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SCCER – FURIES
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The Potential of Residential Rooftop Photovoltaic Energy to Charge Electric Cars for Daily Use

Henry Martin, René Buffat, Dominik Bucher, Martin Raubal

The transport sector is responsible for **36% of the Swiss** total annual **energy demand**. If the transport sector is electrified, significant additional power production capabilities are required. Photovoltaic (PV) energy is the renewable energy source with the highest remaining potential in Switzerland. However, due to its fluctuating power production, it is unclear how PV can contribute to fuel electric vehicles (EV). In this work, we analyze **how much rooftop PV on homes of electric vehicle owners can contribute to cover the energy demand of their vehicles**. In our analysis, we combine a **spatio-temporal PV rooftop model** with **trajectories of electric vehicles** and **sensor information from the cars' batteries**.

Input data

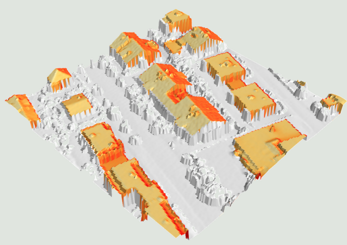

Figure 1: Photovoltaic potential on rooftops [1]

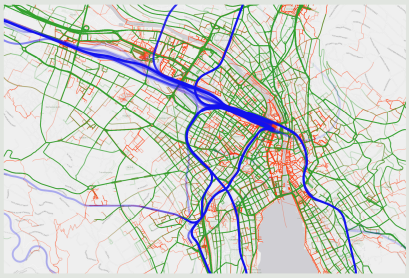

Figure 2: Map-matched movement trajectories of study participants

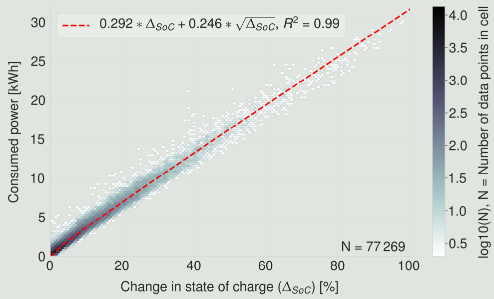

Figure 3: Power consumption as a function of change in state of charge

Results

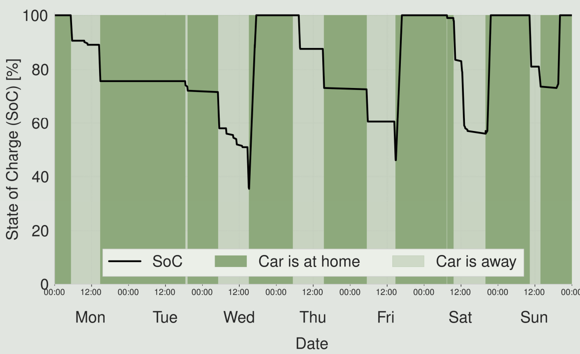

Figure 4: Trajectory data based classification of the EV locations and their charging states for one week in June

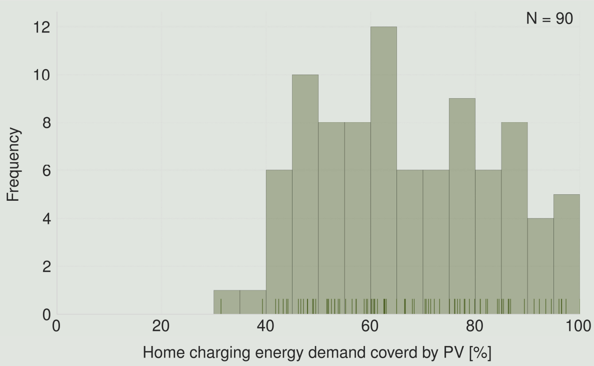

Figure 5: PV coverage potential of all users of our study

Using a PV rooftop model covering the whole of Switzerland (Fig. 1) [1], we compute the potential PV power production on the roofs of the homes of the 90 EV owners of our sample. Combining this with their movement trajectory data (Fig. 2) and the battery state of charge (SoC) recorded by the EVs (cf. Fig. 4), we can determine the total charging demand by applying the power consumption function (Fig. 3) whenever a users car is at his or her home location and is not fully charged. Putting the resulting power demand into relation with the PV production gives an assessment of how much of the power demand could be covered by on-site PV production. Figure 5 shows the potential percentage of PV energy coverage considering that the users' roofs are completely covered by PV panels. Our analysis shows that the **users of our study can cover in average 66.7% of their home charging demand using PV**. For future work, we plan to simulate energy demands more accurately and incorporate hypothetical batteries at users' homes.

[1] R. Buffat, S. Grassi, and M. Raubal. "A scalable method for estimating rooftop solar irradiation potential over large regions." Applied Energy 216 (2018): 389-401.

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