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Abstract for Enerday 2021

Cost-benefit Analysis of Residential On-Site E-Car-Sharing

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Keywords: Electric Mobility, Mixed-Integer Optimization Model, E-Car-Sharing, Flexible Energy Systems, Prosumer.

Motivation

Electric vehicles are a necessary alternative to conventional cars to meet the global and national targets set in the 2016 Paris Agreement. Furthermore, the concentration of traffic in urban centres leads to pollution and poor air quality in cities. The growing popularity of electric vehicles is slowly fading these effects, but multiple obstacles hold the rapid expansion of electric cars back. One of them is that the acquisition costs are higher than an automobile with an internal combustion engine. E-car sharing concepts seem to be a promising practice to face this challenge, as ownership costs can be spread among many users. Various studies have shown the positive impact of different e-car-sharing approaches on urban sustainability (Roblek, Meško, & Podbregar, 2021). Especially when it comes to residential buildings, the added value of shared mobility gets visible as parking space can be reduced while maintaining the mobility offer. This work is part of the Car2Flex project and investigates the feasibility and economic benefits of residential on-site e-car-sharing.

Methods

This work proposes a simple and complete method to describe residential energy management systems' optimal operation with different technologies and set-ups, as shown in Figure 1.

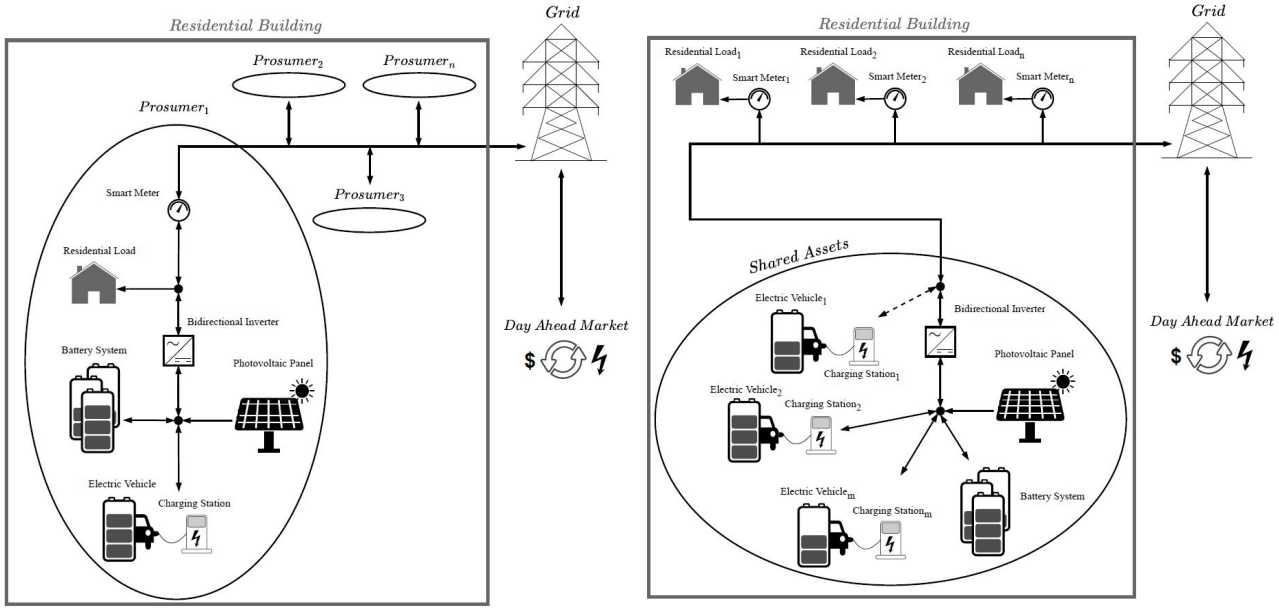

Figure 1: Individual (left) and Sharing (right) set-up of one residential building

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A mathematical optimization problem is defined to determine the optimal investment of each inhabitant in various set-ups and multiple technologies, such as photovoltaic panels, electric cars, charging stations (unidirectional and bidirectional ones) and batteries. Furthermore, considering the grid costs, the trading on the Day-Ahead spot market is optimized to minimize the overall costs. Moreover, in this work, the case of a sharing approach, as shown in Figure 1 (on the right), is simulated. In this case, a joint investment is made, and different methods are investigated to share the costs and the resulting earnings.

Results

This work presents a comprehensive overview of modelling residential energy management systems and evaluating optimal investments in different set-ups and multiple technologies. Furthermore, the potential of residential on-site e-car-sharing for a real-life use case with measured data is investigated. Comparing the considered technologies in different set-ups, we identify various diversities and potentialities. Applying the e-car-sharing approach, we observe how the number of the required electrical vehicles decreases ($m < n$ in Figure 1) and how the joint investments in photovoltaics and batteries can be more profitable for all the stakeholders involved.

References

Roblek, V., Meško, M., & Podbregar, I. (2021, January 18). Impact of Car Sharing on Urban Sustainability. *Energies*.

Acknowledgement

The Car2Flex project is supported with the funds from the Climate and Energy Fund and implemented in the framework of the RTI-initiative “Flagship region Energy” and is part of the research initiative “Green Energy Lab”.

CV

Carlo Corinaldesi was born in Rome, Italy, in 1992. He holds a bachelor’s degree in energy engineering from the Technical University of Turin and an M.Sc. degree in energy and automation engineering from the Technical University of Vienna. Since 2018, he has been working as a project assistant and pursuing the Ph.D. degree at the Institute of Energy Systems and Electrical Drives in the Energy Economics Group at the Vienna University of Technology. Current work focuses mainly on modeling rolling stochastic optimization frameworks of electric power systems, self-consumption optimization and trading wholesale electricity products. Other research interests include the marketing of balancing power, the design of business models and applied game theory.