BRIDGING TRANSPORT AND ENERGY MODELLING:

Deriving Residential Building Occupancy and BEV Charging Demand from Agent-Based Transport Models for Neighborhood-Level Energy Planning

Ella Eisemann, Knut M. Heidemann, Moritz Bergfeld, Daniel Krajzewicz, Simon Nieland, Matthias Heinrichs

Ella Eisemann, Institute of Transport Research – DLR German Aerospace Center

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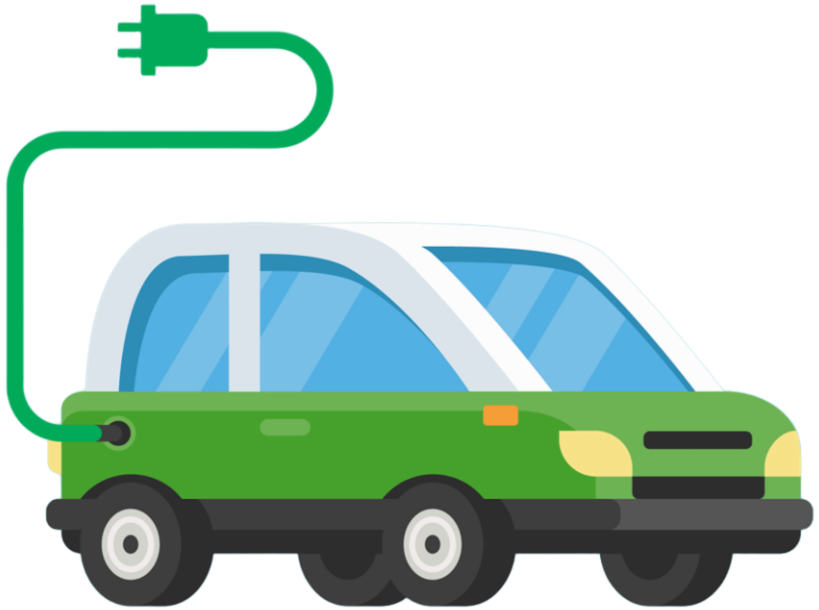
DLR

The rise of electric vehicles



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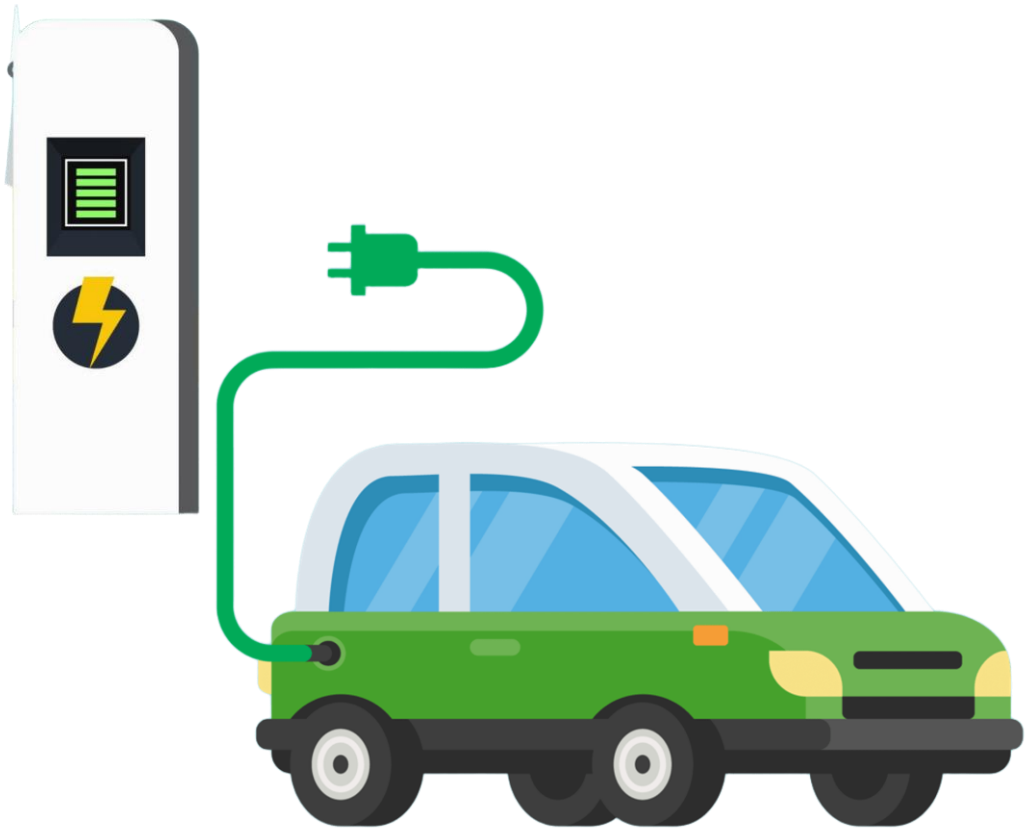
The rise of electric vehicles



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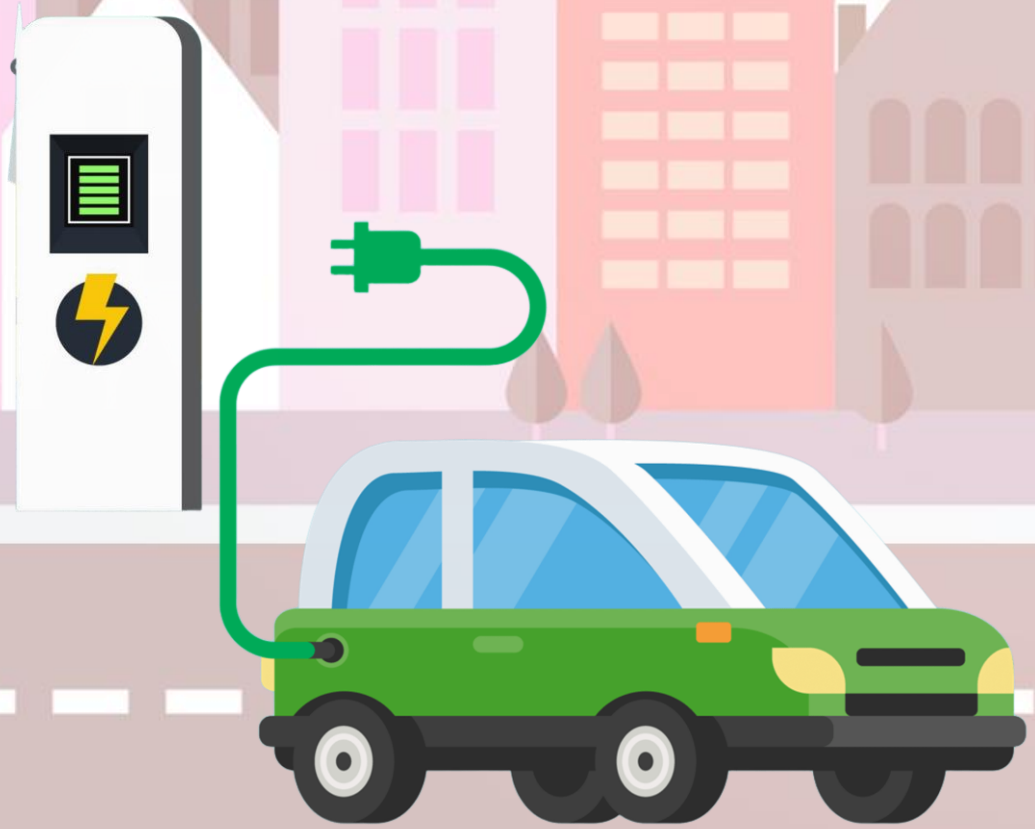

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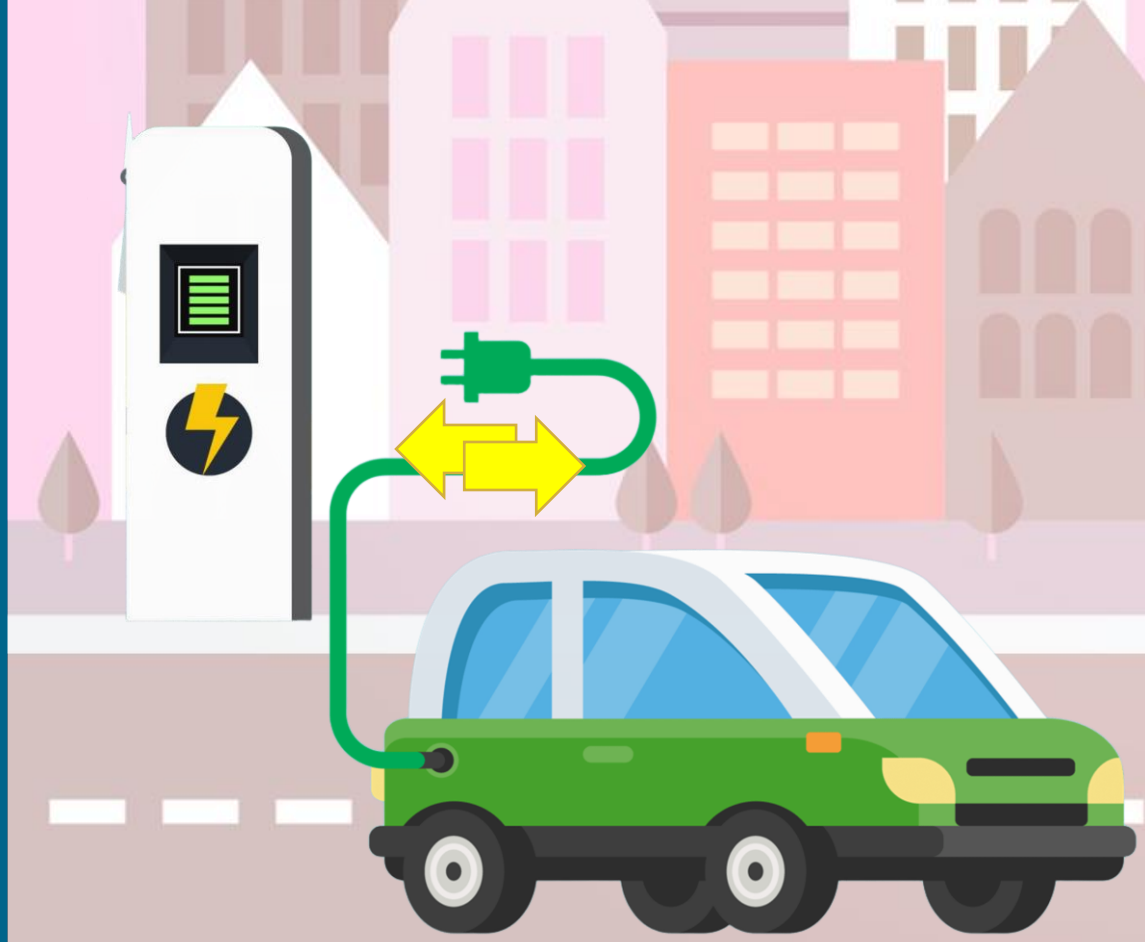
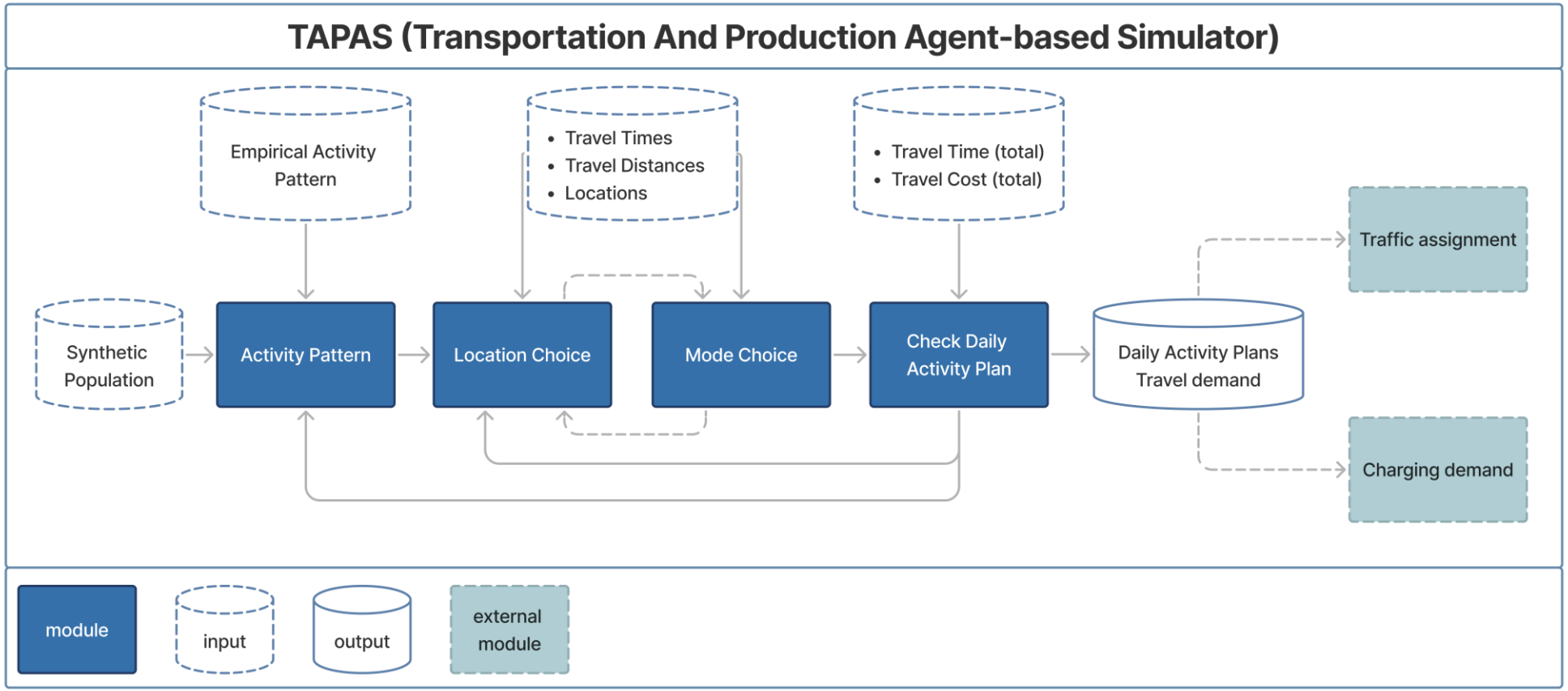


Microscopic, agent-based travel demand modelling



Matthias Heinrichs, Daniel Krajzewicz, Rita Cyganski, Antje von Schmidt, Disaggregated Car Fleets in Microscopic Travel Demand Modelling, Procedia Computer Science, Volume 83, 2016, Pages 155-162, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2016.04.111.

BEV charging demand model CHARGIN

- Daily plans of vehicles from real-world or modelled mobility patterns
- With the driving and parking durations and locations, the battery state is calculated
- Depending on the locations charging possibilities are available
- Based on charging power and price, charging events are modelled

→ individual charging decisions and events are calculated per vehicle

→ these charging demands are aggregated for the entire fleet and geography

Bergfeld, M., Rottoli, M., & Krajzewicz, D. (2025). Consumer Habits based Approach to model Recharging and Grid INtegration (CHARGIN) (1.0). Zenodo. https://doi.org/10.5281/zenodo.10074461

What can agent-based transport modelling contribute to energy modelling?

Building Occupancy

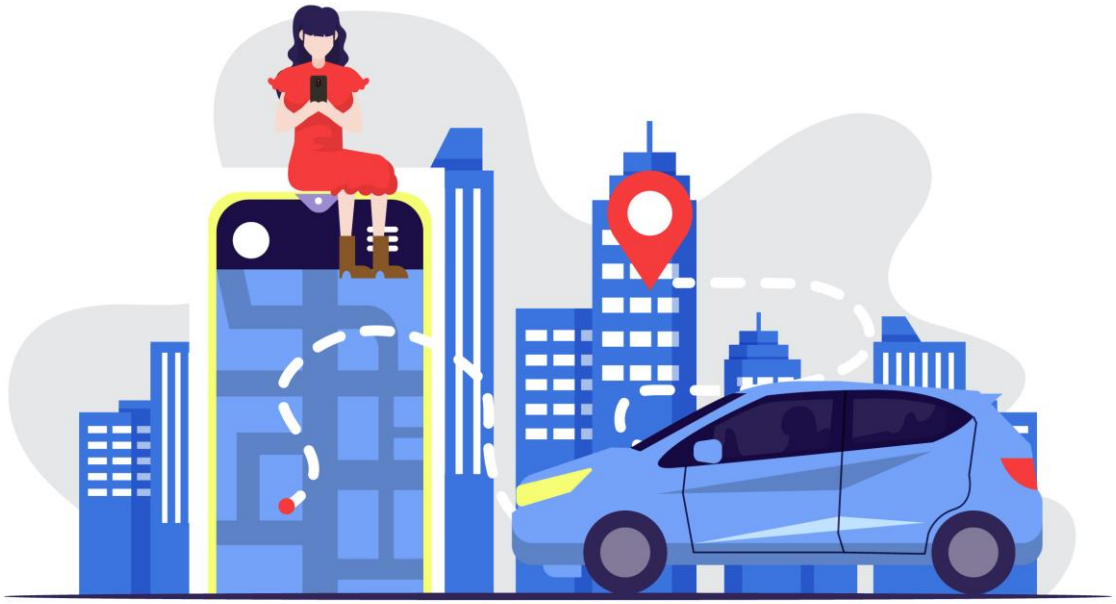
- When are people where?

BEV charging demand

- When and where does charging happen?

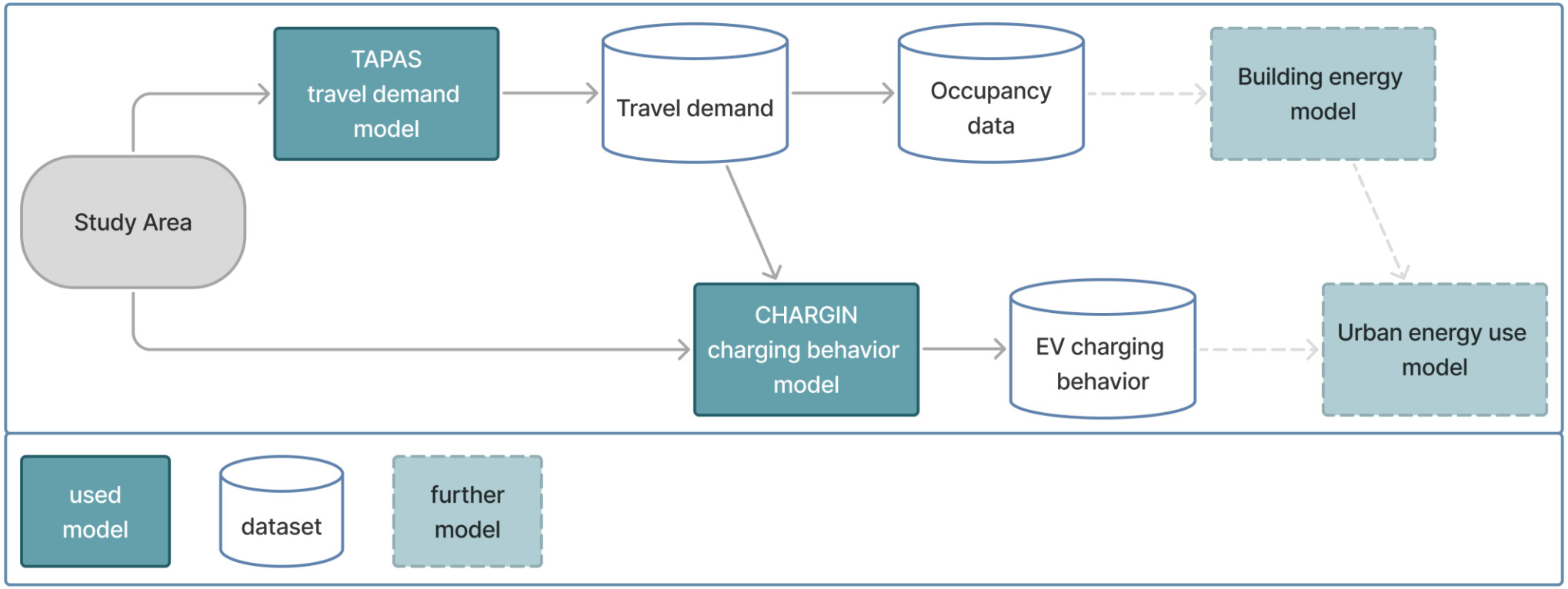
The potential of V2G bidirectional charging

- How could Vehicle to Grid bidirectional charging aid manage electricity grid stress?



Graphic designed by freepik.com

Modeling pipeline



Case study

Study area:

- A part of Moabit, Berlin
- 130 residential addresses, 4483 persons, 2754 households, 1016 vehicles

3 Scenarios of % of BEV in Berlin

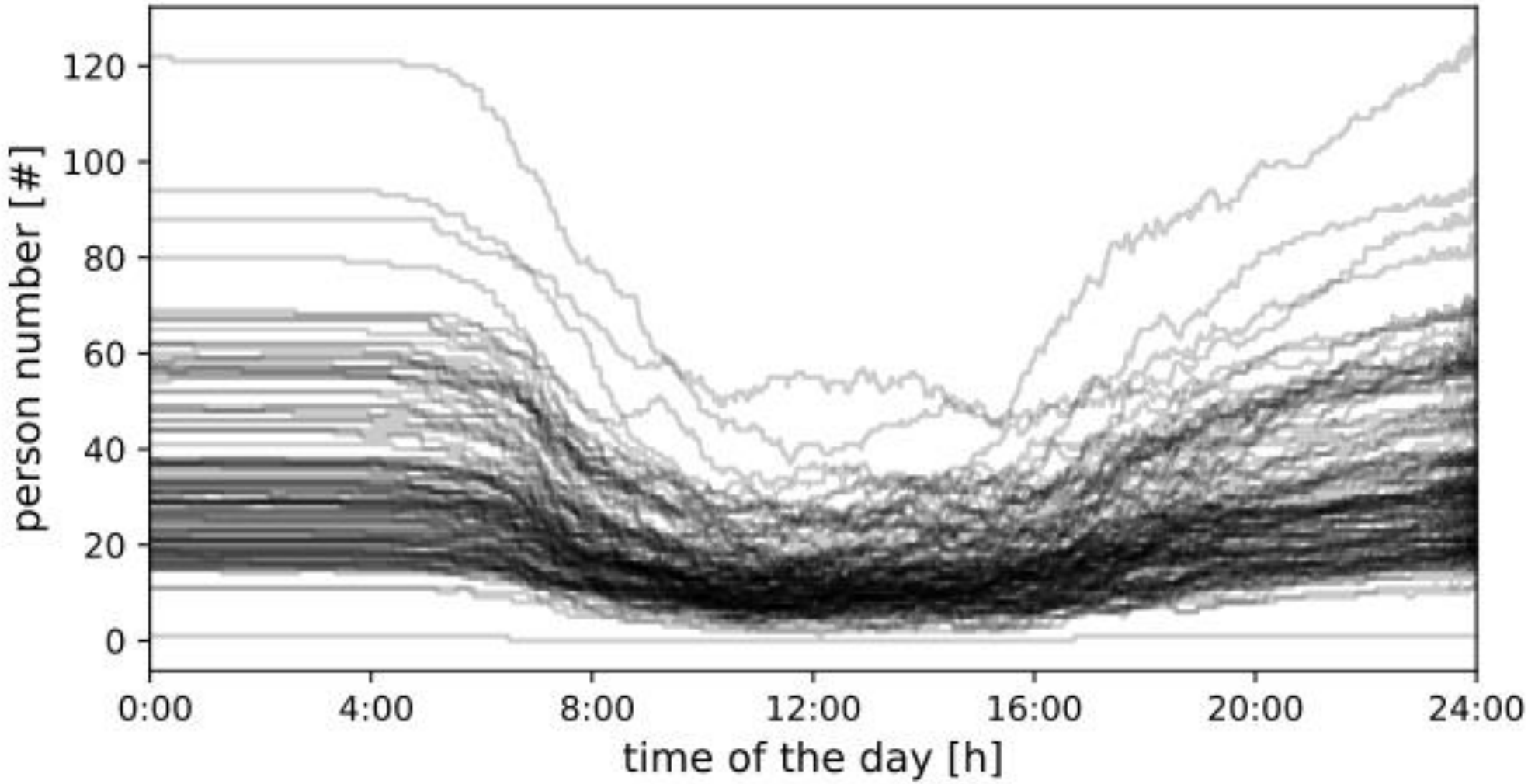
2025: 3,4% BEV

2030: 20% BEV

2050: 75% BEV

Residential Building Occupancy

Residential Building Occupancy



Charging events
(averaged across multiple model runs)

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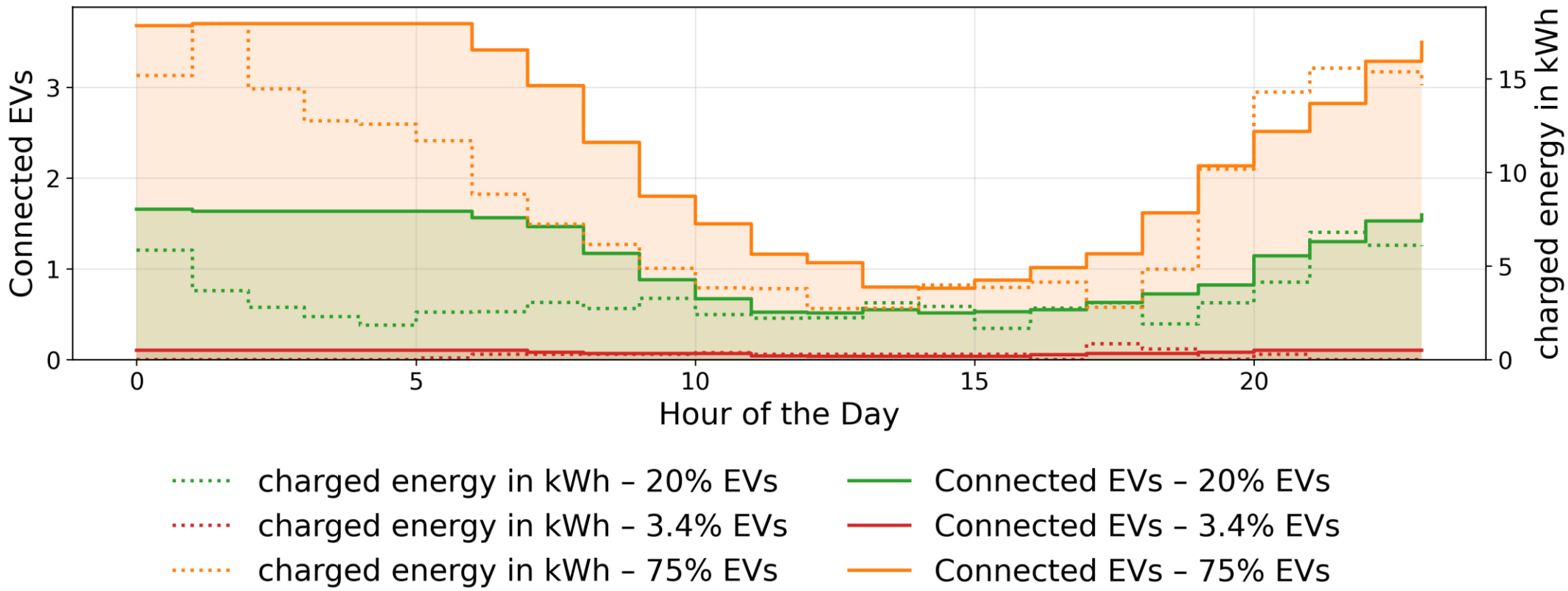


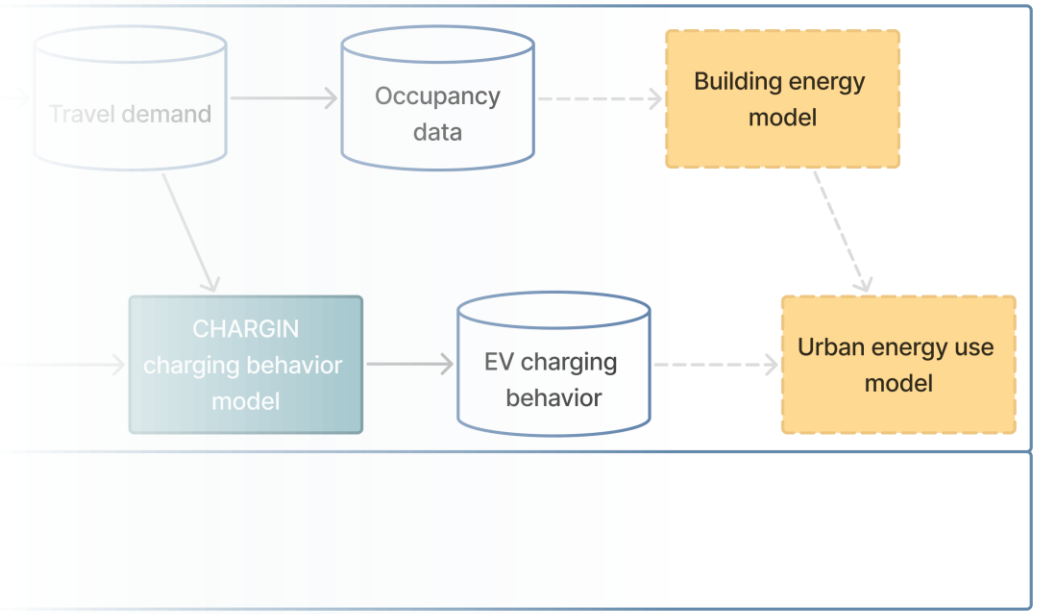
Validation and next steps

Validation

- Validation of occupancy profiles is very difficult

Next steps

- Building and urban energy use modelling using this data has been done and is being published
- After the neighborhood energy modelling a comparison can be done to other state-of the art occupancy profile data
- Occupancy profiles for different locations, not just residential buildings could also be analyzed.



Learnings

Occupancy

Deriving occupancy data for building energy modelling is possible and useful.

Generic assumptions of a population being at home, e.g., between 9 p.m. and 7:30 a.m. don’t hold.

BEV charging demand

BEV charging demands show as expected overnight charging events are the most prevalent

Next step: Map charging demands on both at home, public and other charging

Bidirectional Charging V2G

Highest BEV connection rate coincides with the highest home occupancy rate, underlining the potential of BEVs to mitigate peaks in electricity demand.

Especially pricing policies could push users towards daytime-charging and thus better charging point utilization rates

- Models are still “just“ statistical representations of a reality, not reality itself.
- Microscopic Transport models can provide high spatial and temporal resolution, while on the other hand being computationally very intensive.
- Projections of mobility behaviour can help mitigate problems in sustainable urban transitions.
- Transport modelling and energy modelling need to grow closer together.

THANK YOU

Ella Eisemann

ella.eisemann@dlr.de

Institute of Transport Research

Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR)

German Aerospace Center

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Author:	Ella Eisemann
Institution:	Institute of Transport Research – DLR
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