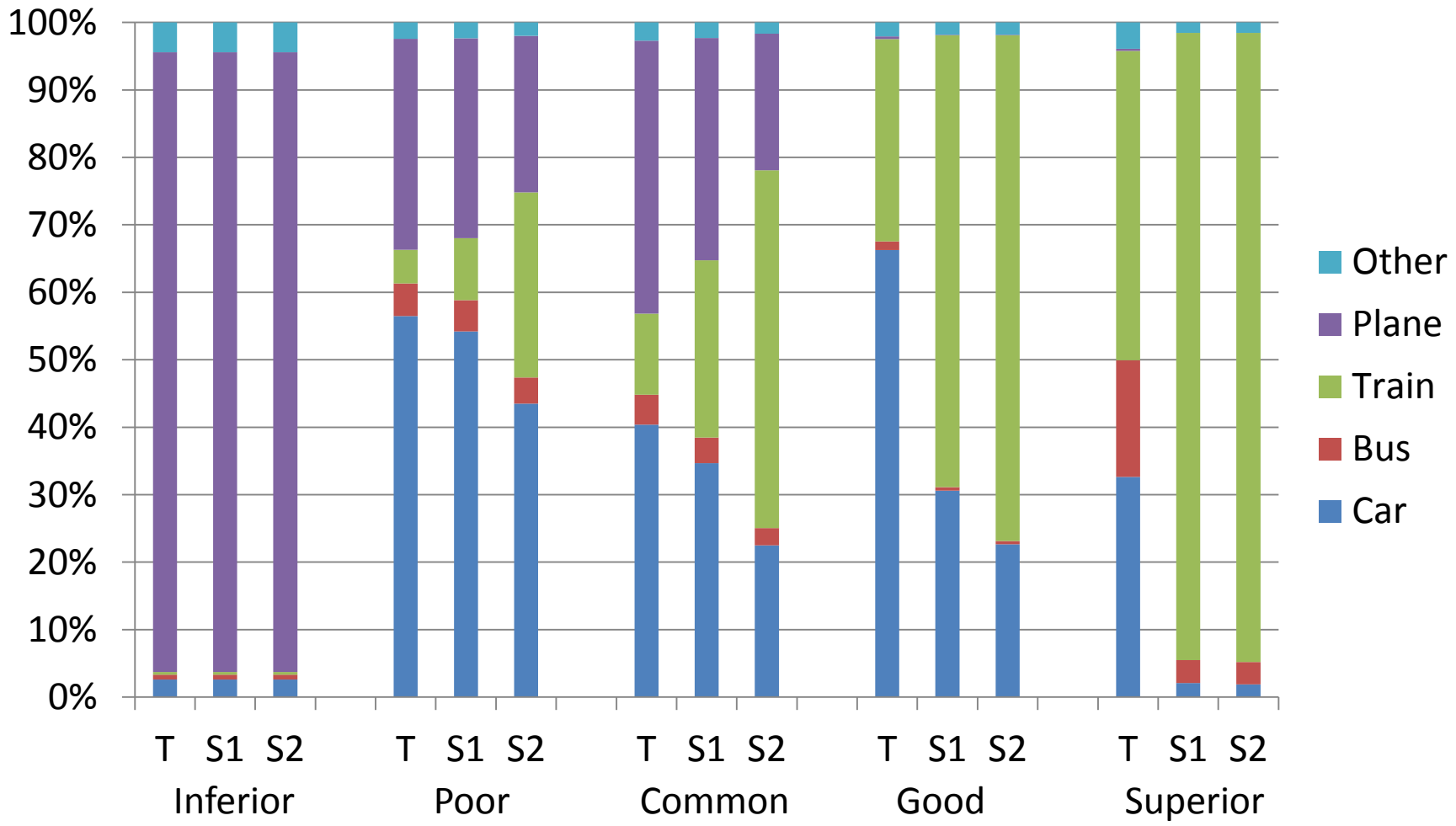


Three scenarios for 2025

- Trend: autonomous growth.
- Doubling train use: doubling market share of the train in each segment (except for the inferior segment).
- Major shift to the train:
  - Inferior: no shift
  - Poor: 25% of non-train journeys.
  - Common: 50%
  - Good: 75%
  - Superior: 100%

  Overall result: 50% market share on distances 100-1000 km.

Impacts on mileage by mode



Potentials for reduction: impacts on total GHG-emissions

	Compared to 2013	Compared to Trend scenario
With reference to all long-distance travelling		
Trend scenario	+16%	-
Doubling train use	+10%	-5%
Major shift to the train	+0%	-13%
With reference to the 4 train-sensitive segments		
Trend scenario	-6%	-
Doubling train use	-10%	-11%
Major shift to the train	-31%	-32%

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Conclusions

- Large modal shifts to the train in Europe have limited impacts on emissions of LD-travel and are expected even not to compensate for the predicted autonomous growth in travelling.
- The main reason is the dominance of the segment where the train is inferior, which is also the fastest growing segment.
- Most efficient policy for reducing GHG-emissions seems influencing destination choice by intercontinental travellers.

Questions?

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