

Research Project

Consumer-driven impacts on the Grid: Peer effects on the diffusion of technologies and strategies to manage PV electricity and demand (Peer-to-Grid)

Third-party funded project

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Principal Investigator(s) [Patel, Martin](#) ;

Co-Investigator(s) [Hahnel, Ulf](#) ;

Organisation / Research unit

Departement Psychologie / Psychology of Sustainability and Behavior Change (Hahnel)

Department

Departement Psychologie

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Solar photovoltaics (PV) is becoming a prime source of electricity supply worldwide, including Switzerland. As a result, the energy sector is undergoing significant changes, first, because PV is intermittent in nature, preventing it from supplying electricity on demand, and secondly, because the investments are made by consumers, leading to distributed electricity generation. Moreover, low-carbon technologies, such as heat pumps and electric vehicles, are significantly increasing their share of electricity consumption in final demand, resulting in particularly sharp power peaks and a modified load profile. Ongoing experiences on the diffusion of renewable energy and energy efficient technologies have illustrated the key role of consumers for a successful energy transition. Consumers impact the instantaneous balance between electricity supply and demand, e.g., the duck curve in California, but also the electricity infrastructure and the business of other actors, such as utility companies. However, the various technological, economic, and social impacts of consumer preferences on technology diffusion and performance have barely been analysed to date, partly because this research requires a strong interdisciplinary approach. Such an approach and resulting findings are essential for steering the Swiss Energy Strategy 2050. Within Peer-to-Grid, we aim to examine consumer preferences for technologies and strategies to manage PV electricity and demand as well as their impact on technology diffusion in defined geographical areas. Moreover, we will determine the impact of preferences and diffusion on the grid infrastructure and other stakeholders such as utility companies and distribution system operators. Our hypotheses are: (i) consumers and utility companies have different preferences to manage PV electricity and demand, and (ii) their decisions do not always approach the social optimum, partly because there is no feedback on the macro impacts of their decisions. In particular, the project aims to address the following research objectives: 1. Understanding the underpinnings of consumer preferences for PV systems and enabling technologies as well as strategies to manage PV electricity and demand. 2. Predicting the diffusion of PV systems and enabling technologies based on assessed consumer data. 3. Assessing the aggregated impacts of consumer preferences on the electricity grid infrastructure. 4. Identifying policy interventions and win-win situations for consumers and utility companies, which stimulate the diffusion of PV and other low carbon technologies (e.g., batteries) at the minimal cost. Peer-to-Grid will make a timely contribution to both basic and applied research. We will apply agent-based modelling (ABM) with validation and geographical representation, using actual consumer preferences and historic PV penetration across rural and urban areas. We will then link ABM to a robust optimisation framework to anticipate grid infrastruc-

ture expansion, and to gain an understanding of policy interventions and business models, which boost PV deployment while minimising the impacts on the electricity grid. This interdisciplinary research is needed to address the pressing societal consequences of climate change and is thus prominent in top journals (e.g., Nature Energy) and grants (e.g., DOE in the USA and ERC in the EU). The applicants are well positioned across various SCCERs such as CREST and HaE. In addition to high-level scientific collaboration with experts in the field (e.g., Prof. Gonzalez, UC Berkeley), we propose an industrial collaboration with the Services Industries de Genève (SIG) to integrate longitudinal customer data in an ABM and to obtain input from industry experts.

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Add publication

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Specify cooperation partners