Raum-zeitliche Optimierung des bidirektionalen EV-Ladens durch Verkehrsflussanalyse und stochastische Energiemodellierung

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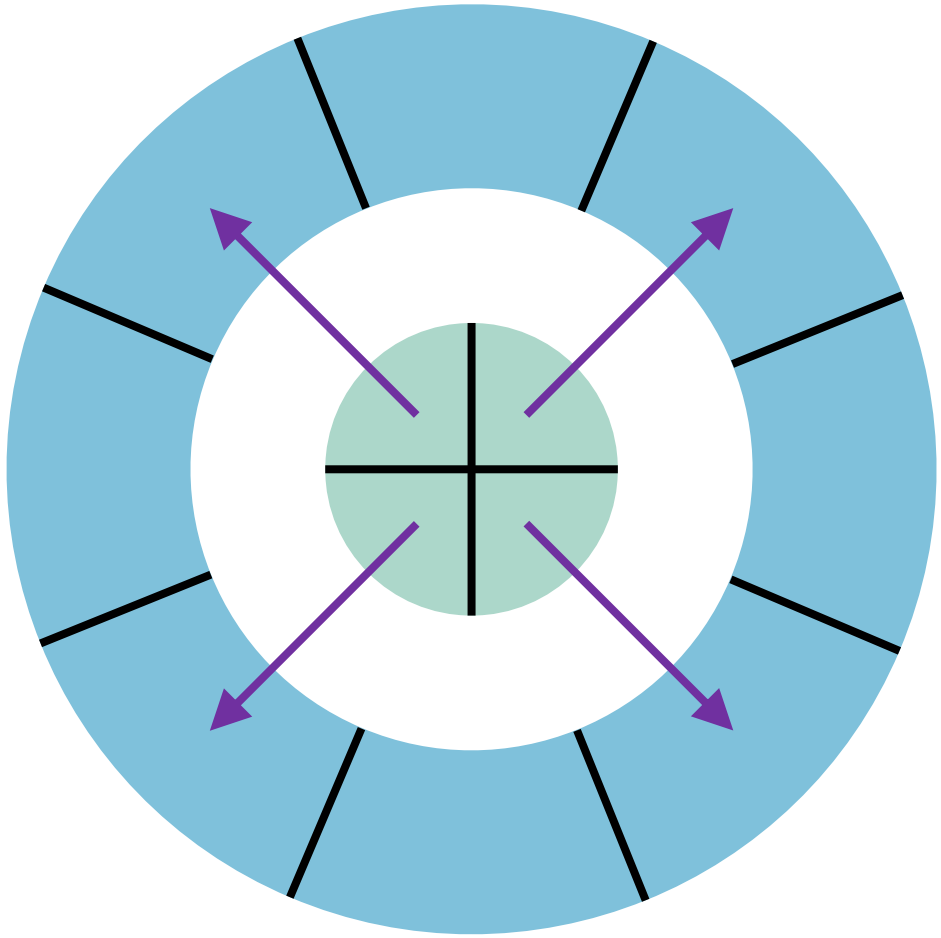
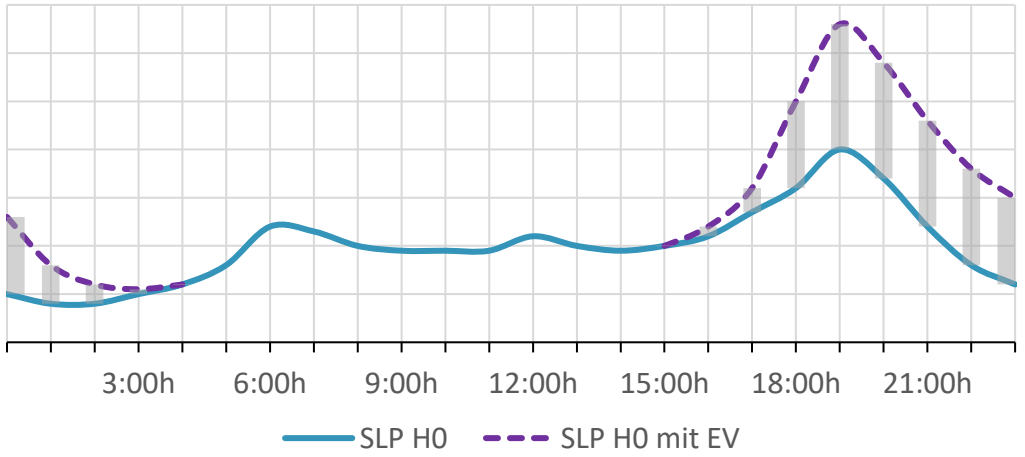
Verkehrsmuster - Abendspitze

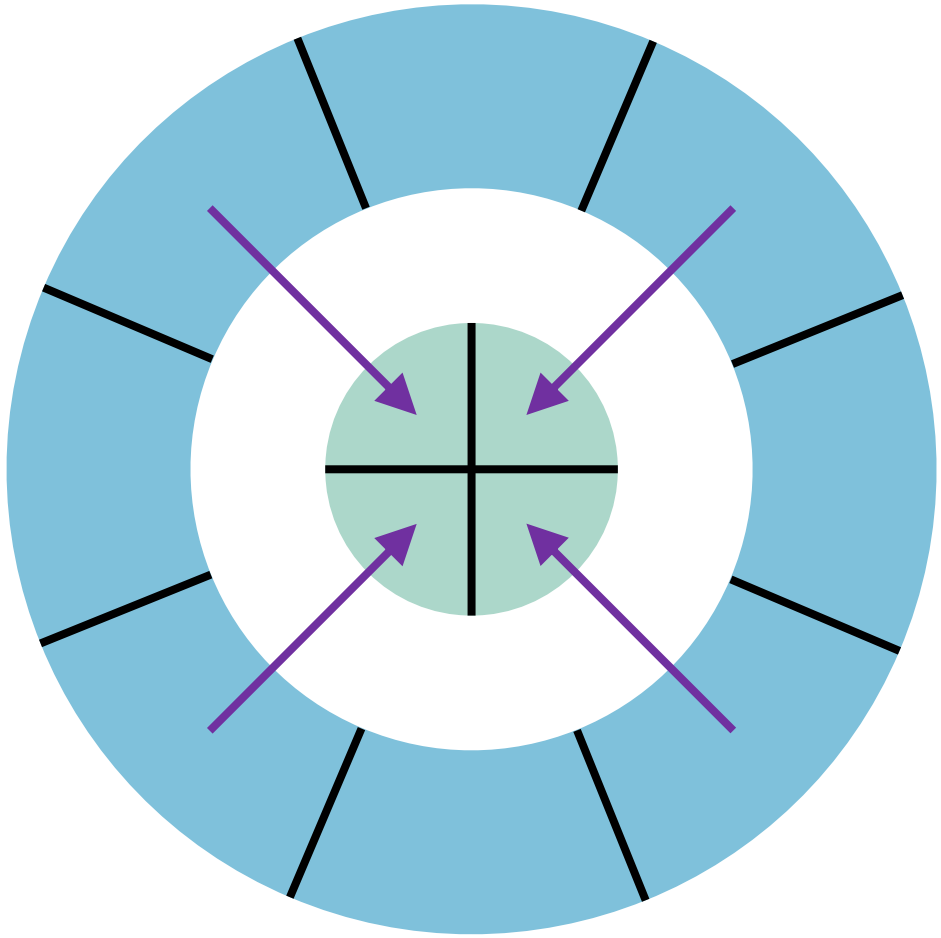


- Laden wenn Produktion durch Erneuerbare gering
- mehrere Engpässe
- Vollladestrategie

Lastprofil - Wohngebiet

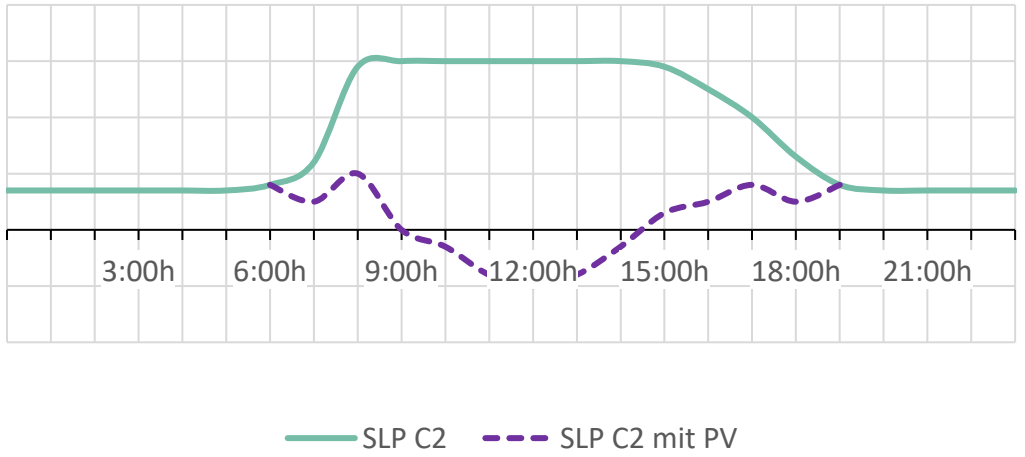


Verkehrsmuster - Morgenspitze



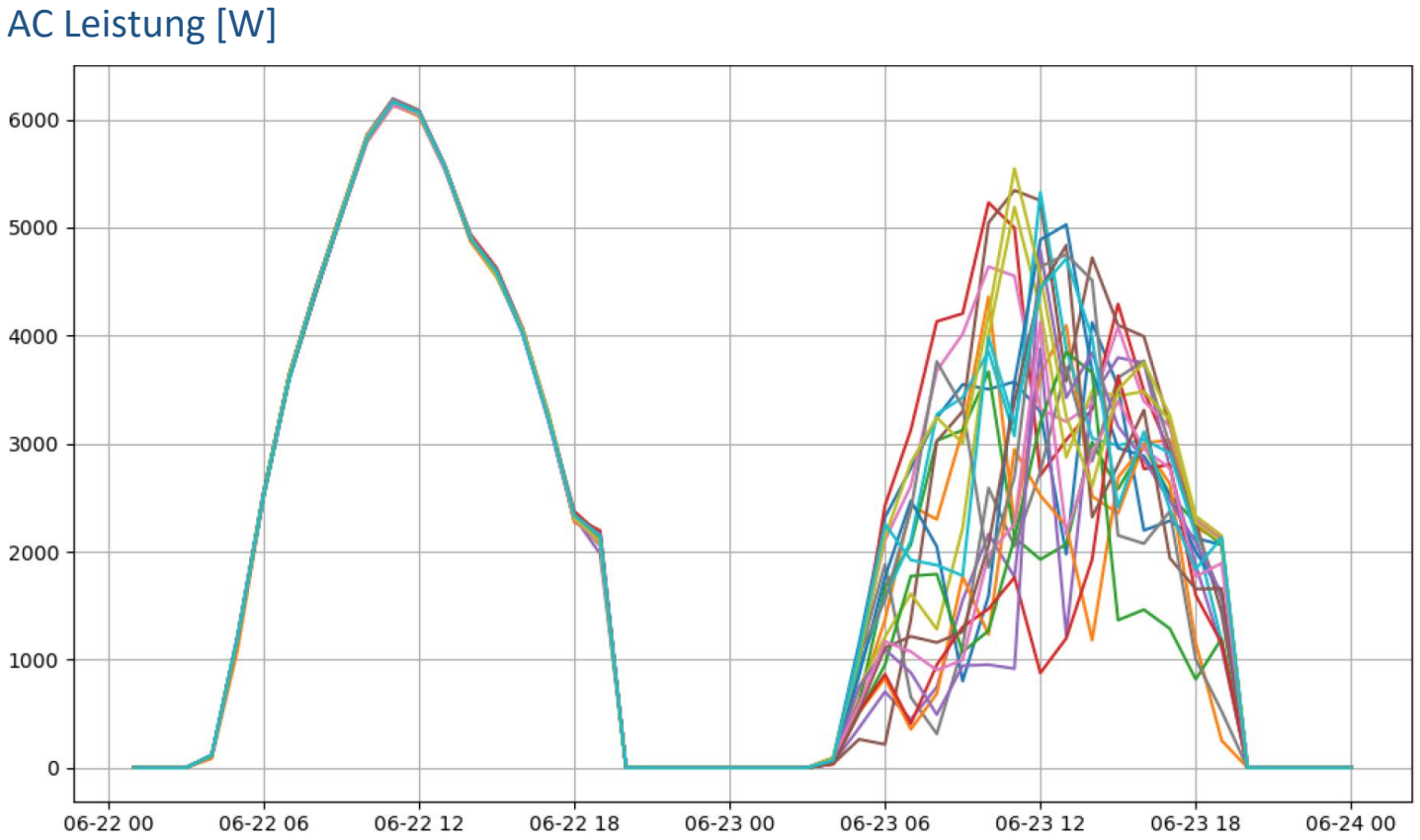
- Batterie State-of-Charge: fast voll
- PV-Überschuss
  - belastet das Stromnetz
  - Einspeisung durch Netzanschluss limitiert

Lastprofil - Industriegebiet

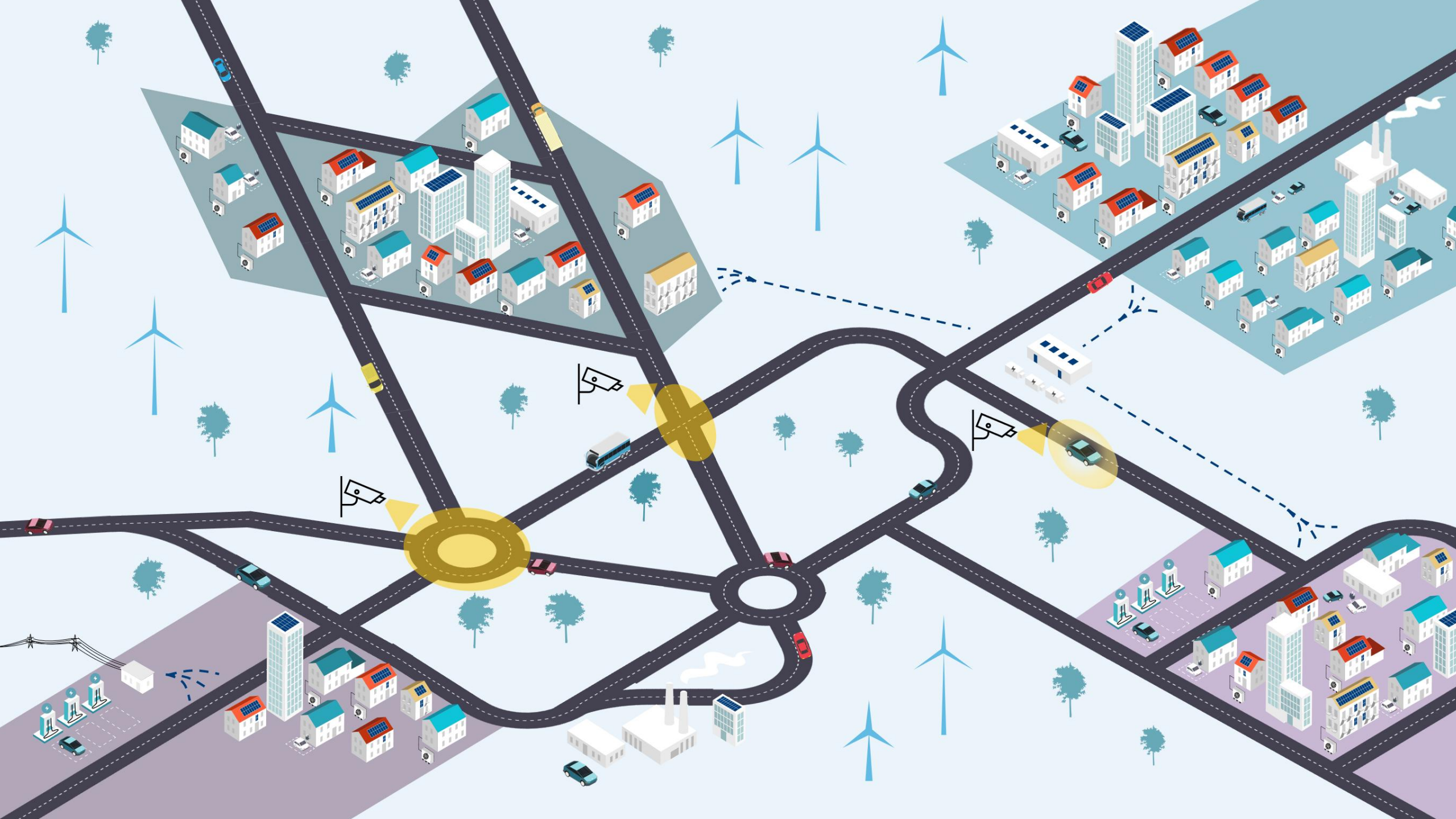


Stochastisches Problem

- PV-Produktion als Beispiel
- Ähnliche Annahmen:
  - Grundlast
  - Wärmebedarf
  - EV-Nutzungsprofile



Ensemble-Kurven einer Prognose-Gruppe



Optimierungsproblem

- variable Anzahl von Energiegemeinschaften mit Speicher
- variierende Strompreise
- (Ent-)Ladeeffizienz unter 100%
- Entscheidungsvariablen:
  - externer Strombezug
  - EV-Ladeleistung

$$\arg \min_{\substack{pwr(c,n) \\ soc(car,n)}} \sum_{n=1}^{192} \left(w * \left(\sum_{c} I(c,n) \right)^2 + x * \sum_{car} SoC(car,n) + y * \sum_{c} Smooth(c,n) + z * Chrg(n) \right)$$

$$I(c,n) = pwr(c,n) * cost(c,n)$$

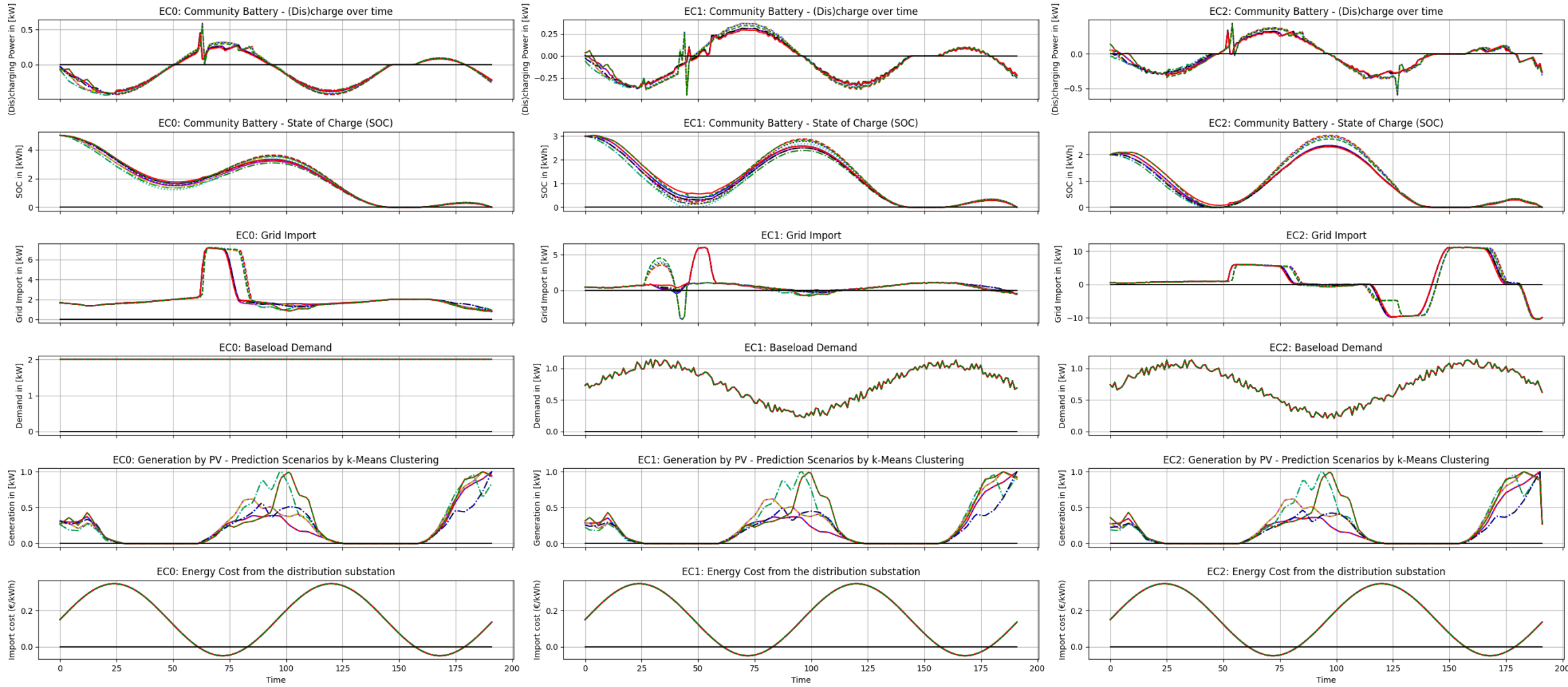
$$SoC(car,n) = soc_{max} - soc(car,n)$$

$$Smooth(c,n) = (pwr(c,n) - pwr(c,n-1))^2$$

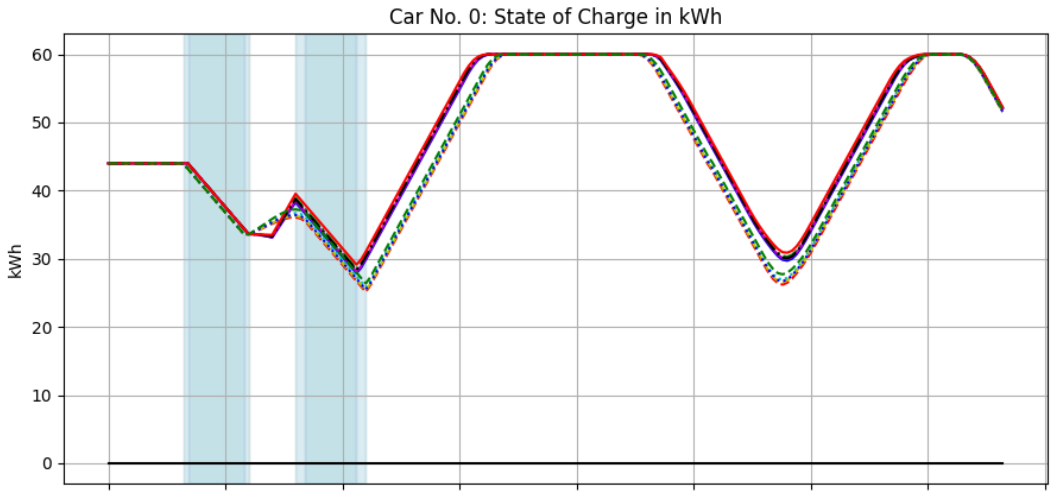
- Pyomo mit MPI-SPPY
- kompatibel mit Solvern wie GLPK, IPOPT, CBC für (MI)LP und NLP

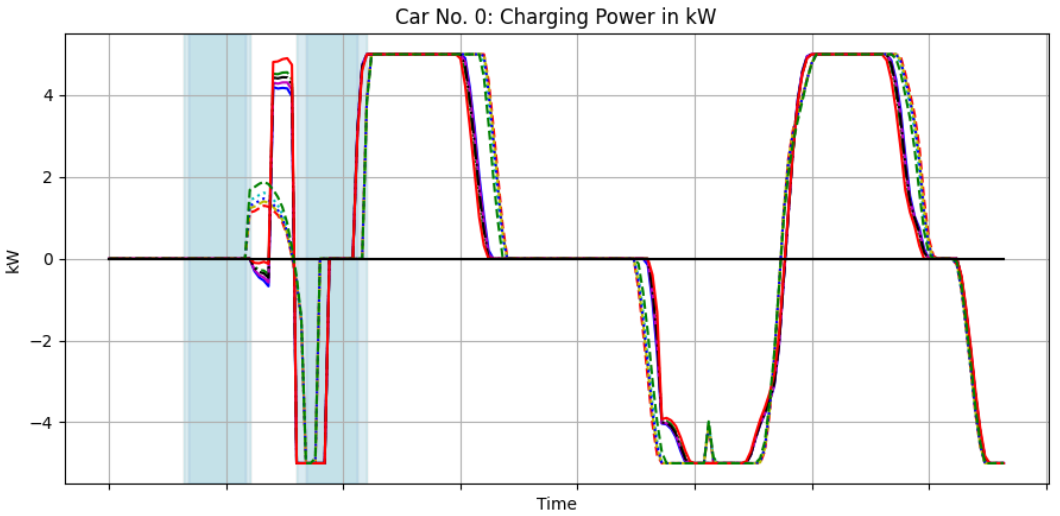
```python
def scenario_creator(scenario_name):
    car_map = {"0": 0, "1": 1, "2": 2, "3": 3}
    prob_car_map = {"0": 0.1, "1": 0.7, "2": 0.1 , "3": 0.1}
    pv_id, car_id = scenario_name.split("_")

    pv_profile, pv_probability = load_pv_data_from_csv(f"Scenario_{pv_id}")
    car_flag = car_map[car_id]

    model = build_model(pv_profile, car_flag)
    sputils.attach_root_node(model, model.obj, id_first_stage_vars(model, 0, 25))
    model._mpisppy_probability = pv_probability * prob_car_map[car_id]
    return model
```

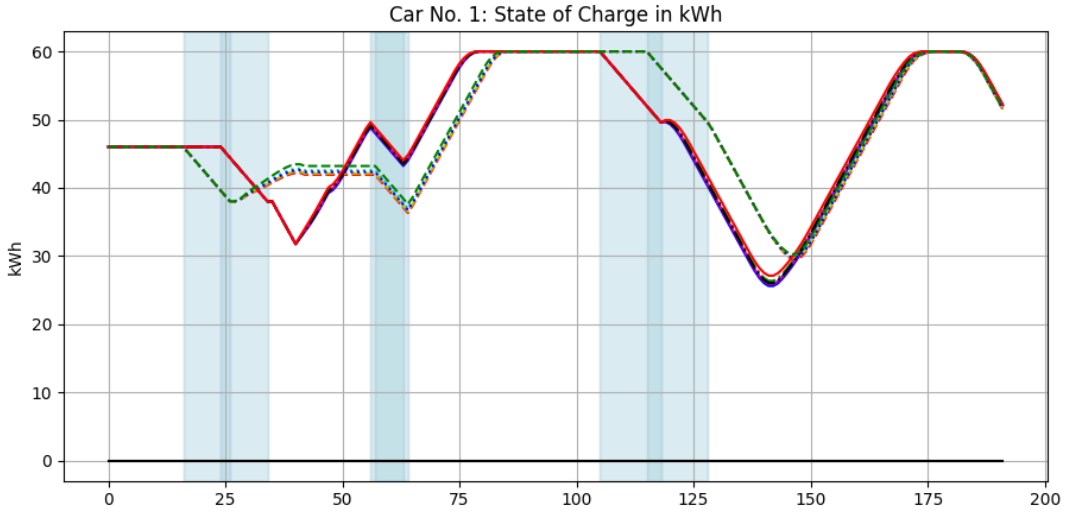
Ergebnisse – Energiegemeinschaft

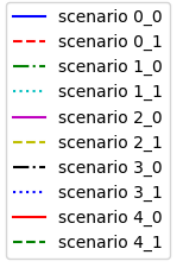


Ergebnisse – EV









- CAR 0: E1 => E2 => E1
- CAR 1: E1 => E0 => E2 => E1

Wer wir sind

Stefan Wilker
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Excited for more !

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