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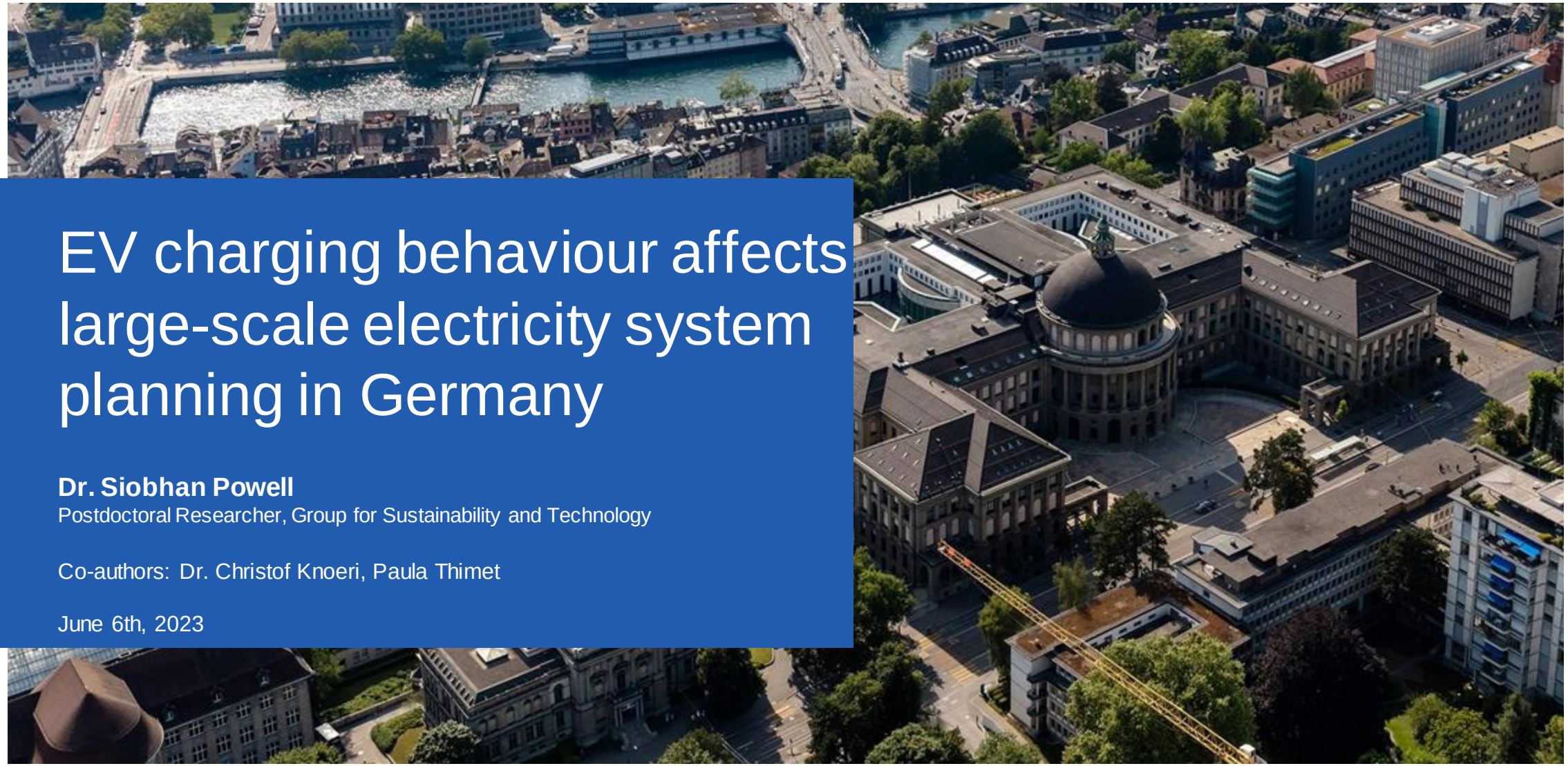


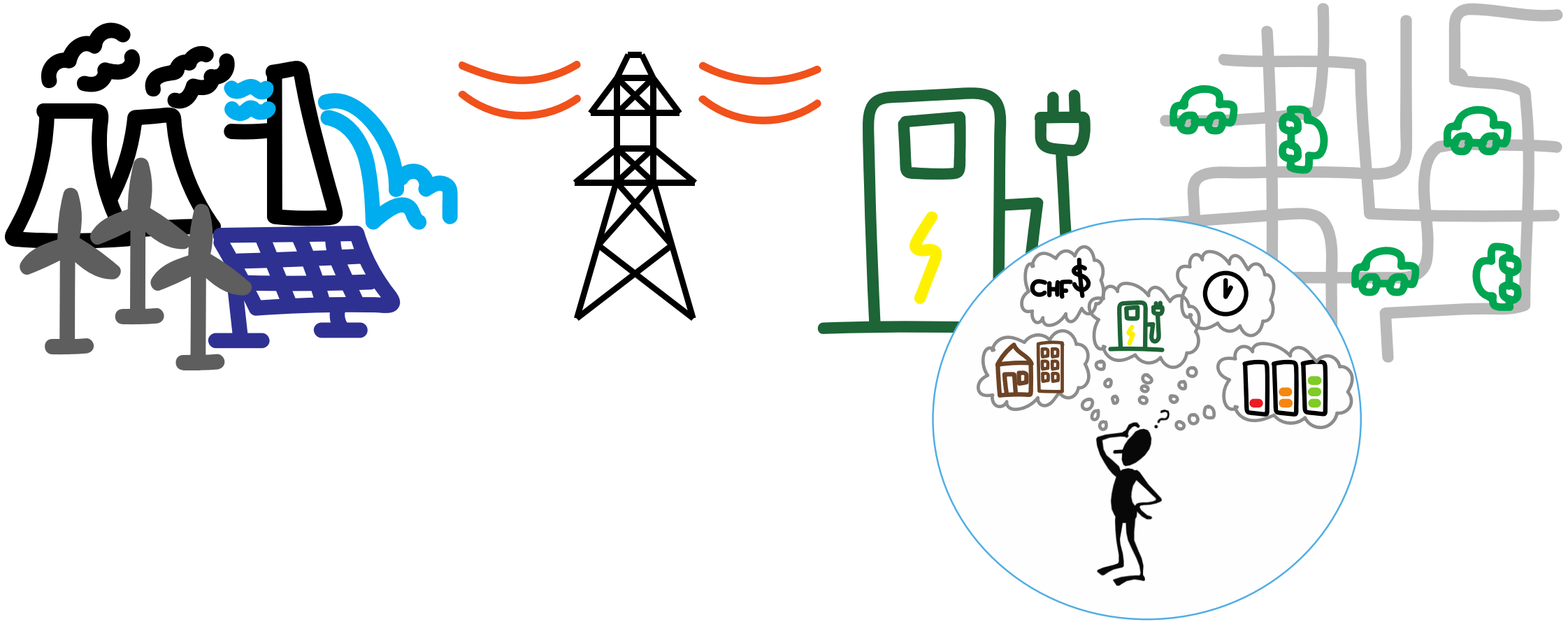
EV charging behaviour affects large-scale electricity system planning in Germany

Dr. Siobhan Powell
Postdoctoral Researcher, Group for Sustainability and Technology

Co-authors: Dr. Christof Knoeri, Paula Thimet

June 6th, 2023

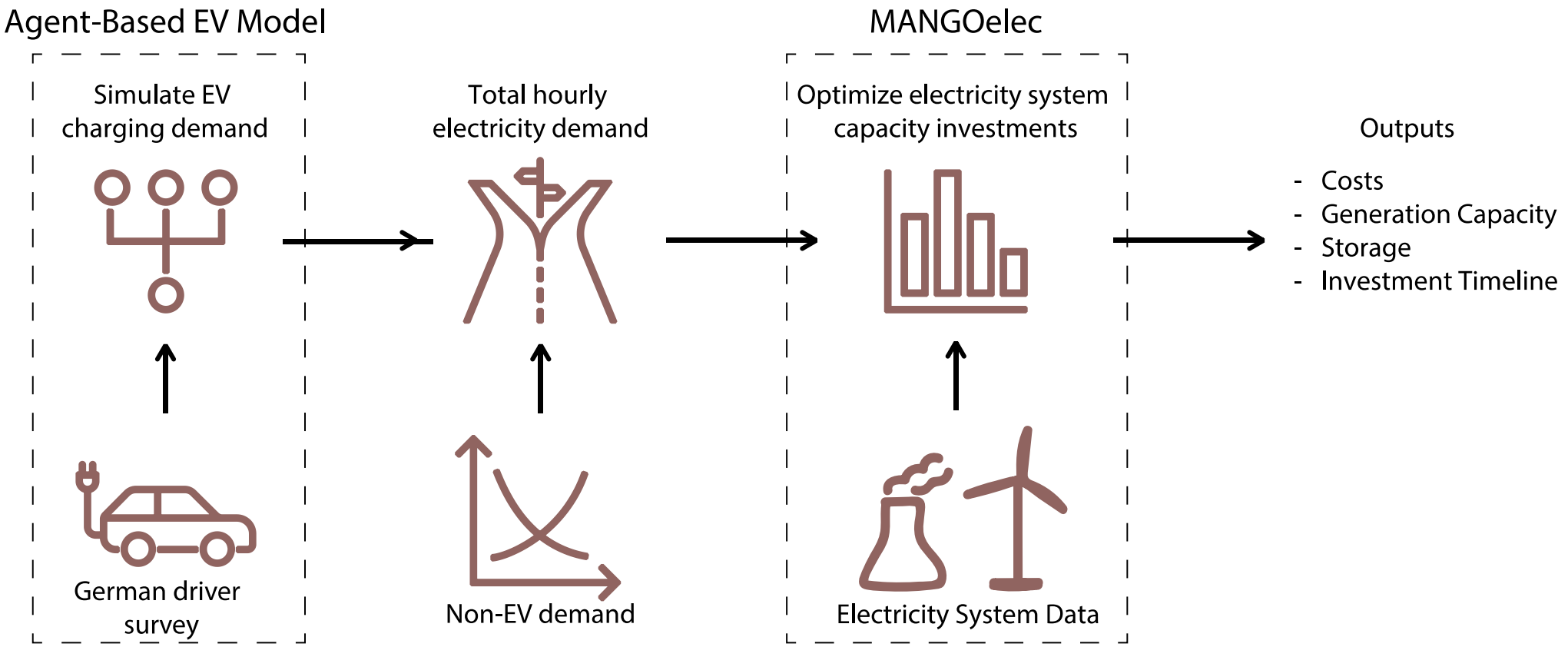
EV charging couples the transportation and electricity sectors



Research Question: *how can policies related to EV charging help optimize this coupling?*

First step: understanding the impact of behaviour. Case study: Germany.

Methods soft-couple EV and grid models for Germany

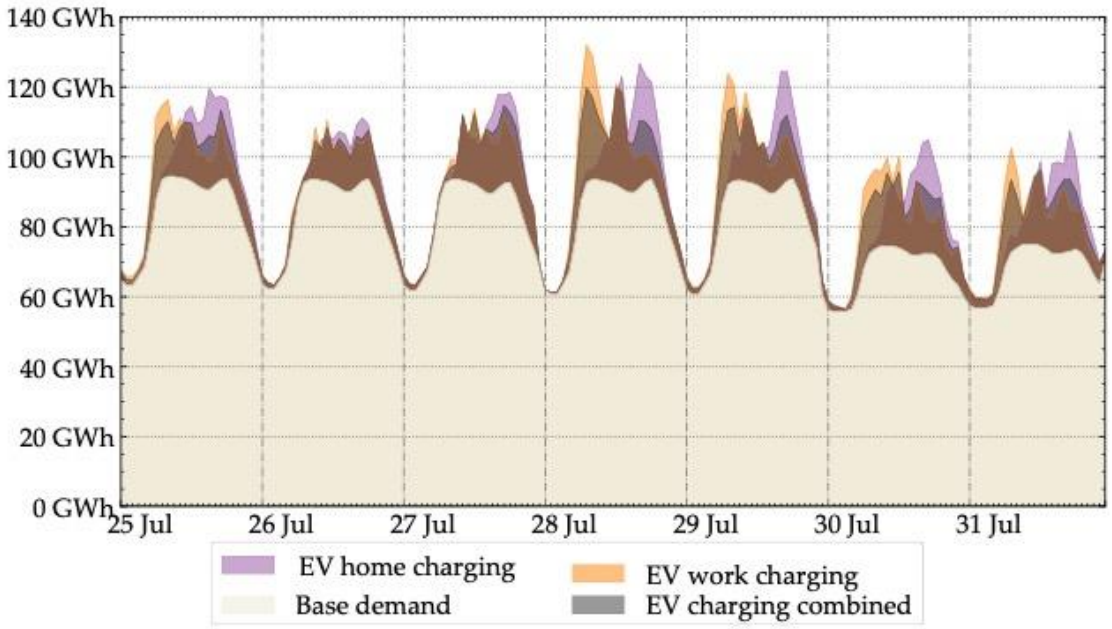


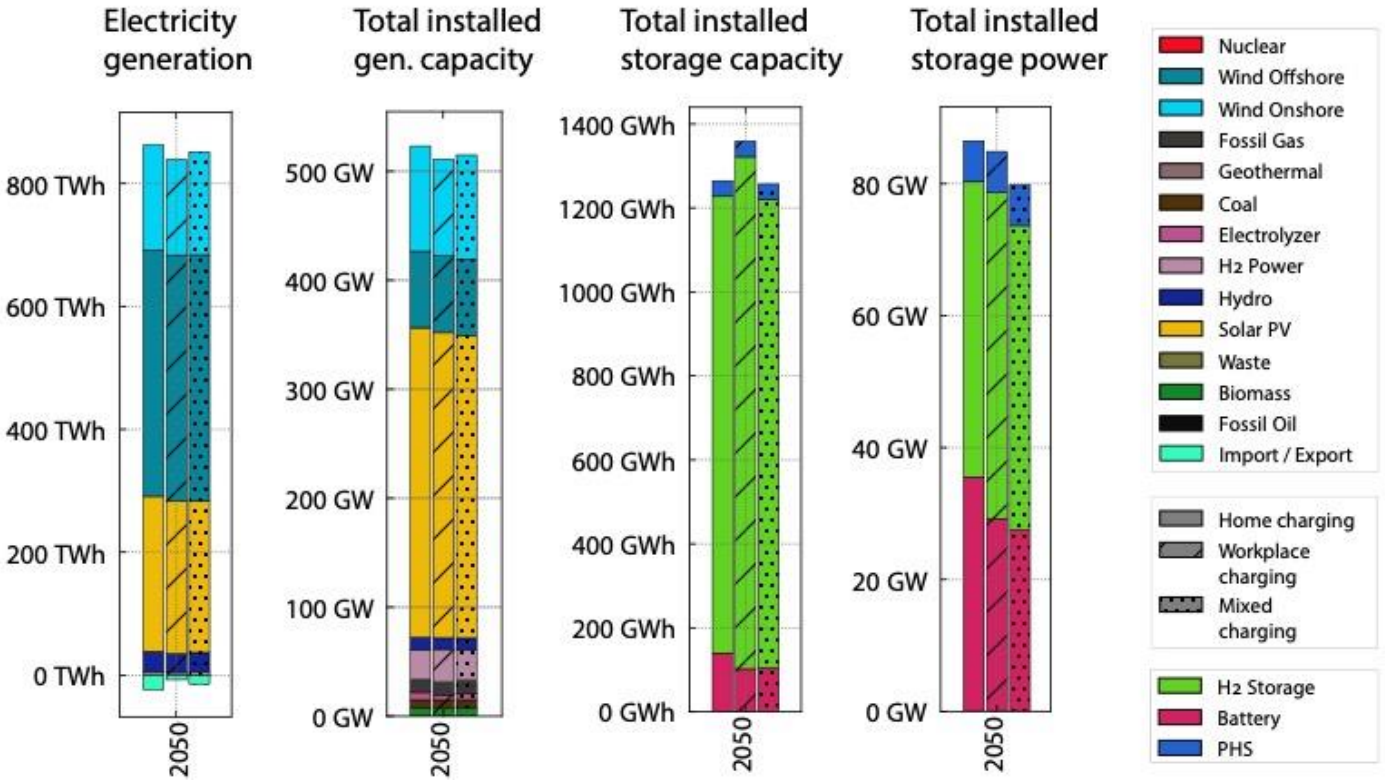
- ABM encodes different behaviour patterns [1]
- Parameterize on drivers' region to estimate future, large-scale demand (future: socioeconomics) [5, 6]

- MANGOelec: MILP of capacity investments 2022 – 2050 with 5-year investment stages [2]
- Seasonal storage represented by linking daily profiles [3]
- Non-EV demand from DESSTINEE model [4]

[1] Gschwendtner et al., 2023; [2] Thimet and Mavromatidis, 2023; [3] Kotzur et al., 2018; [4] Bossmann and Staffell, 2015; [5] Fischer et al., 2019; [6] Powell et al., 2022.

Early results show benefits from daytime charging behaviours





We compare three behaviour scenarios:

1. All drivers can and prefer to charge at home
2. All drivers who work can and prefer to charge at work
3. Drivers in the north prefer home, in the south prefer work.

Early results:

- Home charging → high cost, more solar + battery, higher exports
- Work charging → low cost, less generation, more seasonal storage
- Mixed charging → medium cost, lowest need for storage

Conclusion: Behaviour matters! Many next steps and ongoing further analysis.

References

[1] Gschwendtner, Christine, Christof Knoeri, and Annegret Stephan. "The impact of plug-in behavior on the spatial–temporal flexibility of electric vehicle charging load." *Sustainable Cities and Society* 88 (2023): 104263.

[2] Thimet, Paula, and Georgios Mavromatidis. “What - where - when: Investigating the role of storage for the German electricity system transition”. *Applied Energy.* Under review.

[3] Kotzur, Leander, et al. "Time series aggregation for energy system design: Modeling seasonal storage." *Applied Energy* 213 (2018): 123-135.

[4] Boßmann, T., and Iain Staffell. "The shape of future electricity demand: Exploring load curves in 2050s Germany and Britain." *Energy* 90 (2015): 1317-1333.

[5] Fischer, David, et al. "Electric vehicles’ impacts on residential electric local profiles–A stochastic modelling approach considering socio-economic, behavioural and spatial factors." *Applied energy* 233 (2019): 644-658.

[6] Powell, Siobhan, et al. "Charging infrastructure access and operation to reduce the grid impacts of deep electric vehicle adoption." *Nature Energy* 7.10 (2022): 932-945.

Dr. Siobhan Powell
Postdoctoral Researcher
spowell@ethz.ch

ETH Zürich
Group for Sustainability and Technology
56/58 Weinbergstrasse
8092 Zürich

https://sustec.ethz.ch/

Thank you!