Technical University of Munich
TUM School of Engineering and Design
Institute of Automotive Technology

User-centered Infrastructure Design

Charging & Operations

Understanding behavior

Mobility data sources

In-house GPS & data loggers for high customizability

User surveys uncovering barriers & motivations

3 million km

423 vehicles

tracked

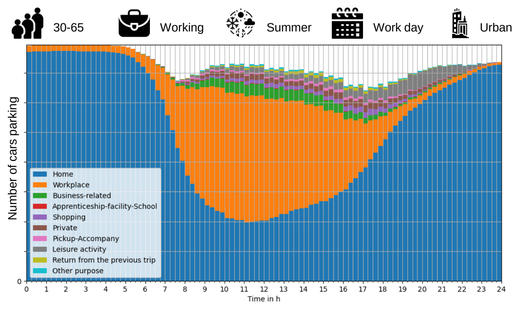
What is your customers' mobility behavior?

Charging Infrastructure

Demand

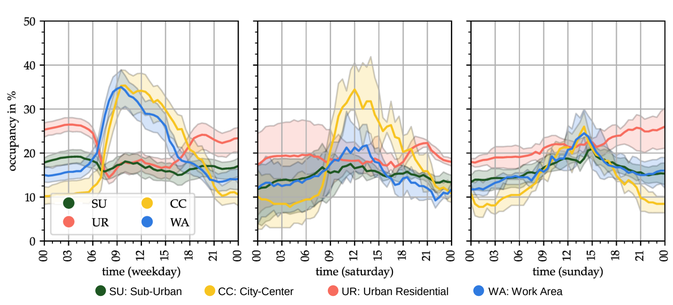
Private

Parking behavior derived from **Mobility in Germany** study enables **charging demand estimation**.



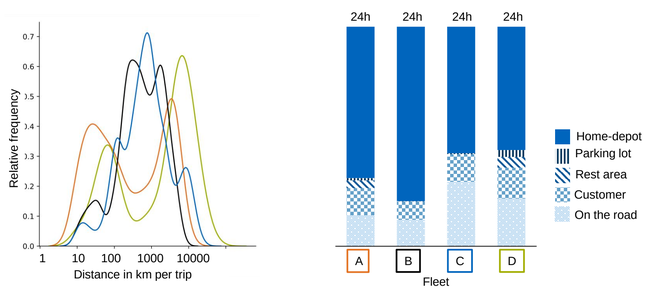
Public

- Charging demand of **public charging** stations can be clustered into **four groups**
- Publication of **Hamburg public charging station dataset** including **occupancy** rates.



Commercial

Commercial use-cases entail great **variety** in terms of required **energy**, dwell **locations** and dwell **times**

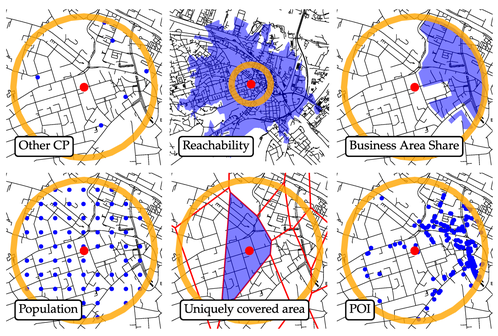


Where and when will people charge in 2030 (charging split)?

Sizing and Placement

Site evaluation

- **Geographic information** for **automated** site evaluation
- **Classification** into one of four charging demand groups based on **local characteristics**



Charger deployment Singapore

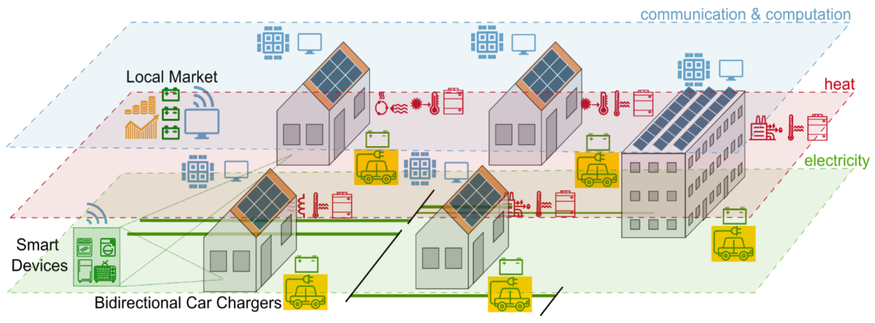
- Validated **adequacy of charger deployment & grid infrastructure upgrade plans** in collaboration with local planning agencies
- Evaluated **impact of smart charging management** and **incentive-based peak demand shifting** on reducing peak energy demand.

Which charging infrastructure achieves high coverage & occupancy?

Design of Coupled Systems

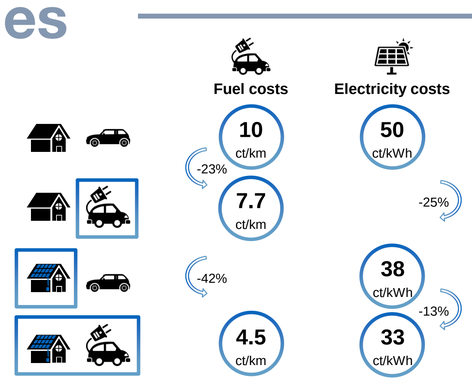
Microgrid simulation

- Bi-directional EV charging is designed as a part of sector coupled multi-energy microgrids.
- Local energy markets or simple energy management schemes can benefit from a mobile battery in an EV
- Possible to perform a static cost optimization and a dynamic simulation study



EV-PV-Synergies

- Electric vehicle has **lower fuel costs** than combustion engine vehicle
- C**ombination** of electric vehicle with **photovoltaic** system has high cost saving potential and can **cut fuel costs in half**



How can renewable energy reduce the fleet cost?