Supplementary Materials

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S1.Used Ecoinvent processes and adjustments for the mode’s life cycle inventory

Vehicle	Manufacturing		Maintenance		Use		End of Life	
	Process	Quantity	Process	Quantity	Process *	Quantity	Process	Quantity
Regular Bicycle	Market for bicycle, GLO	(24 / 17) item/ (15000 personal) (13200 shared)	Market for maintenance, bicycle GLO	(24 / 17) item / (15000 personal) (13200 shared)	Transport, passenger, bicycle RoW	1 km	included in manufacturing	
Electric bicycle	Market for electric bicycle, GLO	(29 / 24) item / (15000 personal) (13200 shared)	Market for maintenance, electric bicycle GLO	(24 / 17) item / (15000 personal) (13200 shared)	Transport, passenger, bicycle RoW	1 km	included in manufacturing	
					Electricity (Study mix)	0.01 kwh	No endlife	
Electric moped	Market for electric scooter, without battery GLO	68.6 kg / (50000 * 1.07)	Maintenance, electric scooter, without battery GLO	68.6 kg / (50000 * 1.07)	Transport, passenger, electric moped GLO	1 km / 1.07	included in manufacturing	
	Market for battery, Li-ion, rechargeable, prismatic GLO	15.2 kg / (50000 * 1.07)	Market for battery, Li-ion, rechargeable, prismatic GLO	15.2 kg / (50000 * 1.07)	Electricity (Study mix)	0.0294 kwh /1.07	Market for used Li-ion Battery GLO	30.4 kg / (50000*1.07)
Car	Market for passenger car, petrol/natural gas GLO	1380 kg * 0.34/ (150000 * 1.24)	Market for maintenance, passenger car GLO	1380 kg * 0.34 / (150000 * 1.24)	Transport, passenger car, medium size,	1 km * 0.34/ 1.24	included in manufacturing	

					petrol, EURO 4 RER			
	Market for passenger car, diesel GLO	1380 kg * 0.66 / (150000 * 1.24)	Market for maintenance, passenger car GLO	1380 kg * 0.66 / (150000 * 1.24)	Transport, passenger car, medium size, diesel, EURO 5 RER	1 km * 0.66 / 1.24	included in manufacturing	
Motorbike	Market for motor scooter, 50 cubic cm engine, GLO	1 item / (55000 * 1.07)	market for maintenance, motor scooter, GLO	1 item / (55000 * 1.07)	Transport, passenger, motor scooter GLO	1 km / 1.07	included in manufacturing	
Bus	Market for bus, GLO	1 item / (1000000 * 13.59)	Market for maintenance, bus	1 item / (1000000 * 13.59)	Transport, bus GLO	1 pkm 0.338 / 1.556	included in manufacturing	
					Transport, bus (natural gas)	1 pkm * 0.342/ 1.556	included in manufacturing	
					Transport, bus (hybrid)	1 pkm * 0.312 / 1.556	Market for used Li-ion Battery GLO	945 kg * 0.312 /

	Market for battery, Li-ion, rechargeable, prismatic GLO	210 kg * 0.312 / (1000000 * 13.59)	Market for battery, Li-ion, rechargeable, prismatic GLO	735 kg * 0.312 / (1000000 * 13.59)				(1000000 * 13.59)
Train	Market for train, passenger, regional GLO	1 item * 0.9553 / (3945826 * 108.3)	Market for maintenance, train, passenger, regional	1 item * 0.9553	Transport, passenger train RoW	1 pkm * 1.43	included in manufacturing	
					Electricity (Study mix)	0.0827 kwh / pkm * 1.43	included in manufacturing	
Rebalancing vehicles	Market for passenger car, electric GLO	634 kg *30 / 150000 * (rebalancing km / sharing km)	Market for maintenance, passenger car, electric GLO	634 kg *30 / 150000 * (rebalancing km / sharing km)	Transport, passenger car, electric	1 km * (rebalancing km / sharing km)	included in manufacturing	
	Market for battery, Li-ion, rechargeable, prismatic GLO	140 kg *30 / 150000 * (rebalancing km / sharing km)	Market for battery, Li-ion, rechargeable, prismatic GLO	140 kg *30 / 150000 * (rebalancing km / sharing km)			Market for used Li-ion Battery GLO	280 kg *30 / 150000 * (rebalancing km / sharing km)
	Market for agricultural trailer RoW	500 kg *30 / 150000 * (rebalancing km / sharing km)	No maintenance				included in manufacturing	

Electric scooter	The Life cycle inventory of electric scooters was extracted from Hollingsworth et al., (2019)

S2.Components and processes for rebalancing infrastructure

Rebalancing infrastructure		
Component	**Ammount, in kg**	**Process**
Station		
Steel	45.36	market for steel, chromium steel 18/8
Aluminium	38.5	market for aluminium alloy, AlMg3
Glass	6.8	market for flat glass, uncoated
Electronic components	1	market for electronics, for control units
Polypropene granulate	0.5	market for polypropylene, granulate
Stretch blow moulding	0.5	market for blow moulding
Dock		
Steel	23	market for steel, chromium steel 18/8
Electronic components	0.5	market for electronics, for control units control units
Polupropene granulate	0.5	market for polypropylene, granulate granulate
Stretch blow moulding	0.5	market for blow moulding

S3.Calculation of Average trip distance

Average trip duration, in minutes				
Substituted modes (Modes of transport that users previously travelled with)	Current modes of transport			
	E-scooter	Shared electric moped	Shared electric bicycle	Shared conventional bicycle
Walking	10.32	11.90	11.00	12.92
E-Scoter	N/a	15.00	25.00	11.67
Personal conventional bicycle	17.15	12.30	17.67	12.30
Shared conventional bicycle	15.67	10.63	15.37	N/a
Personal electric bicycle	30.00	6.50	15.00	N/a
Shared electric bicycle	34.00	10.00	N/a	N/a
Motorcycle	16.67	13.53	25.00	16.50
Personal electric moped	15.00	N/a	N/a	N/a
Shared electric moped	8.00	N/a	N/a	N/a
Car	25.00	15.77	N/a	17.50
Train	20.01	14.78	21.92	16.46
Bus	17.89	14.23	16.55	16.70
Induced trip	25.00	12.20	N/a	14.33

Average trip duration, in minutes. Data obtained from the survey, where E-scooter, Shared electric moped users and Shared (electric and conventional) bicycle users were asked how much time their trip took. The answers were classified depending on the mode that every user substituted.

As an example: E-scooter users who previously walked to their destination now have 10,32 minute trips, while E-scooter users that used the train previously now spend 20,01 minutes travelling, which is a longer average trip. That may be because walking trips tend to be shorter than train trips. Thus, a user that substituted walking for micromobility will (on average) travell a shorter distance than a user that substituted public transport for micromobility.

Average trip distance, in kilometers				
Substituted modes (Modes of transport that users previously travelled with)	Modes of transport			
	E-scooter	Shared electric moped	Shared electric bicycle	Shared conventional bicycle
Walking	2.15	4.74	2.14	2.19
E-Scoter	N/a	5.98	4.86	1.98
Personal conventional bicycle	3.57	4.90	3.44	2.08
Shared conventional bicycle	3.26	4.23	2.99	N/a
Personal electric bicycle	6.25	2.59	2.92	N/a
Shared electric bicycle	7.08	3.98	N/a	N/a
Motorcycle	3.47	5.39	4.86	2.79
Personal electric moped	3.13	N/a	N/a	N/a
Shared electric moped	1.67	N/a	N/a	N/a
Car	5.21	6.28	N/a	2.96
Train	4.17	5.89	4.26	2.79
Bus	3.73	5.67	3.22	2.83
Induced trip	5.21	4.86	N/a	2.43

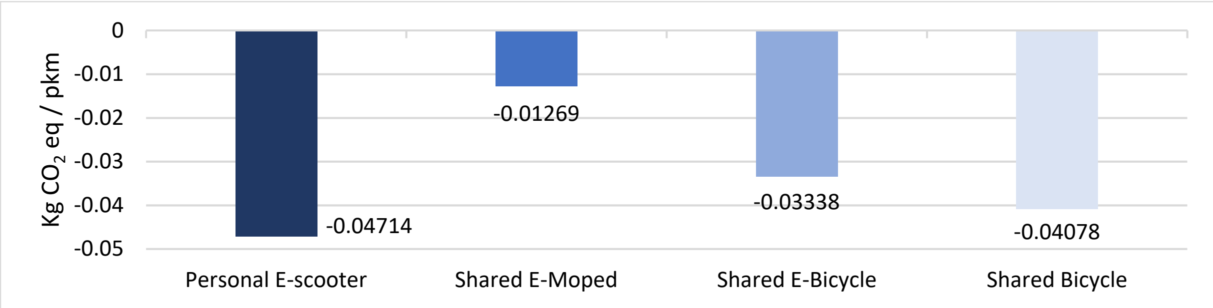
Average trip distance, in kilometers. The result was obtained by multiplying the average trip duration by the speeds of each of the four studied modes, as explained in the paper.

S4.Scenarios

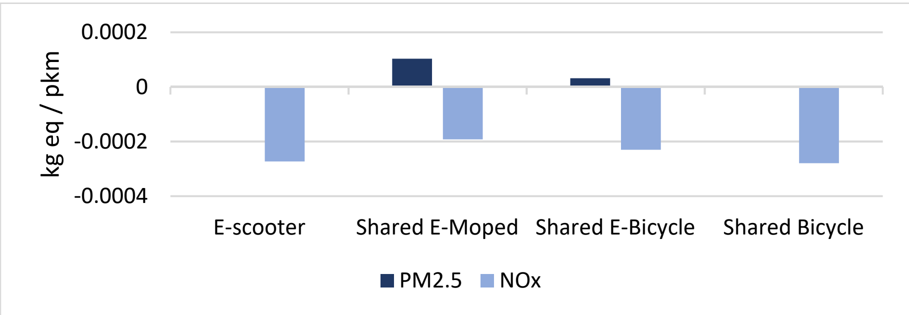
To understand how the environmental performance of micromobility can be improved based on the life cycle of the vehicles and the observed modal changes we carry out five scenarios. Two of which are related to different modal changes and the other three are related to the life cycle of the modes. The results are shown as the comparison of the micromobility modes to their modal changes, as was calculated in section 4.2.

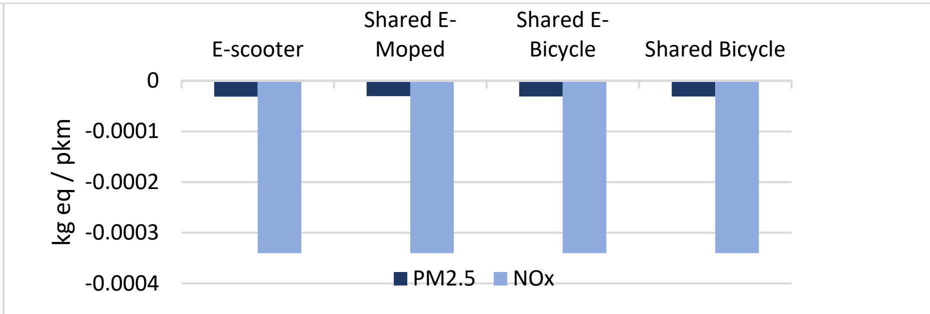
1. **Modal change (A). Car – Motorbike dependent city:** 50% of the modal change comes from private fossil fuelled cars and private fossil fuelled motorbikes.

25% Regular Car, 25% Regular Motorcycle, 10% Bus, 10% Train, 10% personal electric bicycle, 10% personal bicycle, 10% walking.



Global warming potential





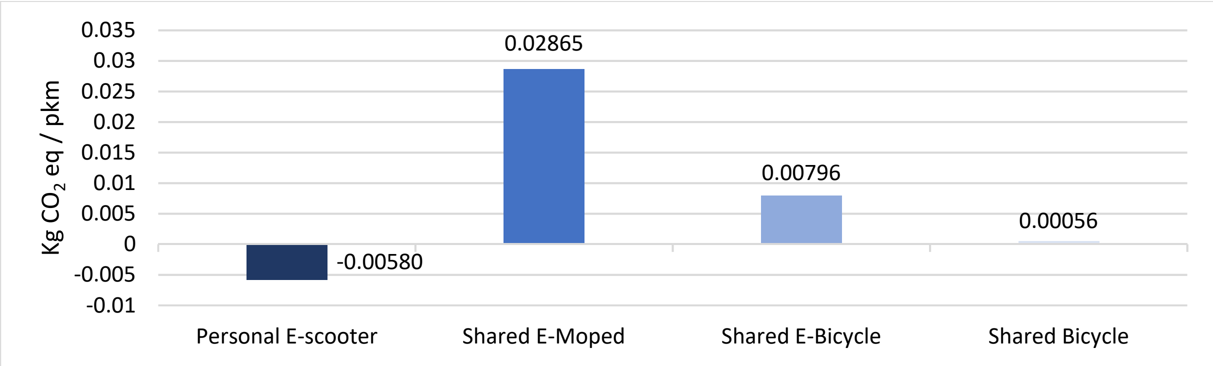
Human health hazard emisions during the whole life cycle

Human health hazard emissions in the city

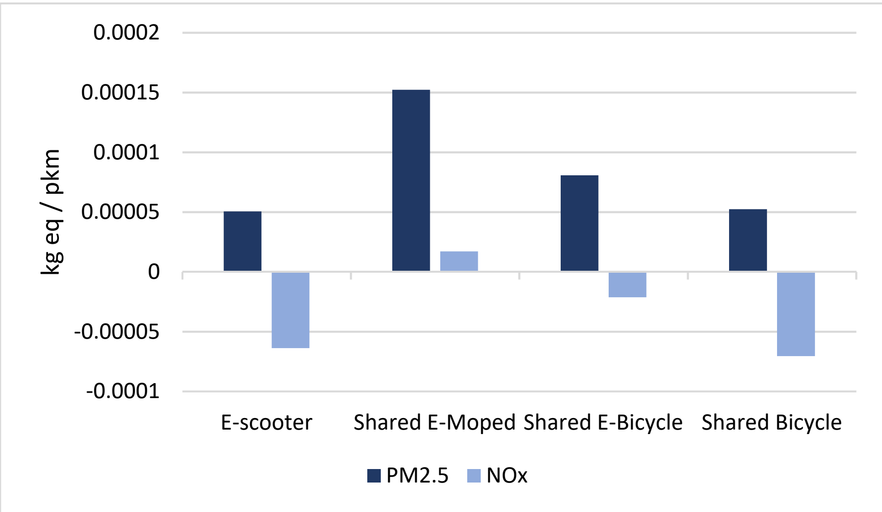
As shown, if micromobility was applied to a polluting city, the environmental impacts of the micromobility modes would be overwhelmingly lower than its modal change.

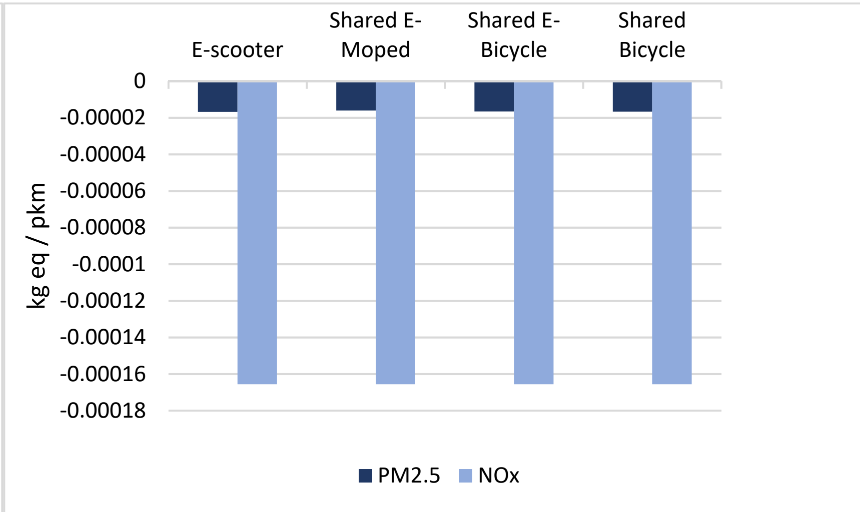
2. **Modal change (B) – Active city:** Walking and cycling make up 50% of the modal change

10% Car, 10% Motorbike, 10% Bus, 10% Train, 10% personal electric bicycle, 25% personal bicycle, 25% walking.



Global warming potential





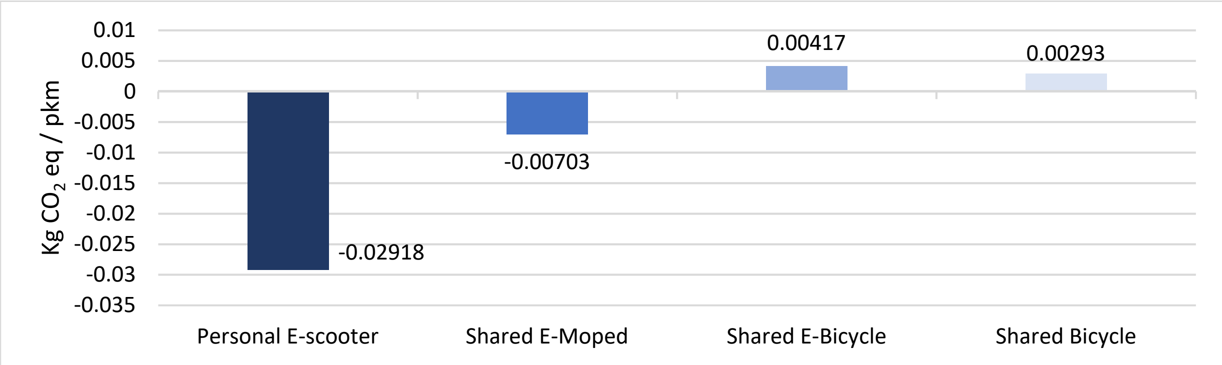
Human health hazard emisions during the whole life cycle

Human health hazard emissions in the city

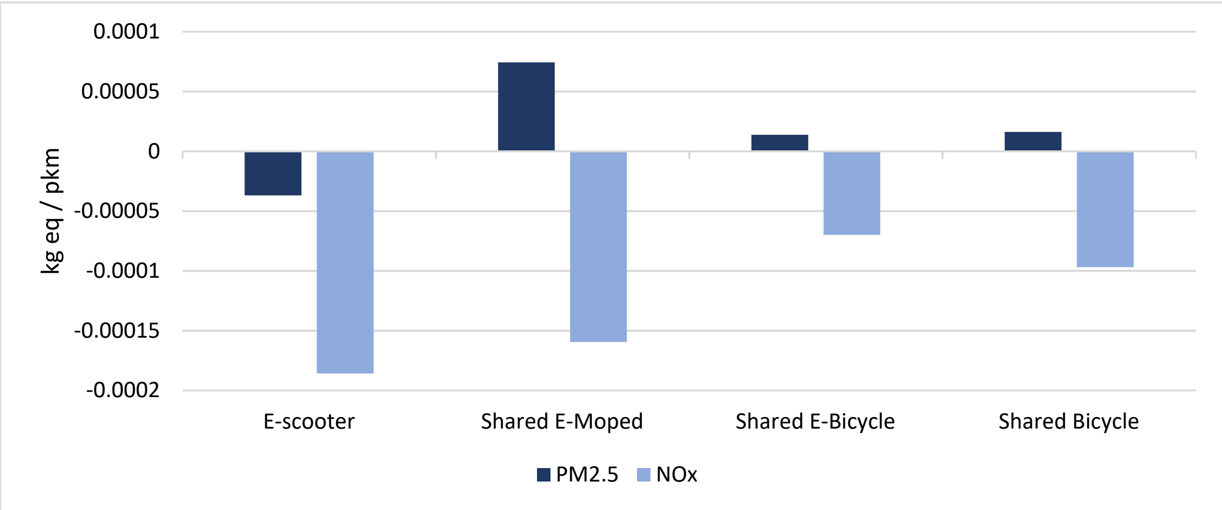
As shown, in an active city, the modal change to micromobility could have a negative environmental impact.

3. Micromobility life cycle (A). Durable micromobility. Lifespans of target vehicles doubles

(Lifespan of Electric scooter, shared e-moped, shared e-bicycle and shared biccycle) *2



Global warming potential

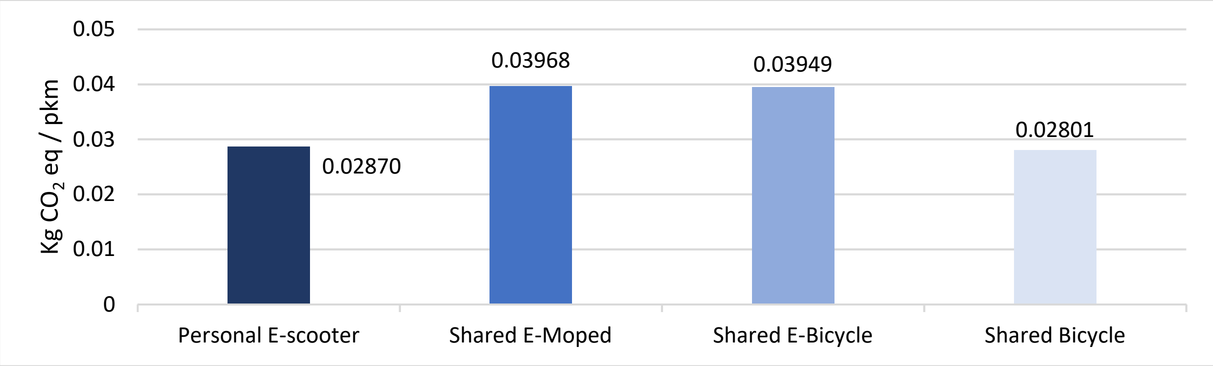


Human health hazard emisions during the whole life cycle

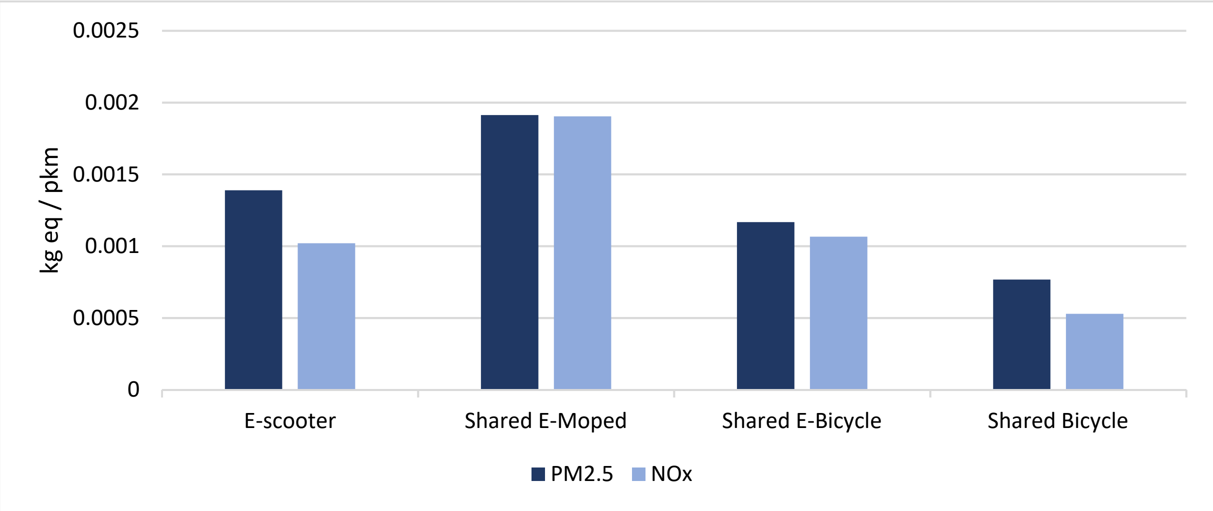
A lifespan of double lenght would slightly improve the environmental performance of the target micromobility modes. This does not affect the city emissions.

4. Micromobility life cycle (B). Short-Lived micromobility. Lifespans of target vehicles halves.

(Lifespan of Electric scooter, shared e-moped, shared e-bicycle and shared biccycle) *0,5



Global warming potential

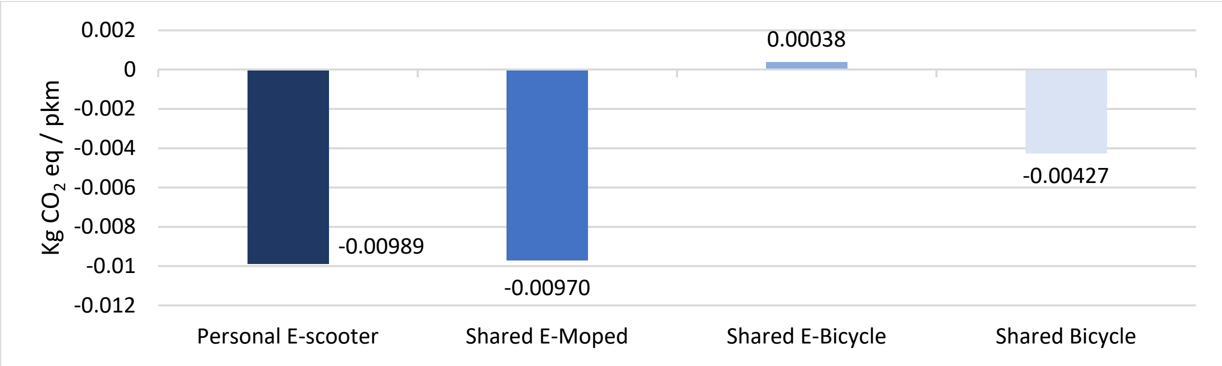


Human health hazard emisions during the whole life cycle

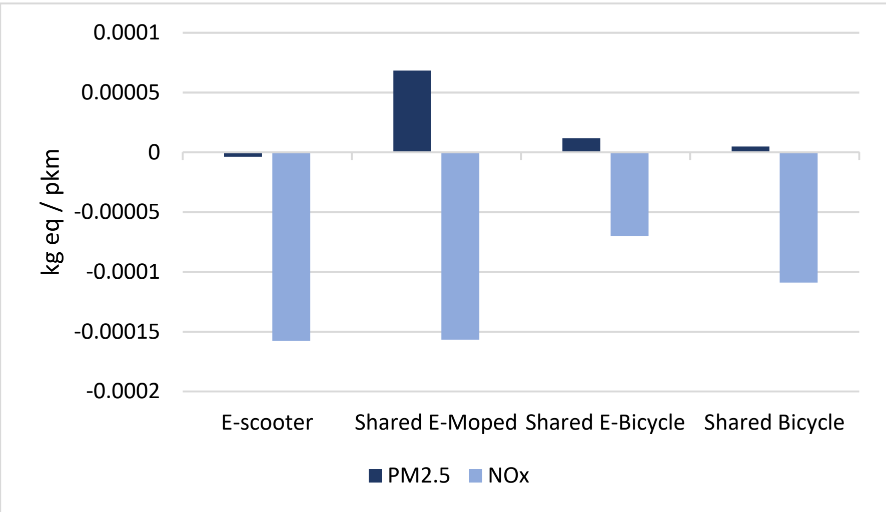
A lifespan of half the lenght would worsen the environmental performance of the target micromobility modes, and make all their emissions higher compared to its substituted modal change. This does not affect the city emissions.

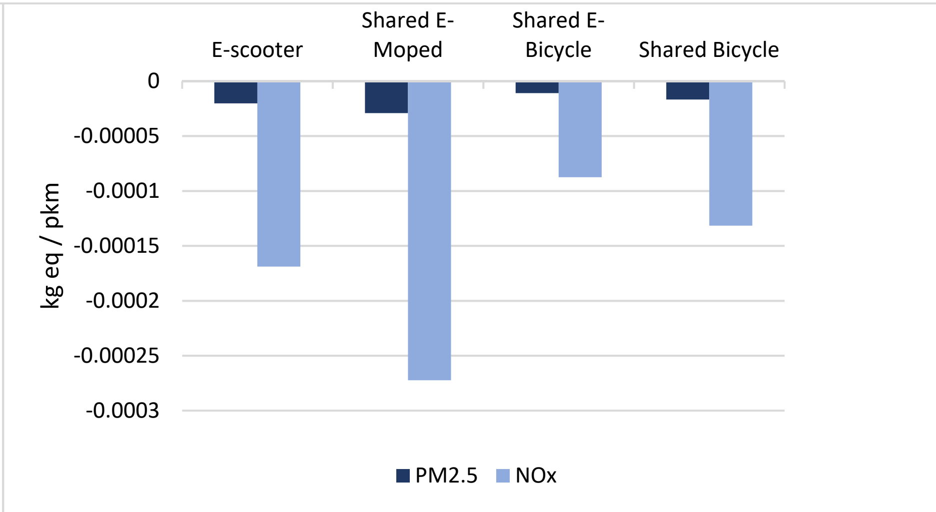
5. Micromobility life cycle (B). Efficient sharing logistics. Sharing logistics needs are reduced by half.

(Sharing logistics and infrastructure for the three shared modes)*0,5



Global warming potential





Human health hazard emisions during the whole life cycle

Human health hazard emissions in the city

A reduction in sharing logistics and infrastructure needs would reduce the overall impact of the shared modes. E-scooter is not affected.