Open-source Integration of V2H with Residential HEMS for Flexible Energy Management and Self-sufficiency in Prosumer Homes

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Introduction

Climate change and policy agreements to reduce GHG emissions have motivated the exponential growth of e-mobility. This context challenges the balanced operation of the power system, due to increasing peaks and risk of congestion. Highly flexible approaches to charging EVs are needed, and bidirectional EV charging schemes (V2X) are regarded as a key solution to achieve this.

Value of vehicle-to-home (V2H)

Vehicle-to-home – V2H – is an energy management strategy that perceives the EV as an additional flexible asset at the service of a HEMS, except for user constraints, offering:

1. Tariff optimization in context of TOU or dynamic rates,
2. Power peak shaving for contract capacity management,
3. Back-up power, in extreme outage circumstances.

Due to its behind-the-meter setup and non-dependency on grid and market regulations for benefits, V2H is highly attractive for homeowners. However, HEMS are often proprietary solutions, and to rapidly integrate bidirectional EV charging into this industry could be complex and lengthy.

Cloud implementation of V2H SCAs

The DriVe2X project is testing the real-world integration of smart charging algorithms (SCAs) for V2H into a HEMS cloud infrastructure, with view to co-optimizing user energy bills and GHG emissions (Figure 1).

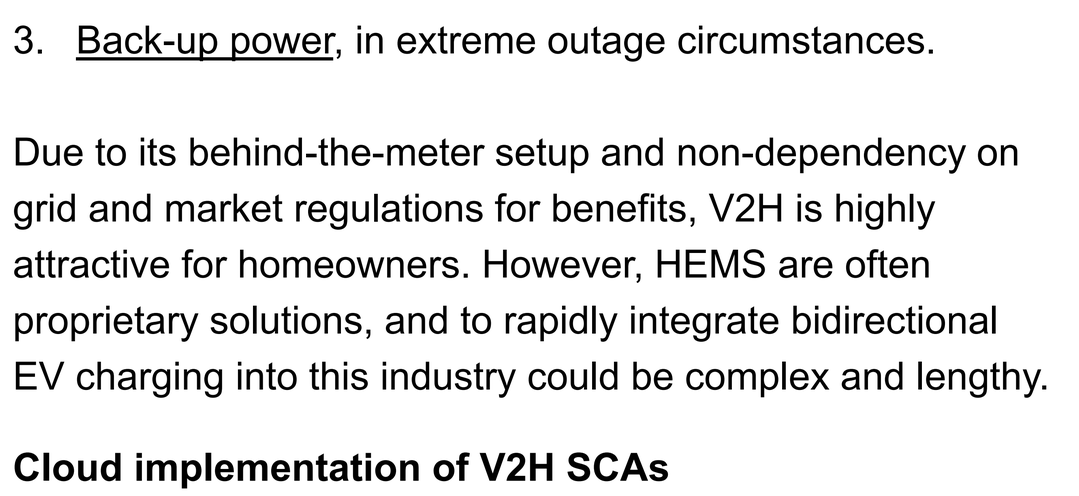

Figure 1. Smart charging system infrastructure.

A tailored-made, multi-functional modular UI is implemented in an open-source environment, both on web and mobile, allowing the user to control and monitor its smart V2H session (Figure 2). New inputs to the algorithm are computed into the charging schedule at a 1-min basis.

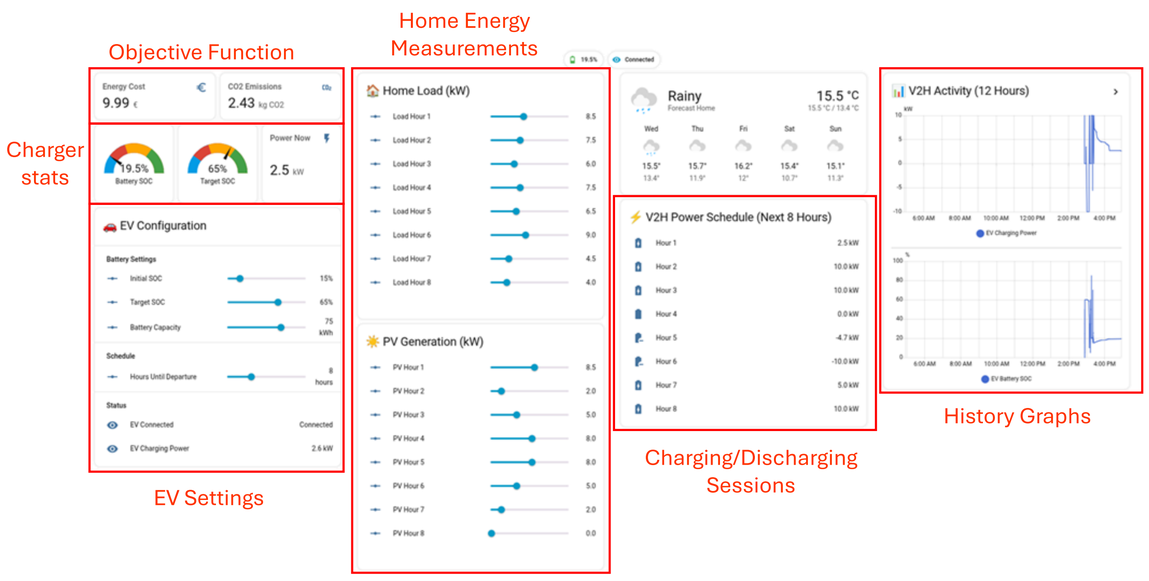

Figure 2. Web dashboard for smart EV charging/V2H monitoring and scheduling.

Preliminary smart control results

A V2H schedule for the next 11h (Figure 3) shows optimal management of bidirectional charging power and battery SOC, upon price signals and user connection constraints.

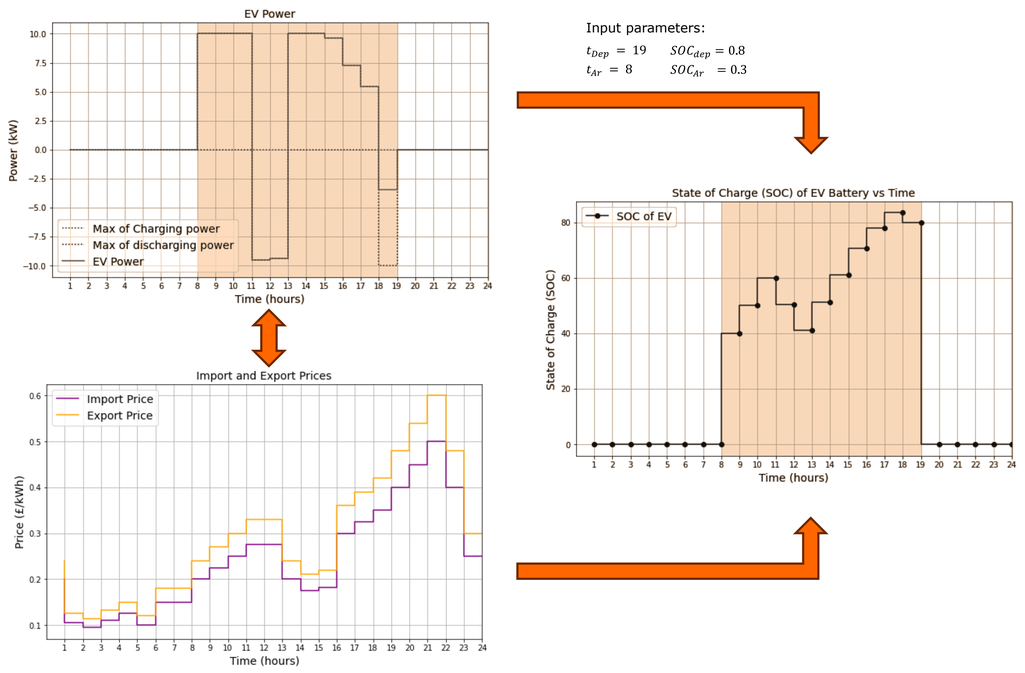

Figure 3. Smart V2H decisions displayed on a forecasted 11h charging schedule.

Conclusions

The open-source, modular implementation of V2H control in HEMS could accelerate V2X uptake in prosumer homes.

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