ETH zürich MIE lab

Center for Sustainable Future Mobility (CSFM)

Vehicle-To-Grid for Car Sharing

Paper preprint

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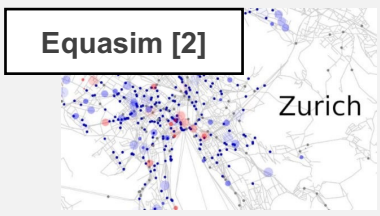
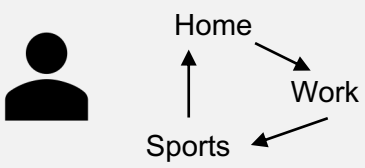
1 Introduction

Car-sharing services can effectively reduce the number of privately owned cars and thereby CO_2 emissions. Furthermore, their batteries may be relevant to providing ancillary services with so-called "vehicle-to-grid" (V2G) technology, i.e., charging and discharging the vehicle dependent on power demand. In this project, we aim to quantify the potential gains of V2G for car sharing owners and grid operators in future scenarios for 2030.

2 Methods – Simulation of Future Scenarios

Simulation of future car sharing behaviour (agent-based)





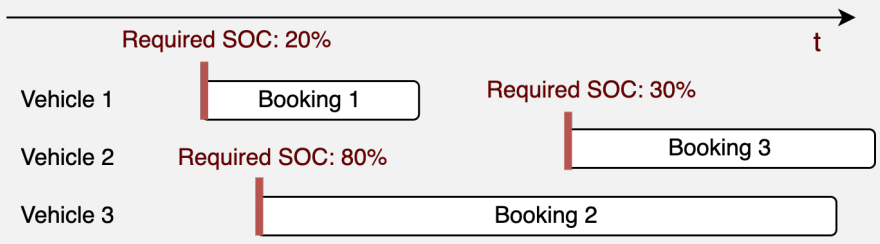
Home → *Work*
Car / Bus / Car sharing?

- Scale current population
- Simulate mobility profiles
- Sample car sharing users
- Decide when they use car sharing
- Run simulation & collect car sharing trips

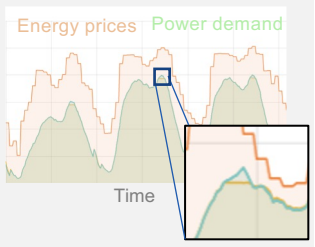
A mode choice model is learnt data-driven

→ Random Forest trained on mobility dataset including car sharing mode

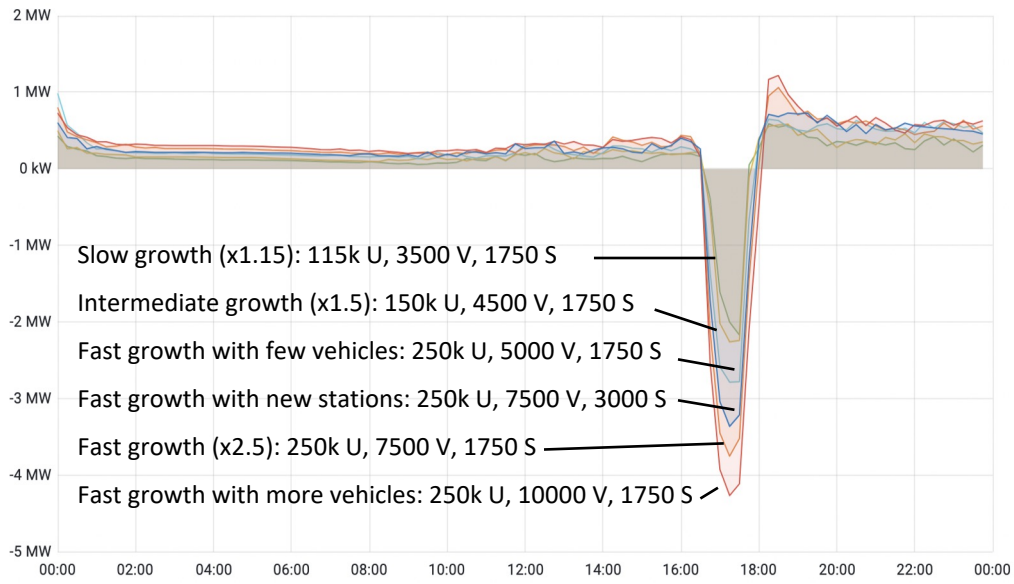
3 Methods – V2G Optimization



- Maximize fleet-level objective, e.g.
  - Peak shaving
  - Revenues for the car sharing service
- Constraints:
  - Car availability for reservations
  - Sufficient State-of-Charge (SOC) for reservations



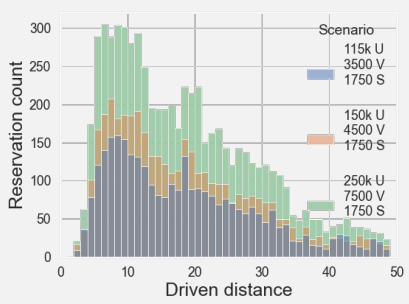
4 Results and Discussion

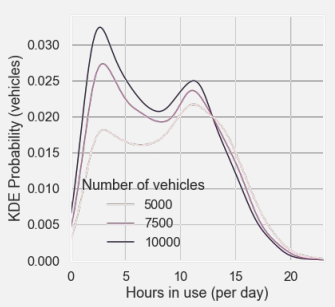


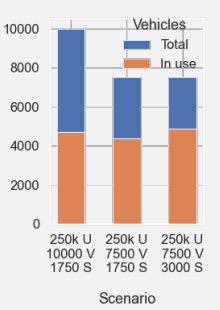
→ The highest peak shaving potential can be achieved when many vehicles are deployed at fewer stations

→ New stations induce more demand than additional vehicles at existing stations

→ Fewer vehicles lead to higher utilization rates and less opportunity for V2G







5 Conclusion and Expected Impact

- Despite the higher utilization rate of shared vehicles, there is a clear potential for V2G.
- There is a sweet spot where both car sharing fleet owners and grid operators benefit from V2G.
- Decision makers should consider the potential for ancillary services of EV fleets and facilitate the deployment of V2G by removing barriers.

References

1. Nespoli, Lorenzo, et al. "National-scale bi-directional EV fleet control for ancillary service provision." *arXiv preprint arXiv:2210.07756* (2022).
2. Hörl, Sebastian, and Milos Balac. "Introducing the eqasim pipeline: From raw data to agent-based transport simulation." *Procedia Computer Science* 184 (2021): 712-719.

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