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PATHFNDR

Electromobility + buildings

The business case for small-scale vehicle-to-grid in Switzerland

Work package 6

Daniel Andersen[1] and **Siobhan Powell**[1]
[1]Group for Sustainability and Technology, ETH Zürich

1 OBJECTIVES AND CONTRIBUTION

Flexible electric vehicle (EV) charging could benefit the electricity system and help integrate renewables, if given the right incentives. Bidirectional vehicle-to-grid (V2G) technology increases EV flexibility and could increase those benefits. However, the business case for small-scale V2G is unclear [1], limiting widespread deployment and leading to calls for policymaker intervention. In this paper [2], we:

1. Test the business case for V2G for small-scale aggregators in Switzerland
2. Investigating the trade-offs between three policy options to make V2G profitable under multiple electricity tariff designs.
3. Offer insight to policymakers aiming to support V2G deployment.

2 REGULATION SCENARIOS

Per-kWh price components: $T^t_{ch} = T^t_{energy} + T^t_{network} + T_{national} + T_{municipal}$

1. Taxes reimbursed on discharged energy: Yes or No
2. Network charge reimbursed on discharged energy:
    1. None
    2. “Minimum”, always the low network charge in the tariff
    3. “Current”, the network charge at that time in the tariff
    4. “Tracked”, based on the when energy in the battery was charged

3 METHODS

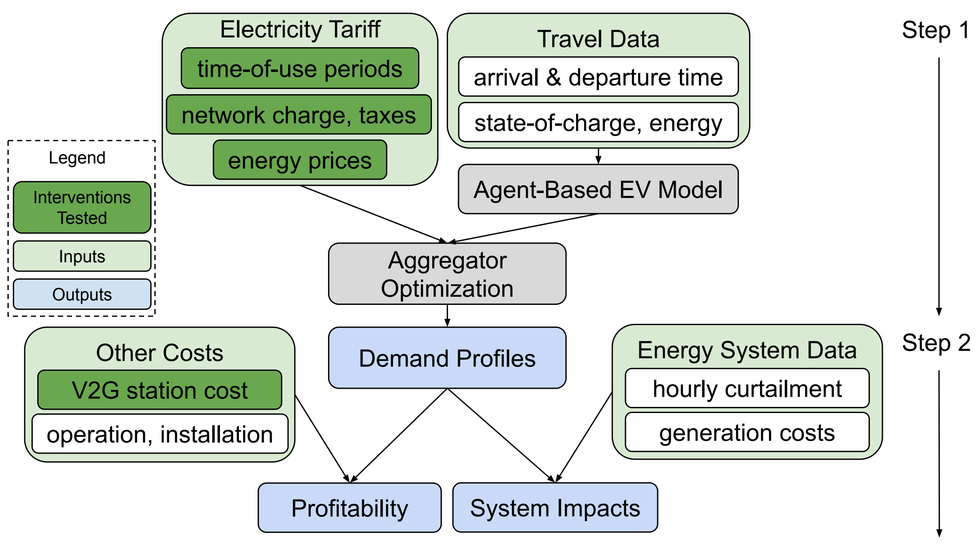

Fig 1. Analysis flowchart.

We test each tariff case for a Swiss workplace aggregator:

- Data from MZMV Swiss travel survey [3] with agent-based model of charging [4]
- Test case with 80 kWh batteries, 11 kW workplace chargers, 50 EVs for 25 chargers, assumption drivers have access to home charging.
- Optimization delivers the same total energy by departure as for uncontrolled.

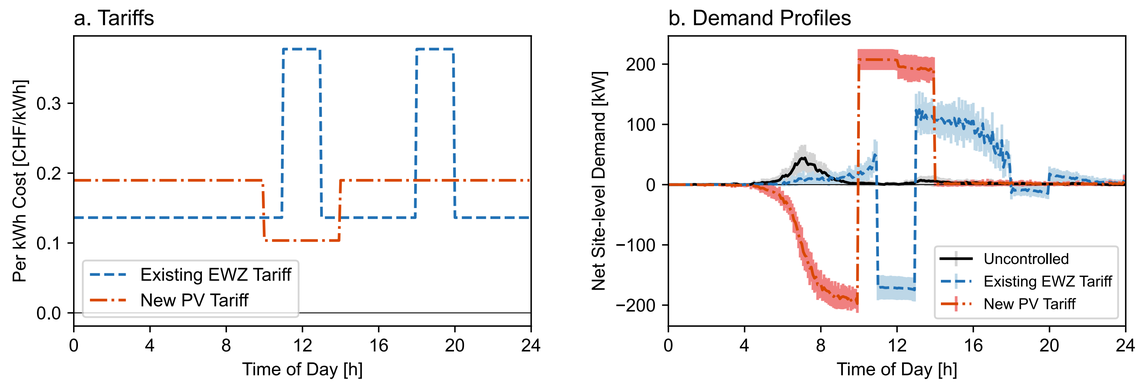

Fig 2. Base tariffs and controlled V2G charging profiles. Std dev over 50 model runs.

4 RESULTS AND CONCLUSION

Conclusion 1: Low-high electricity price spread must overcome round-trip losses.

$$T_{dis,max} > \frac{1}{\eta^2} T_{ch,min}$$

Conclusion 2: Policy interventions can improve profitability.

- Regulations should change to avoid “double taxation”. Reimbursing taxes or network charges for discharged energy improves profitability.
- Subsidies for new stations may be needed until prices come down.
- The business case is very sensitive to tariff and regulation scenarios.

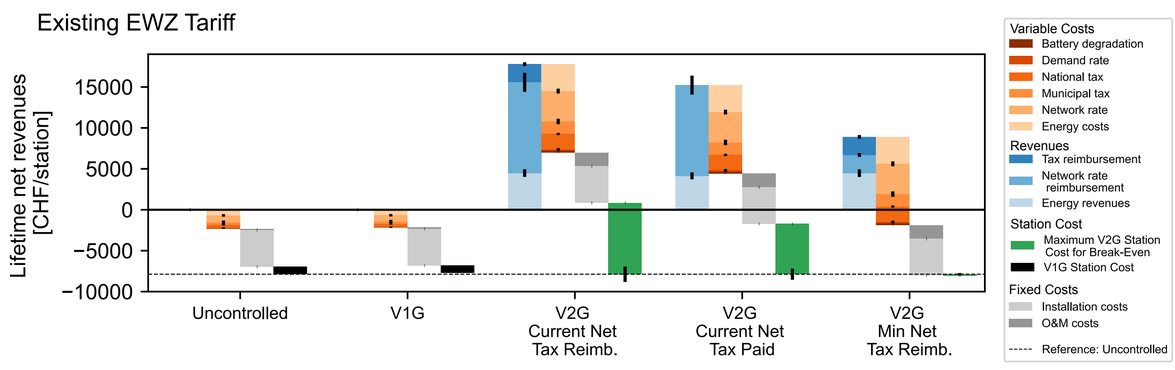

Fig 3. Breakdown of costs and revenues compared with uncontrolled charging.

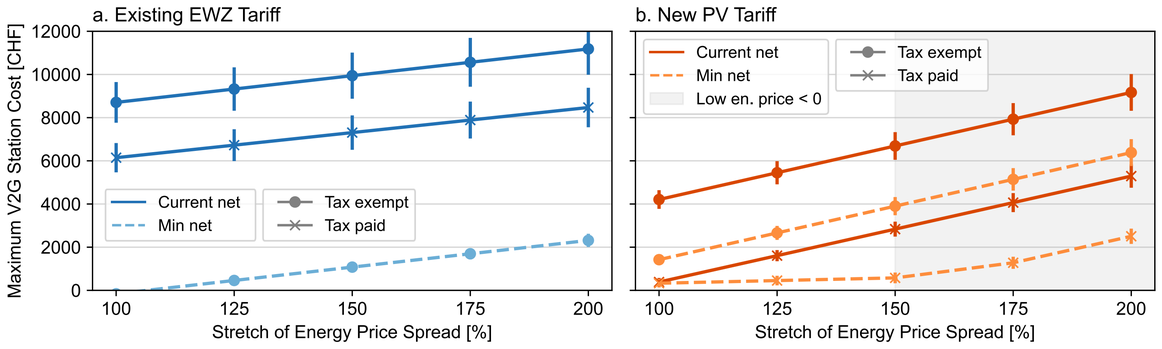

Fig 4. Stretching the spread between low and high prices improves profitability.

Conclusion 3: New time-of-use periods will improve future system impacts of V2G.

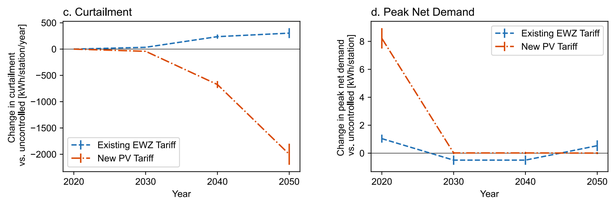

Fig 5. By 2050, the PV tariff could reduce curtailment by up to 2000 kWh per station per year.

REFERENCES

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CONTACT

Dr. Siobhan Powell
ETH Zürich
Group for Sustainability and Technology
spowell@ethz.ch
https://sustec.ethz.ch/

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