SIMULATION BASED ASSESSMENT OF A VEHICLE-TO-BUILDING USE CASE FOR AN INDUSTRIAL SITE

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Introduction

The number of battery electric vehicles (BEVs) is strongly increasing and expected to reach 42% market share until 2030 in the EU [1]. This strong increase is a big challenge for the energy system but offers at the same time opportunities due to the usage of advanced charging concepts with different grid level integrations [2] as smart charging (V1G), vehicle-to-home (V2H), vehicle-to building (V2B) and vehicle-to-grid (V2G). Within the EU-project "XL-Connect" these possibilities are investigated and compared for different use cases. One example is a so-called virtual demonstration action for the company Neuman Aluminium in Austria. At this industrial site renewable energy production in combination with different storage and charging technologies are investigated.

In general, the company Neuman Aluminium, located in Lower Austria, produces aluminum parts and has an overall yearly energy demand of ~110,000 MWh. The energy demand in 2022/23 of the use case can be divided in ~36% electricity demand and ~64% natural gas demand. Neuman Aluminium employed two hydroelectric power plants with an overall size of 0.95 MWp and a photovoltaic (PV) system of size 1.1 MWp. Currently, these power plants produce 4,100 MWh/year. As the production covers only ~10% of the needed electricity, Neuman wants to increase their renewable energy production by employing additional PV systems (up to 4 MWp). In addition, the virtual demonstration action considers an additional scenario where two wind turbines (5 MWp each) are assumed. Therefore, three future scenarios for the virtual use case are elaborated (see Table 1).

	Status Quo	Scenario 1	Scenario 2	Scenario 3
Hydroelectric power plant	0.95 MWp	0.95 MWp	0.95 MWp	0.95 MWp
Photovoltaic system	1.1 MWp	1.3 MWp	4 MWp	4 MWp
Wind power station	-	-	-	10 MWp

Table 1 Neuman Aluminium Scenario Overview

In addition to the expansion of the renewable energy production of Neuman Aluminium, smart energy management systems will be analysed and discussed. Therefore, a V2B concept, where BEVs on the company parking lot are used as energy storage is explored.

Methodology

To analyze these scenarios, a four-step approach is applied (see Figure 1).

1) The energy production and consumption data of Neuman Aluminium will be assessed.
2) The periods and amount of surplus of energy production for the different scenarios will be determined.
3) A vehicle-to-building concept for a parking area with 300 vehicles for self-consumption optimization or peak shaving is investigated and conceptualized.
4) A concept with a battery storage is compared to the vehicle-to-building concept as an alternative solution.

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Figure 1 Work steps for the analysis of the Neuman Aluminium use case

First Results and Outlook

The analysis of the energy production and consumption data for the status quo and for scenario 1 showed that the energy demand is much higher than the energy production. Figure 2 shows the energy production and consumption for an average week during summer and winter in scenario 2.

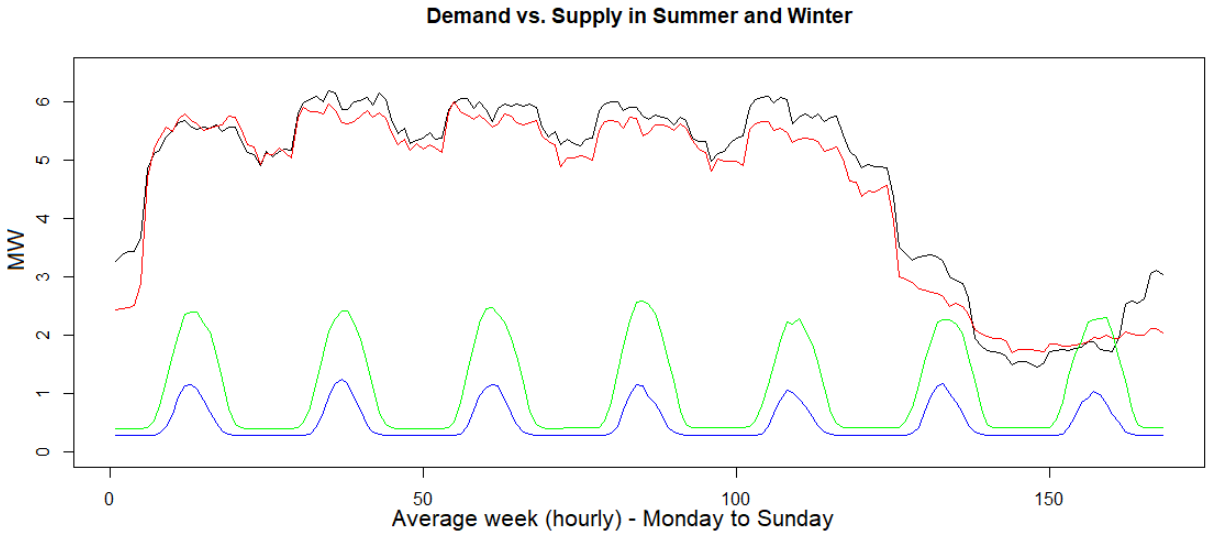

Figure 2 Average energy demand and supply of Neuman Aluminium during the week

It can be seen that for scenario 2 there is only a small energy surplus on Sunday during summertime. As during the weekend no or only little production takes place the parking lot will also be almost empty and thus a V2B concept seems not to be feasible. However, with higher renewable generation (especially scenarios 3) storage options including V2B could make sense again.

A central part in the investigation of the V2B concept is the analysis and simulation of the parking lot occupancy and thus the potentially available battery capacity for V2B. Further, the user behavior of BEV drivers (e.g. under which conditions user agree that their BEVs can be charged or discharged) shall be considered to estimate the actual available battery capacity. Finally, the V2B concept will be compared to a conventional battery storage in terms of energy savings and economic benefits.

References

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