



Estimation of environmental and societal impact of new mobility services deployment

EIDEIC 2022



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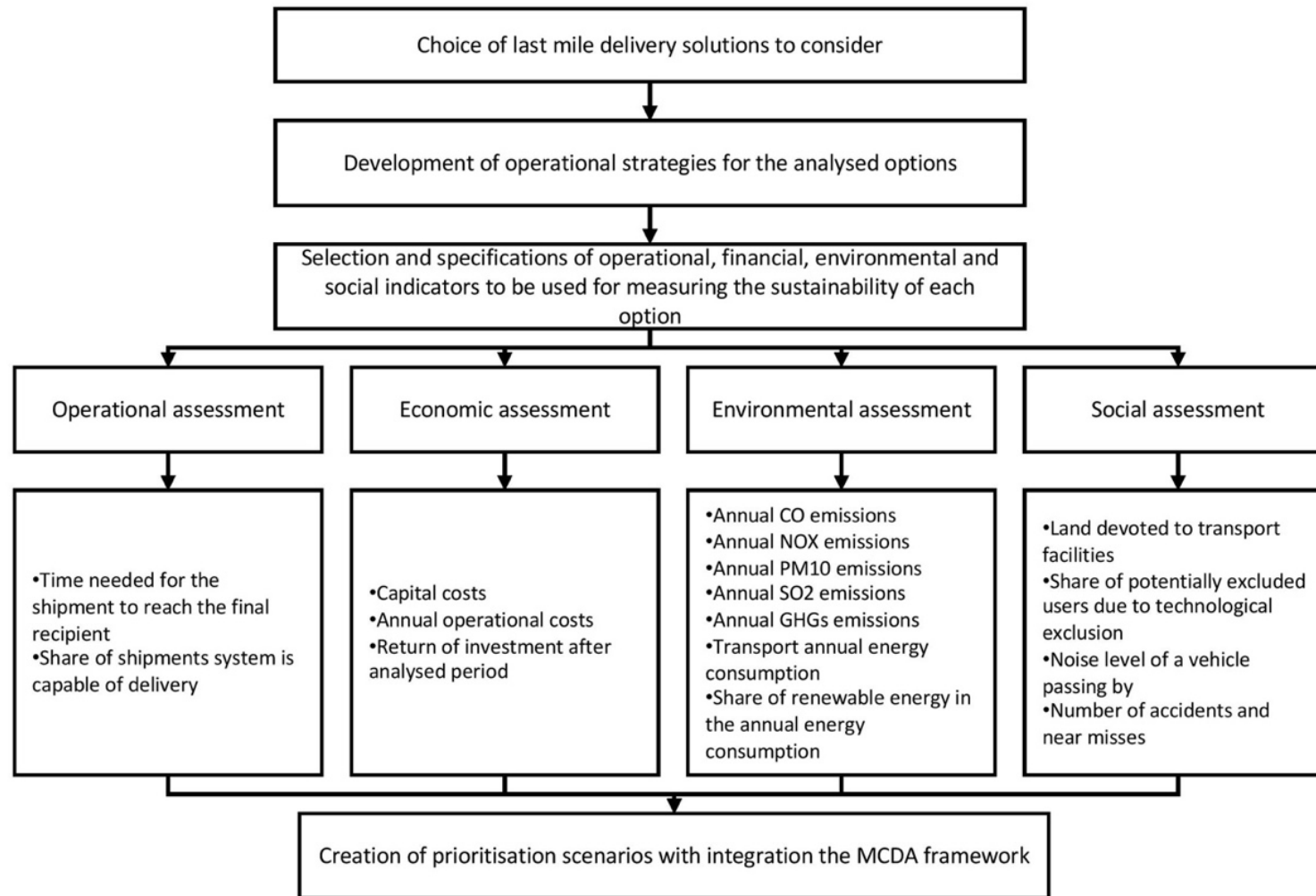
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Joint
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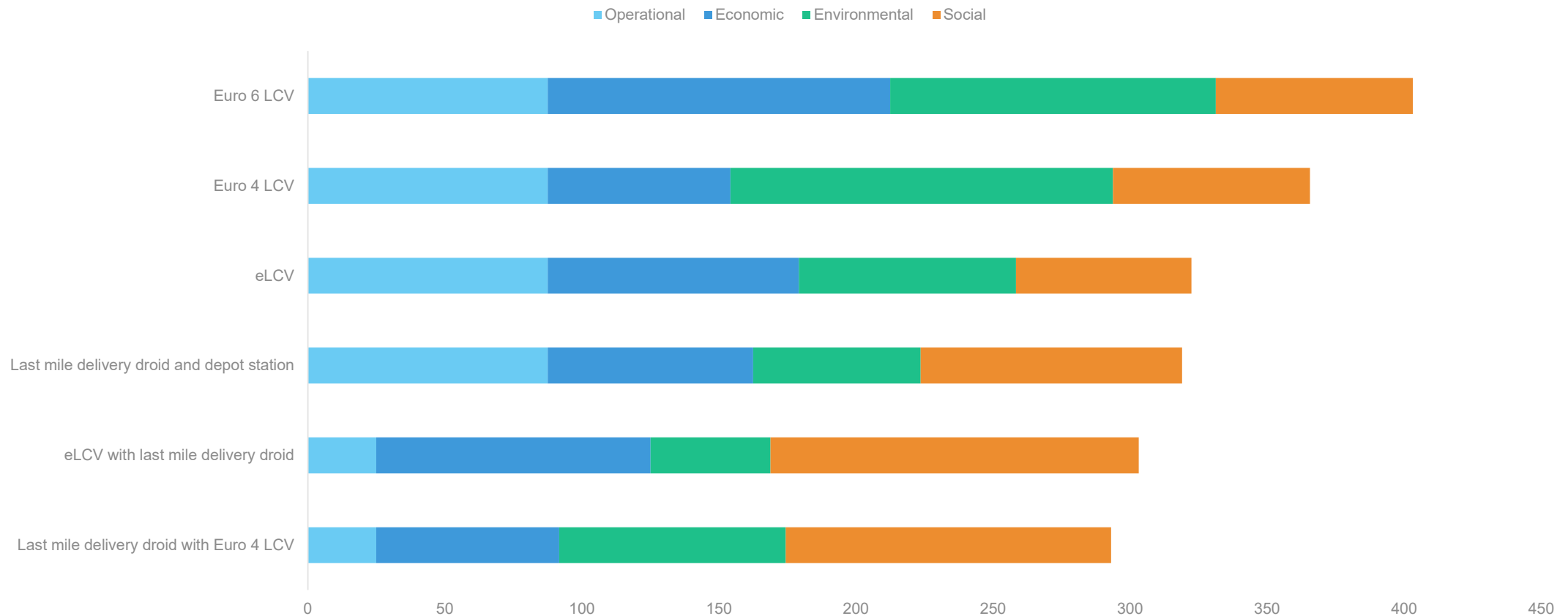
Introduction

- Collaborative Doctoral Partnership between the Joint Research Centre of European Commission and University of Cantabria
- Working with innovation in mobility at the Future Mobility Solutions Living Lab (FMS-LL)
- Focus on environmental and social impact of new mobility services tested at the FMS-LL
- Beginning of the PhD in Q1 2020
- Projected defence date Q4 2022

Impact of on-demand autonomous droids



Impact of on-demand autonomous droids

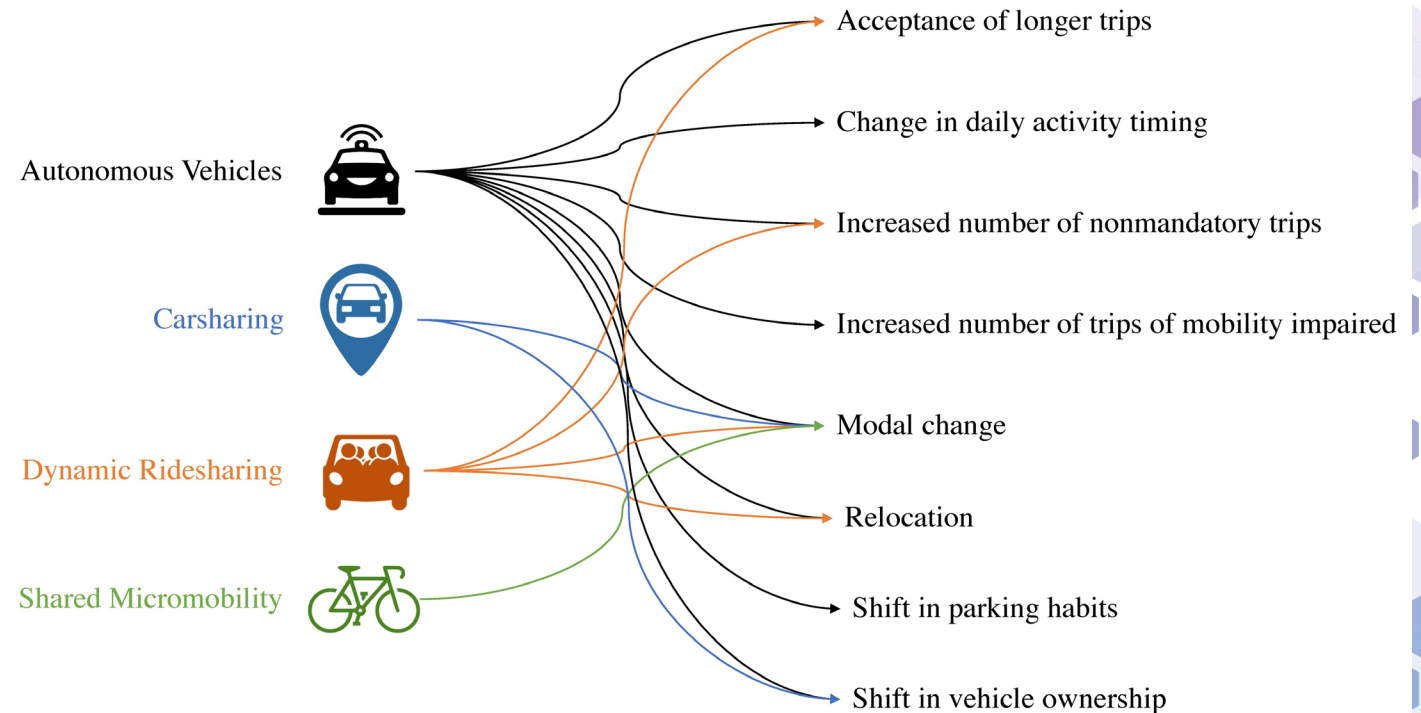


Impact of on-demand autonomous droids

- Even with **a marginal consideration of social and environmental factors**, the carbon-intensive combustion engine **LCVs did not outperform the electric innovations**
- Delivery droid-based systems could **reduce the electricity consumption and following emissions**, while **lowering the investment cost** as compared to an eLCV.
- The system that is based on delivery droids also has its **shortcomings**, namely the **limited cargo** space and **low maximum weight** of the parcel, **unproven safety** record and the plausible **marginalisation of digitally excluded**.
- There is a need to **establish the safety** of the droid through implementation on a testing ground, preferably **within living lab**, in which participants are already using innovation. Guaranteed safety of the droid would significantly improve the scores.


Impact of autonomous vehicles

- Systematic literature reviews study with pending publication focusing on classification of behaviour changes that could occur due to vehicle automation.
- Technical overview of possible models and tools to use and complementary courses required to better comprehend the field.



Impact of autonomous vehicles

- Design, implementation and analysis of mixed logit stated preference survey on the parking preference of private AVs considering four alternatives: on-street parking nearby, dedicated garage on the outskirts of a city, sending the vehicle back home and cruising. Considered attributes: parking cost, fuel cost (environmental proxy), waiting time.
- Aiming to:
 - Provide empirical evidence on the preferences of parking in the future, once new parking strategies, enabled by vehicle automation, emerge.
 - Focus on a hypothetical scenario in which AVs are privately owned and used in a similar manner to today's private cars.
 - Support transport modelers in their simulation studies and impact assessments
 - Give first hints to urban planners to conceptualize the city of the future.



European Commission

Parking in the Era of Autonomous Vehicles - Investigating the Future Individual Preferences and their Implications

Ada Garus, Luigi dell'Olio, Maria Alonso Raposo, Andromachi Mourtzouchou, Ruben Cordera Piñera, Borja Alonso Oreña, Amandine Duboz, Biagio Cluffo

1 INTRODUCTION

Researchers already predict that the ability of the vehicle to park by itself could radically change the land use in cities and open up new parking strategies.

- The suburban areas are expected to remain similar, with an AV parked where a regular car is today.
- In areas of higher population density, neighbourhood parking zones or collective garages are expected to appear.
- At journey destinations, AVs could drop their passengers and drive to an allocated parking space or a collective garage on the outskirts of the city.
- AVs might not need to find a parking spot and simply drive around on the streets, waiting to be called back (known as cruising).
- The vehicles could be sent back home to serve other household members.

2 STUDY DESIGN

A questionnaire was developed consisting of four parts:

- Mobility habits
- Socioeconomic and sociodemographic questions
- Attitudinal statements towards:
 - Innovation,
 - Innovation,
 - AV acceptance,
 - Sustainable car free cities
- Six choice sets of the parking strategy:

A	B	C	D
Parking cost: 0.6	Parking cost: 11.6	Parking cost: 0.6	Parking cost: 0.6
Fuel cost: 0.6	Fuel cost: 0.6	Fuel cost: 0.6	Fuel cost: 0.6
Waiting time: 10 min	Waiting time: 0 min	Waiting time: 0 min	Waiting time: 0 min

3 MODELLING FRAMEWORK

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                    graph TD
                        LR[Literature Review] --> MLD[Mixed Logit with latent variables]
                        FG[Focus groups] --> MLD
                        SP[Stated Preference pilot survey] --> MLD
                        AT[Attitudinal traits and statements] --> MLD
                        SPS[Stated Preference Bayesian efficient design] --> MLD
                        CFA[Confirmatory Factor Analysis] --> MLD
                    
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4 INDIVIDUAL PREFERENCES

The results indicate that the lifestyle traits and preferences, reflected through the latent variables, could impact decisions concerning parking.

ENVIRONMENTAL CONCERN

UNCONVENTIONAL

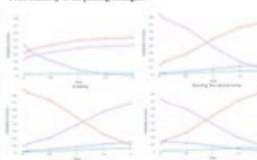
AV ACCEPTANCE

INDEPENDENT OR CAR FREE CITIES

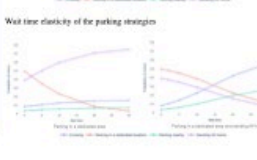
5 PRICE AND WAIT TIME IMPACT

The results were used to provide insights for policymakers on the future parking policies through pricing and wait time elasticity studies.

Price elasticity of the parking strategies



Wait time elasticity of the parking strategies




AIM OF THE PROJECT

- Provide empirical evidence on the preferences of parking in the future, once new parking strategies, enabled by vehicle automation, emerge.
- Focus on a hypothetical scenario in which AVs are privately owned and used in a similar manner to today's private cars.
- Support transport modelers in their simulation studies and impact assessments
- Give first hints to urban planners to conceptualize the city of the future.

POLICY IMPLICATIONS

- Central parking lots could be limited, without the negative pull back from users, who would turn to other parking strategies.
- Cost of cruising and sending the vehicle home should be regulated, to avoid negative externalities caused by empty vehicle miles travelled.
- Cruising in street is not accepted and should be limited before the users get used to this strategy to minimise the negative pull-back.
- Educational campaigns should target early adopters, who are more likely to choose unsustainable parking.
- Increasing wait time results in lower demand for dedicated parking areas on the outskirts of the city. Some of the parking areas not far away from central locations should be kept (such as park and ride).
- Despite the applied policy, there would always be individuals who would send AVs home, so they can serve other household members.

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WANT TO KNOW MORE?

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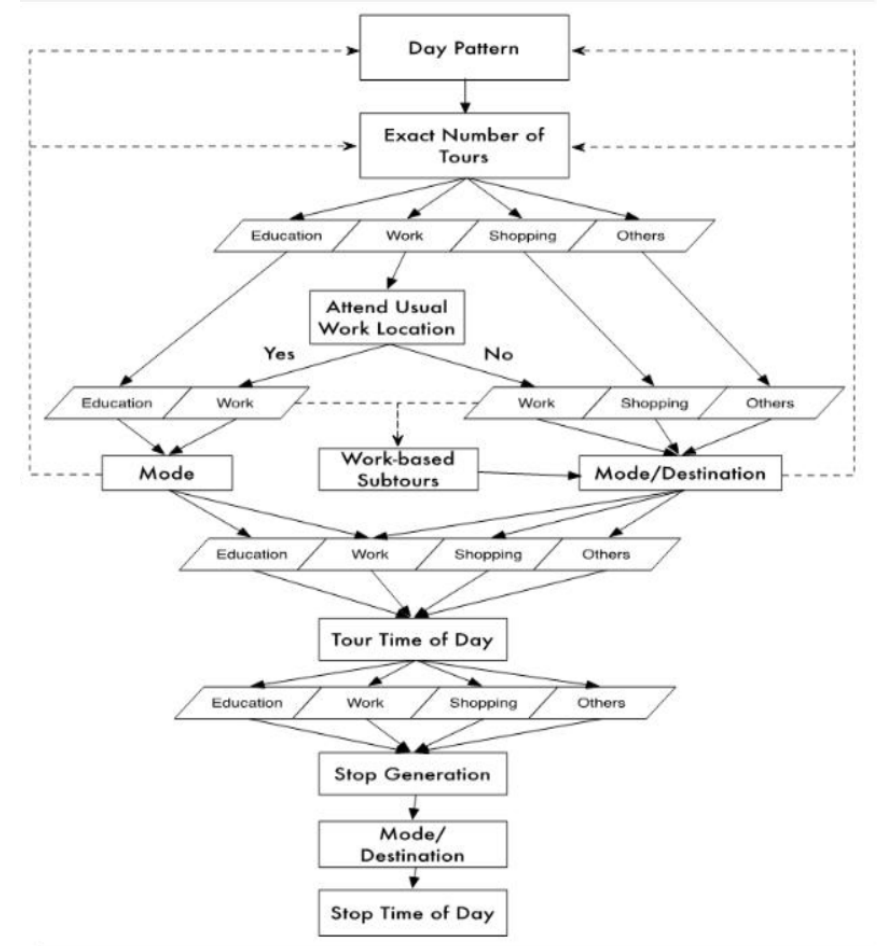
SCAN TO SEE THE SURVEY

SCAN TO CONNECT

Impact of autonomous vehicles

- Implementation of identified behavioural changes into the Activity Based Model (state of the art framework used for transportation demand modelling) that constitutes of synthetic population and a chain of travel choice models.
- Synthetic population of Santander created using Variational Autoencoder and data provided by UNICAN.
- Travel choice models estimated using biogeme and travel diaries of Santander population.
- Travel demand simulated using an MIT state of the art SimMobility software.
- Travel supply simulated using Aimsun Next combined with Aimsun Ride plug-in.
- Data prepared and analysed using python and its numerous libraries.



Scientific impact

Publications:

- Last-mile delivery by automated droids. Sustainability assessment on a real-world case study, Sustainable cities and society (2022)
- JRC Future Mobility Solutions Living Lab (FMS-Lab): conceptual framework, state of play and way forward, European Commission Report (2021)

Work pending publication:

- Impact of New Mobility Solutions on travel behaviour and its incorporation into travel demand models, Journal of Advanced Transportation
- Parking in the Era of Autonomous Vehicles - Investigating the Future Individual Preferences and their Implications, Transportation Research: Part A

Conferences and seminars:

- Parking in the Era of Autonomous Vehicles - Investigating the Future Individual Preferences and their Implications, Transportation Research Board Annual Meeting (2022)
- Sustainability assessment of last mile delivery droids for postal services at JRC Ispra, The Joint Research Centre seminar (2022)



Thank you!





BACK-UP



Impact of on-demand autonomous droids

Dimension	Objective	Indicator	Euro 4 LCV	Euro 6 LCV	eLCV	eLCV + last mile delivery droid	Last mile delivery droid + Euro 4 LCV	Last mile delivery droid + depot station
Operational	Quality of service	Time needed for the shipment to reach the final recipient	2-3 days	2-3 days	2-3 days	0-1 day	0-1 day	0-1 day
		Share of door-to-door deliveries	100%	100%	100%	100%	100%	95%
Economic	Economic productivity	Capital costs [€]	-	32 000	38 000	42 535	13 605	23 605
		First year operational costs [€]	2 834	1 645	822	817	927	834
		Return of investment after analysed period	0%	18%	25%	23%	67%	41%
Environmental	Air pollution prevention	Annual CO emissions [g]	309,50	132,81	0,22	0,12	0,58	0,69
		Annual NOX emissions [g]	419,31	259,43	0,52	0,29	21,62	51
		Annual PM10 emissions [g]	132,09	8,03	0,007	0,004	13,30	42,46
		Annual SO _x emissions [g]	2,06	1,94	48,17	26,88	9,84	10,05
	Climate stability	Annual GHG emissions [g]	2 544 244	2 394 075	1 146 159	639 492	480 975	409 989
	Energy efficiency	Transport annual energy consumption [kWh]	8 604	8 093	2 373	1 324	1 331	1 216
Share of renewable energy in the annual energy consumption		0%	0%	33%	33%	12%	13%	
Social	Community development	Land devoted to transport facilities [m2]	20	20	20	30	30	10
	Equity	Share of potentially excluded users due to technological exclusion	No	No	No	Yes	Yes	Yes
	Noise minimisation	Noise level of a vehicle passing by [db]	74	74	70	66	65	66
	Safety and security	Number of accidents and near misses	0	0	0	ND	ND	ND