Analysis of Electric Moped Scooter Sharing in Berlin: A Technical, Economic and Environmental Perspective

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Introduction

Forschungscampus EUREF Mobility 2 Grid

Challenges of private vehicles in cities:

- **Usage Rate**
  Average in Germany 3-5%
- **Occupancy**
  Average in Germany:
  1,5 People/vehicle
- **CO2 emissions**
- **Toxic emissions**
  NOx, CO, particulate matter etc.…
- **Space and Resources**
- **Energy**

Solutions?

Pexels.com (Rodomir Chapygin)

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Solutions?

- Emission-free vehicles


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- Carsharing

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- Toxic emissions
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- Space and Resources ✓
- Energy ✓

Solutions?

- Emission-free vehicles
- Carsharing
- Electric moped scooter sharing? ? ?


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Methodology

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Methodology

MATSim Open Berlin Scenario

Electric scooter specifications

Simulation parameters

Electric moped scooter sharing simulation

LCA

TCO

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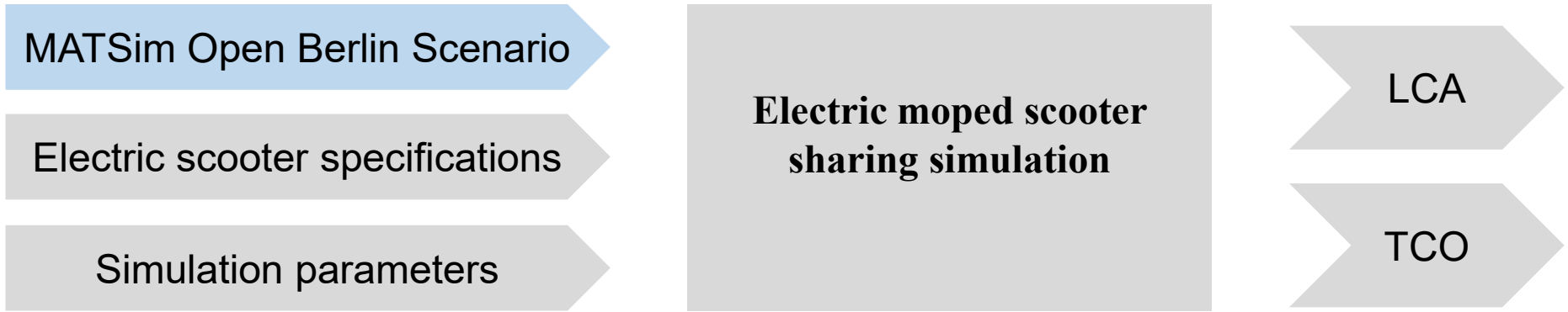

MATSim

- Multi agent transport simulation
- Open-source software based on OSM
- Simulation of up to 100% of all people and trips in a given area

Open Berlin Scenario

- 1, 10, 100% Scenario of transport in Berlin
- Based on open data such as traffic counts, census data and commuter statistics
- Open available on GitHub

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Govecs Flex

- Nominal engine power: 2 kW
- Battery capacity: 3.4 kWh
- Cycle life: 1500
- Range: 90 km
- Max Speed: 45 km/h

https://govecsgroup.com

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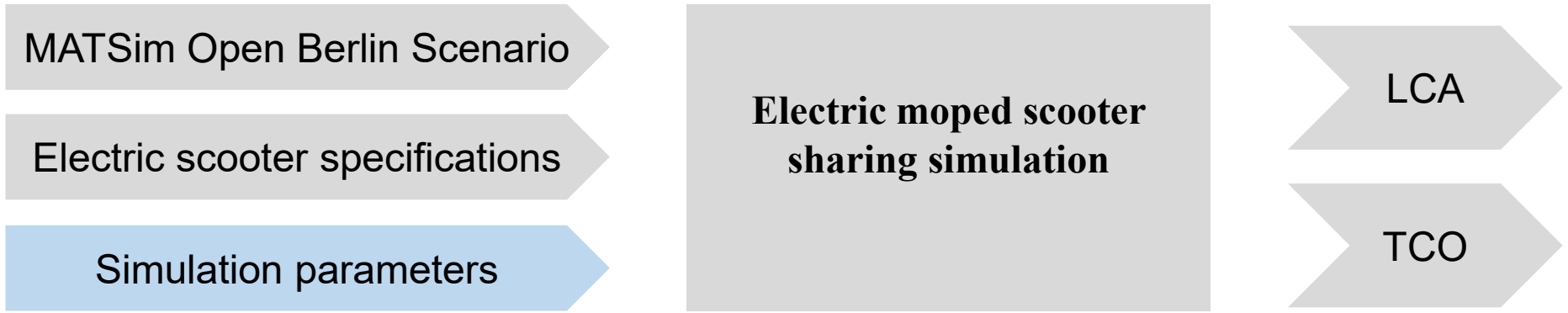

Vehicle

- Simulation Time: 1 year
- Scooter Lifetime: 5 years
- Operational fleet factor: 85.5 %
- Decay factor: 0,25%/ month

Behavior

- Yearly hours with rainfall: 13%
- Max. walking distance: 500 m
- Battery safety buffer: 20%
- Min trip distance: 1.5 km

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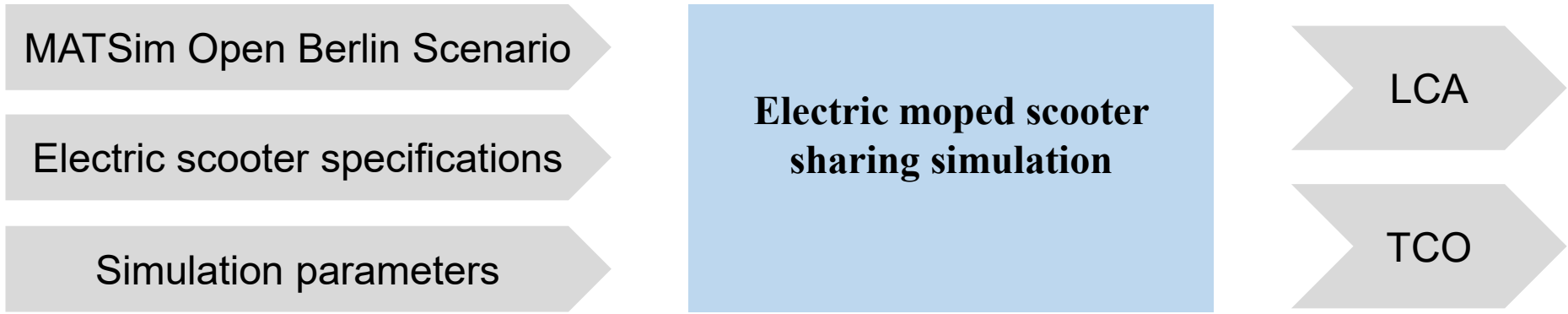

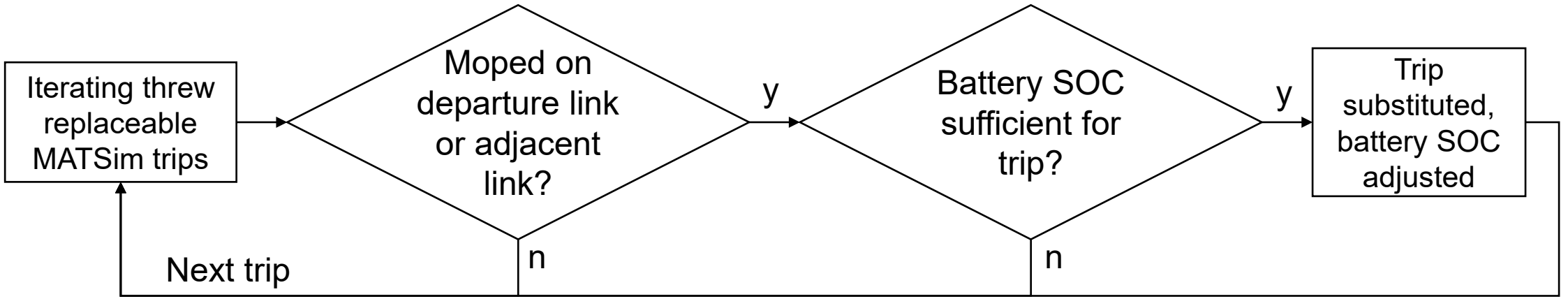

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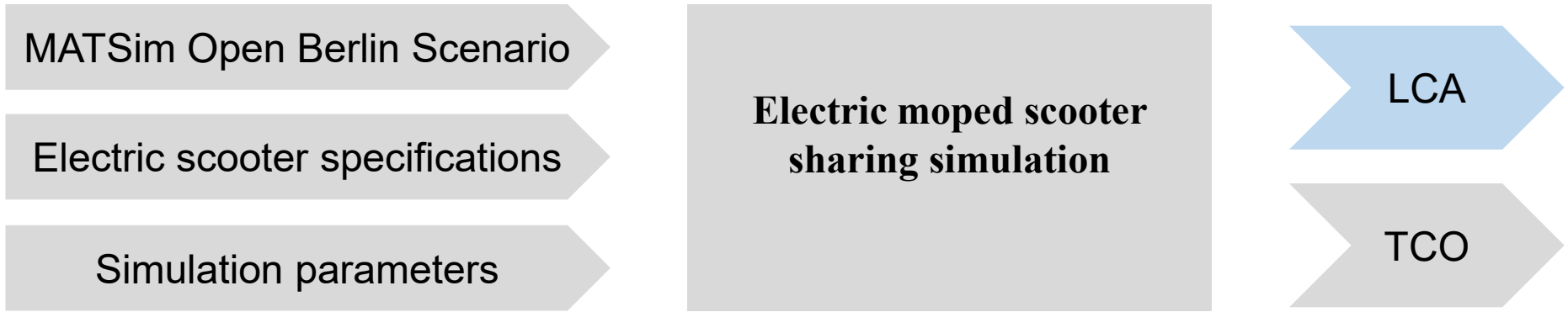

Life cycle assessment

- Cradle-to-grave: resource extraction, production, usage, disposal
- Functional unit: 1 km driven by fleet
- Database: ecoinvent 3.6. Cutoff Unit

Impact categories:

- Global warming potential (GWP)
- Additionally in the paper: cumulative energy demand (CED) acidification potential (AP), eutrophication potential (EP) and particulate matter formation potential (PMFP)

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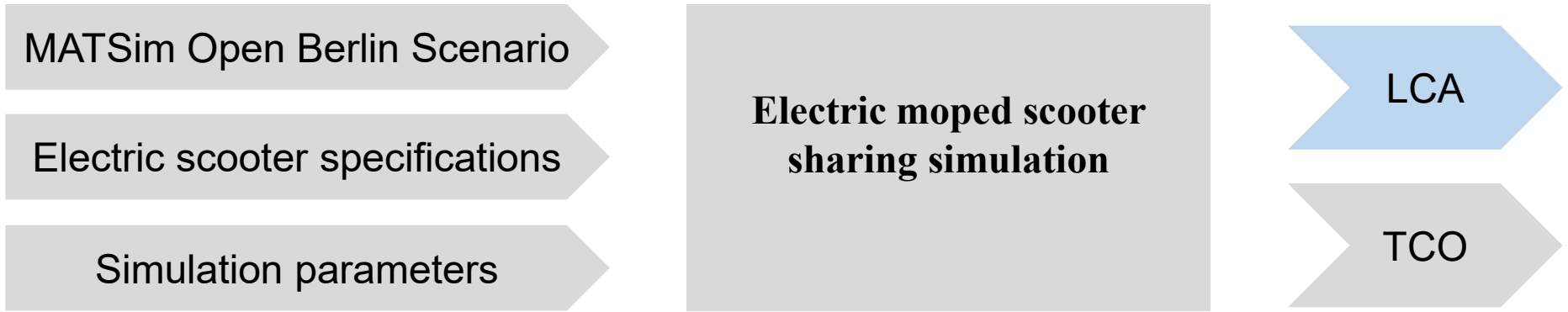

Electricity gid mix 2019 Germany

- Fossil: 45%
- Renewable: 38%
- Nuclear: 11%
- Import: 6%

Electricity 100% renewable

- Wind: 51%
- Photovoltaics: 35%
- Geothermal: 7%
- Water: 4%
- Biogas 3%

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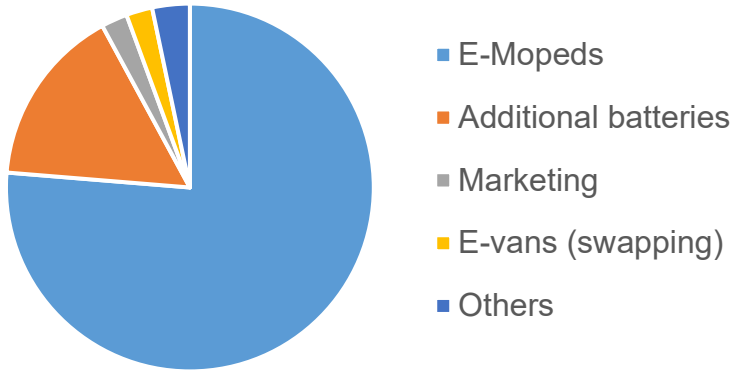
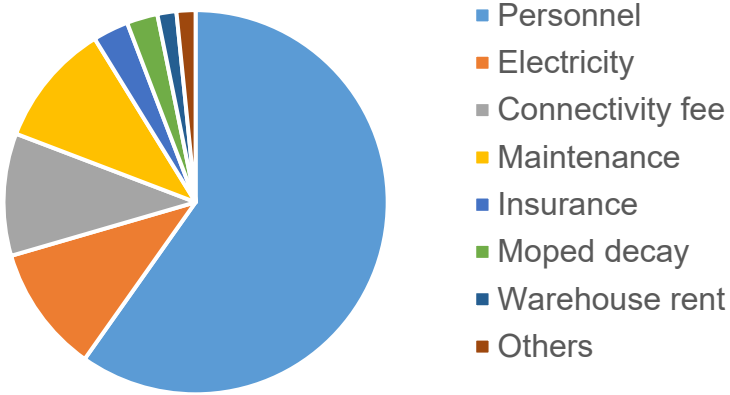
Capital cost



Operating cost



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Methodology

	Base Scenario	Medium Scenario	Max Scenario
Active Vehicles	2.500	10.000	50.000
Total Fleet/ life time	3.369	13.476	67.375

Additional specifications

- Battery swapping via e-vans (70%) and cargo bikes (30%)
- 50% additional batteries
- Battery swapping time of 1 hour

Results

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Results & Discussion

	Base Scenario	Medium Scenario	Max Scenario
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Total Fleet/ life time	3.369	13.476	67.375

Total e-moped trips	55,951	204,817	670,655
Av. utilization rate	22.38%	20.48%	13.41%

Results & Discussion

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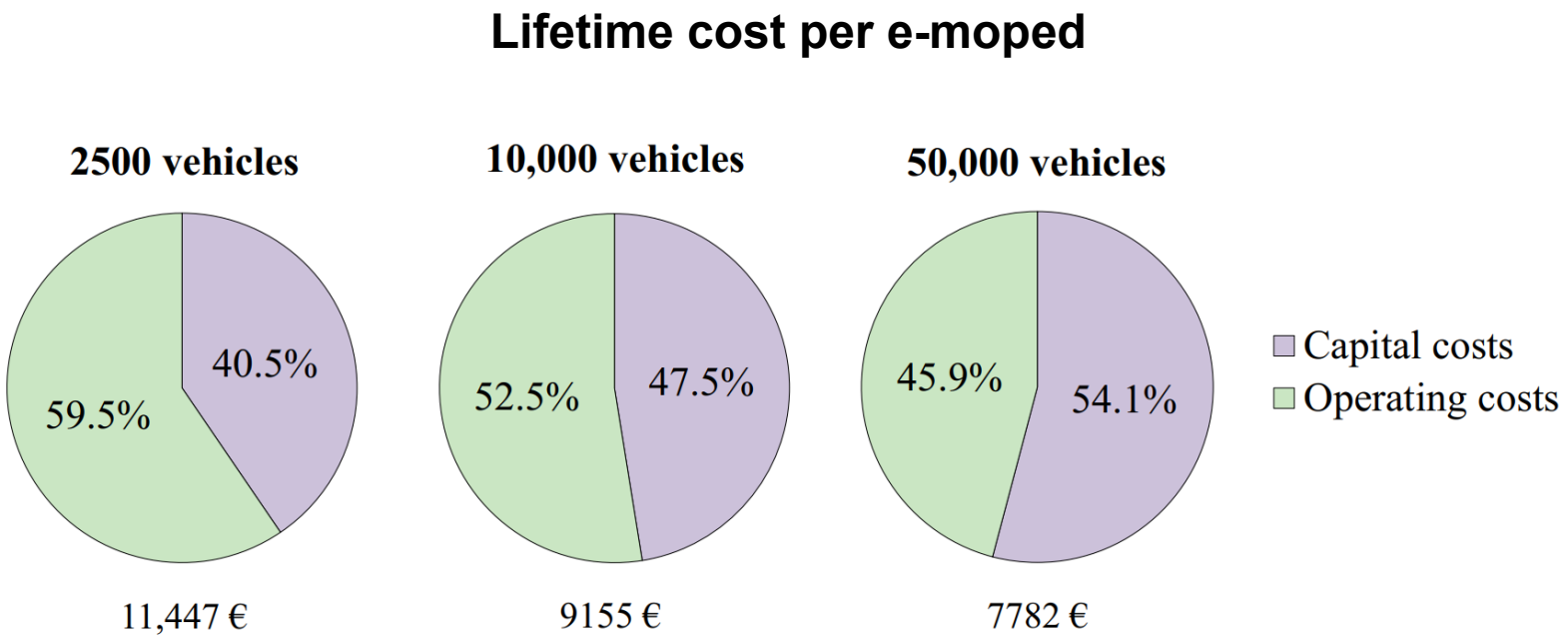
Total Fleet/ life time	3.369	13.476	67.375

Total e-moped trips	55,951	204,817	670,655
Av. Utilization rate	22.38%	20.48%	13.41%

Share e-moped trips of possible trips	5.52%	20.20%	66.14%
Share e-moped trips of all trips	1.95%	7.13%	23.33%

Results & Discussion

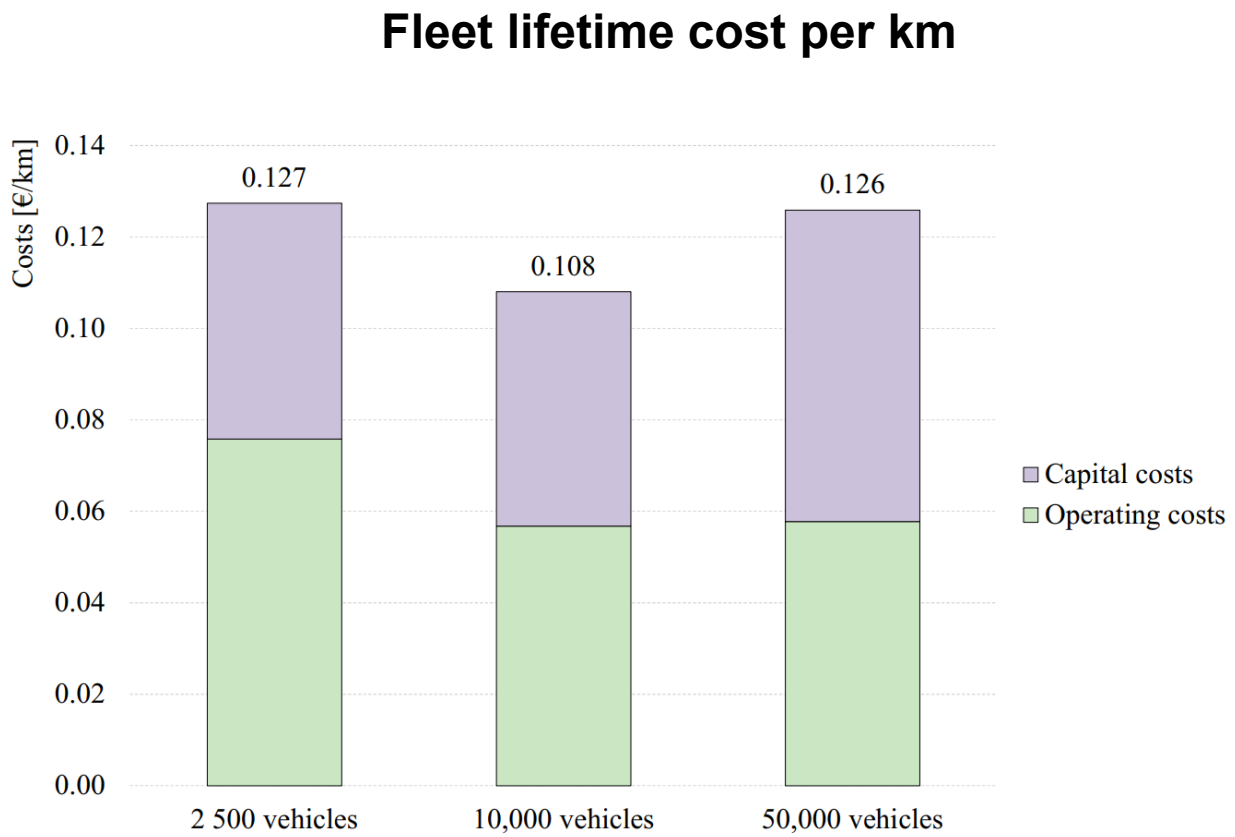
TCO



Results & Discussion

TCO

Typical sharing price in Berlin	0.2 – 0.3 €/min [1]
Distance-based price (20 km/h)	0.6 – 0.9 €/km
TCO VW ID.3 (15,000 km/a)	0.62 €/km [2]

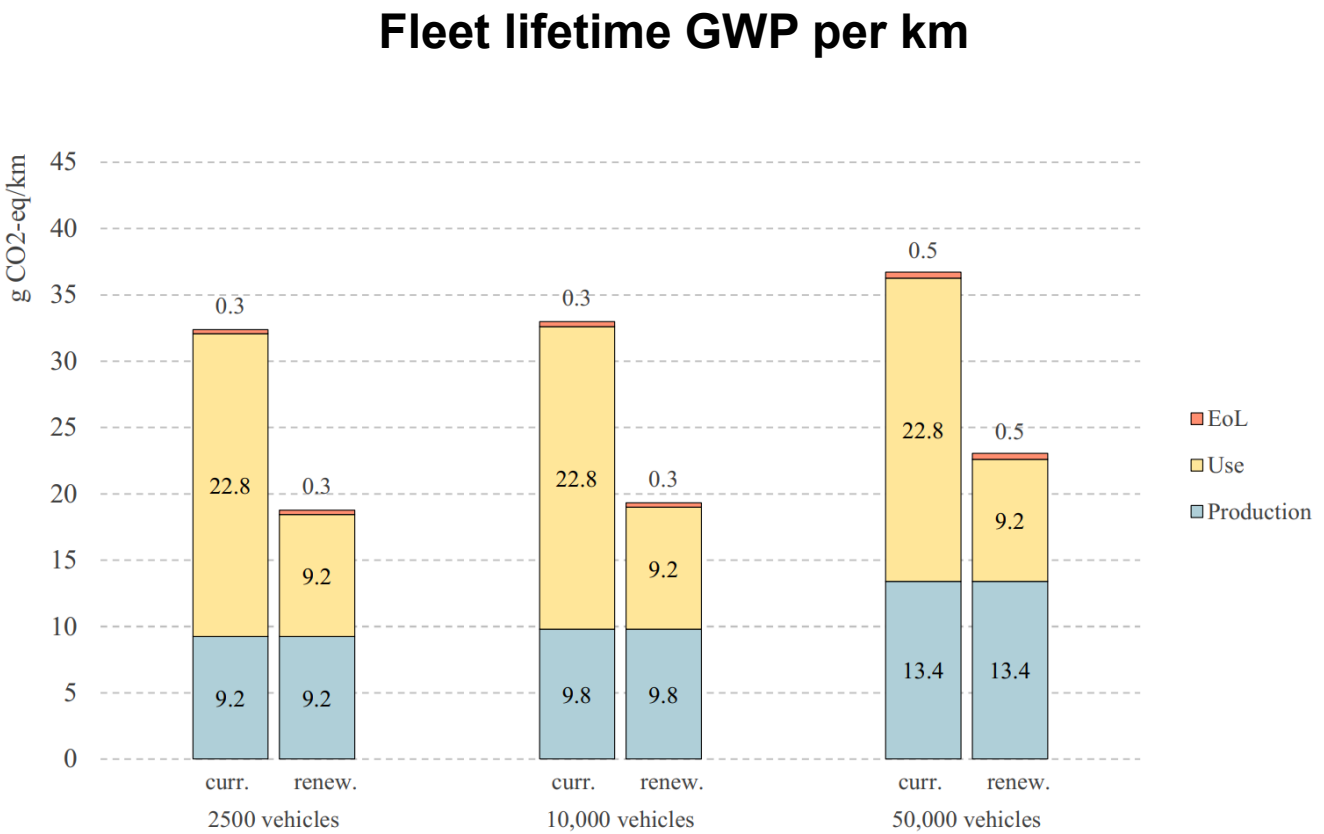


Results & Discussion

LCA

- Use phase emissions constant over scenarios
- Production and EoL emissions rise with the fleet size due to usage rate decreas

LCA VW ID.3 (15.000 km/a) 97 g CO2 eq/km [3]



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Conclusion

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Conclusion

- E-moped sharing offers economic and ecological advantages over battery electric private cars
- The advantages are reduced as the number of replaced journeys increases
- Due to low attractiveness during rainy hours (and possibly cold days) the service has limitations

➢ E-moped sharing can be a valuable part of a sustainable urban mobility solution when combined with other services such as car and ride sharing as well as public transport


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Thank you
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Sources

[1] https://emmy-sharing.de/preise/

[2] https://assets.adac.de/Autodatenbank/Autokosten/autokostenuebersicht_s-v.pdf

[3] Syré, Anne Magdalene; Shyposha, Pavlo; Freisem, Leonard; Pollak, Anton; Göhlich, Dietmar (2024): Comparative Life Cycle Assessment of Battery and Fuel Cell Electric Cars, Trucks, and Buses. In: *WEVJ* 15 (3), S. 114. DOI: 10.3390/wevj15030114.

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