Datenübersicht und heuristischer Algorithmus zur Reduzierung der Spitzenlast in einem E-Bus Depot

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FHV
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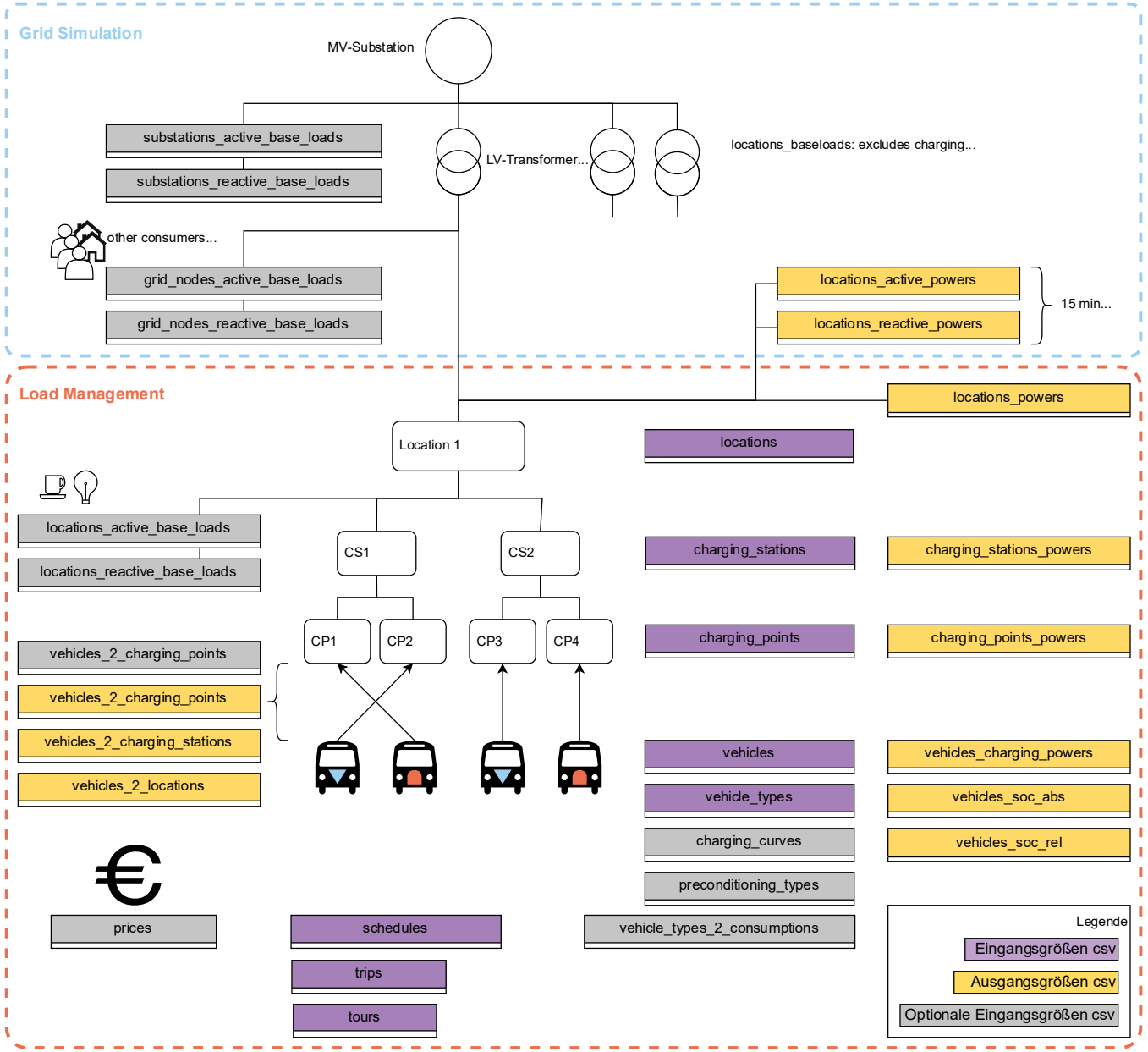
Interreg
Alpenrhein-Bodensee-Hochrhein

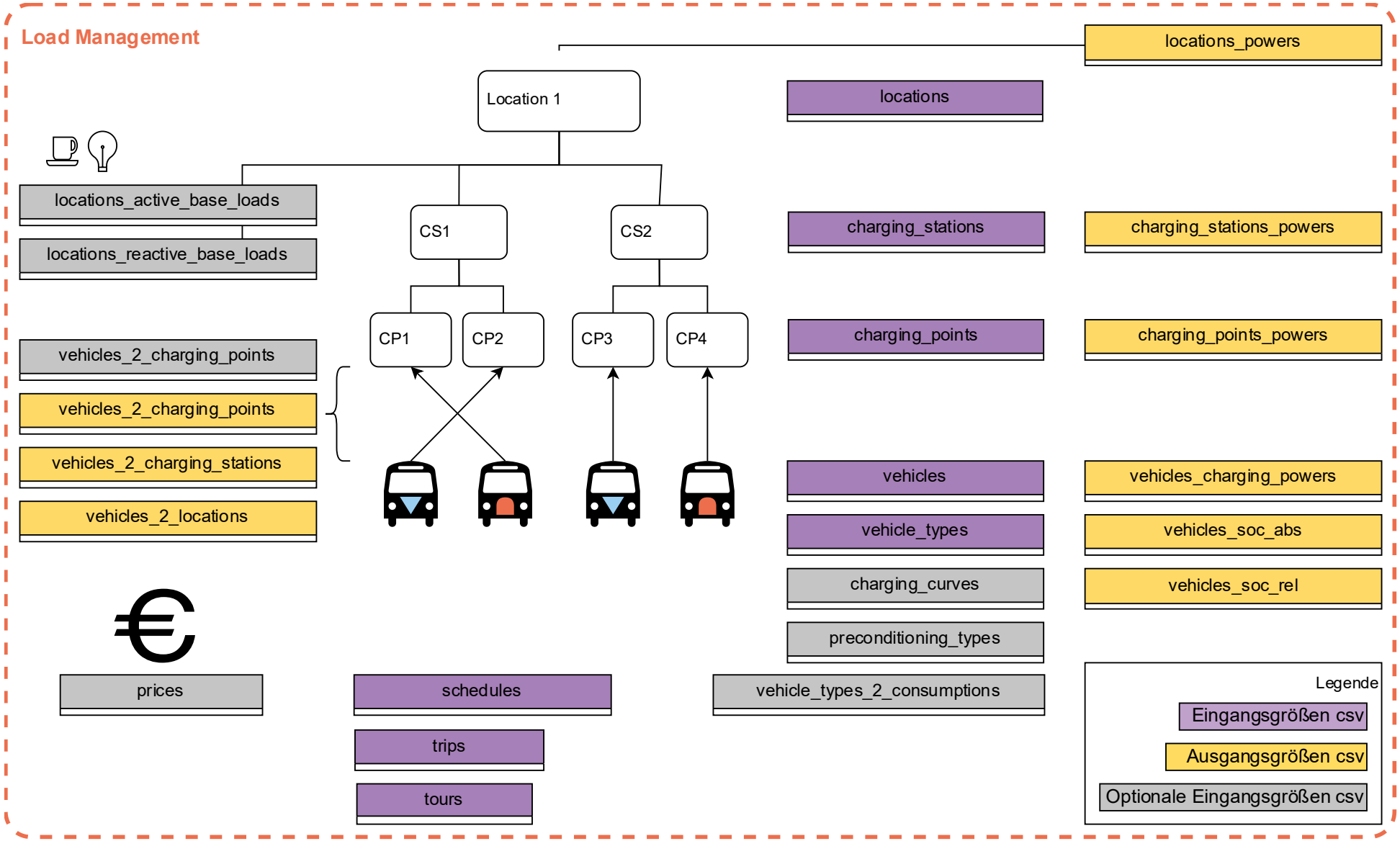
Kofinanziert
von der
Europäischen
Union

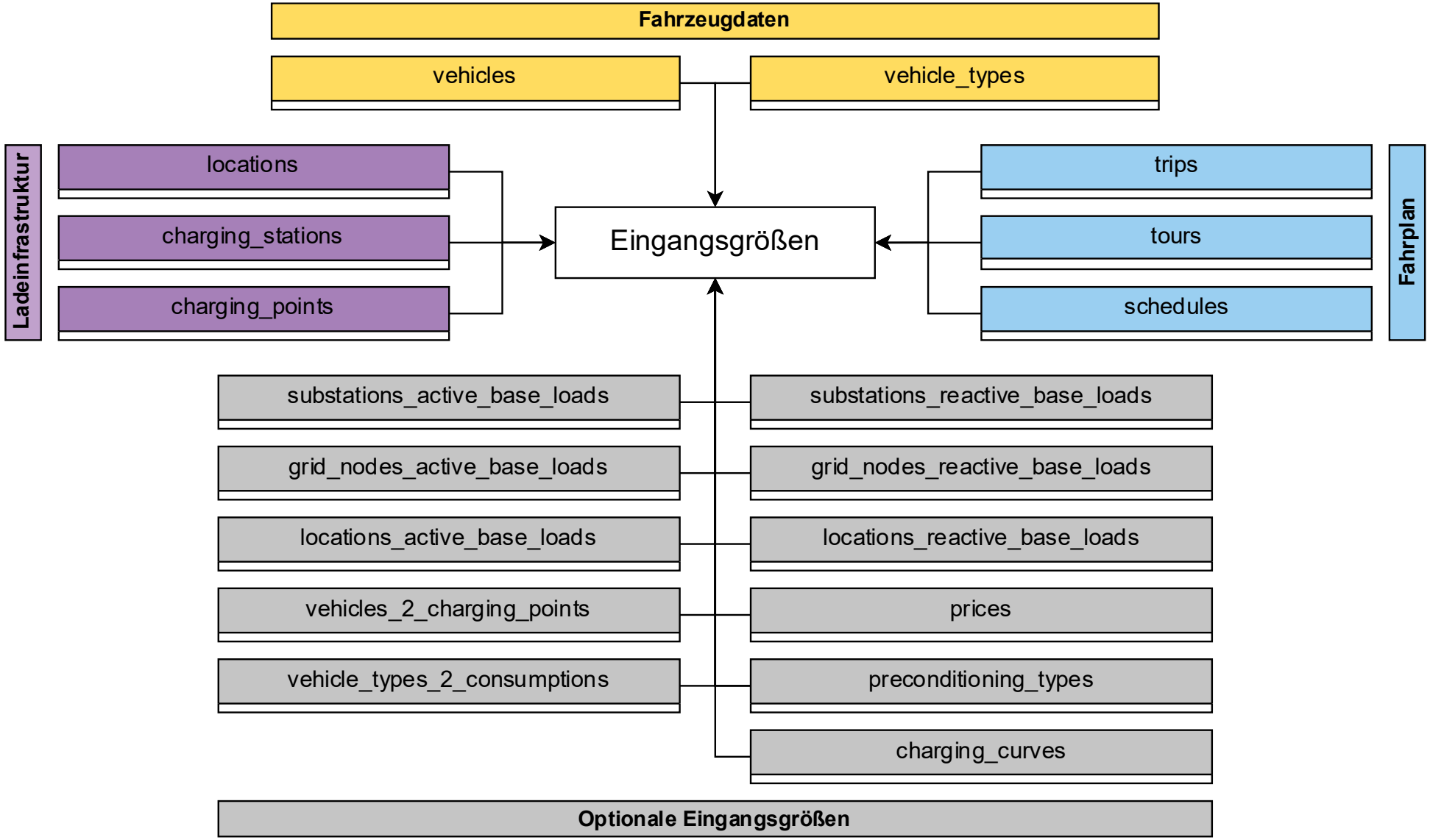
und Partnerstaaten

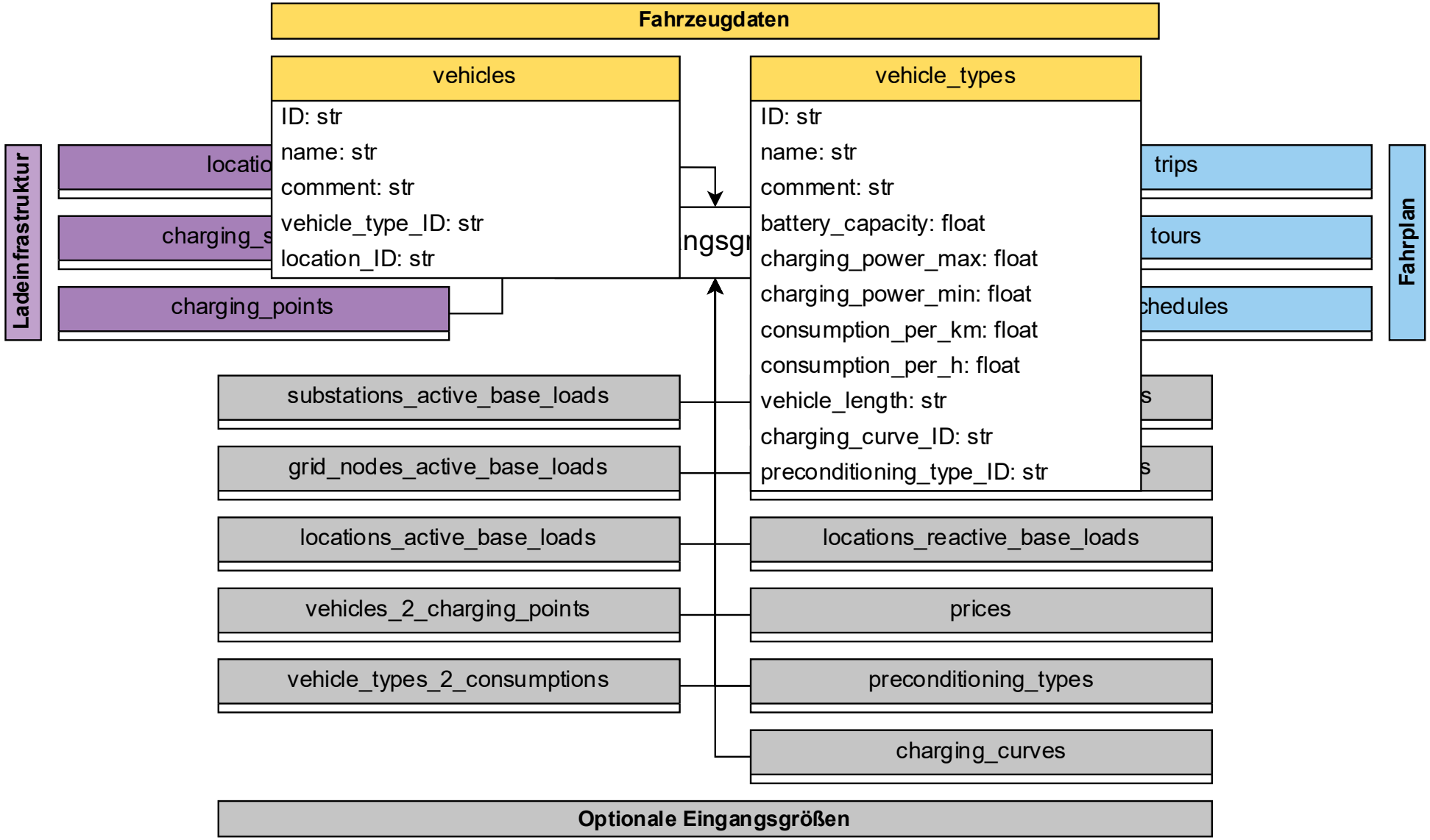
Datenübersicht E-Bus System

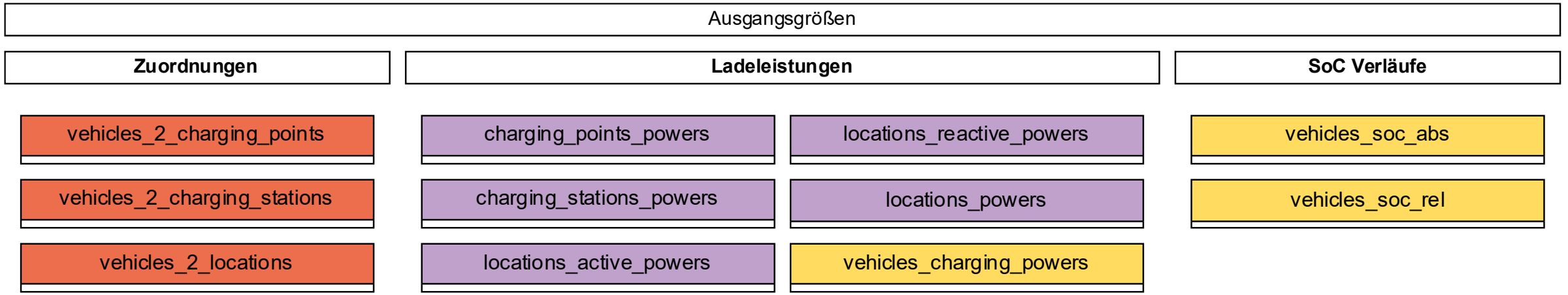


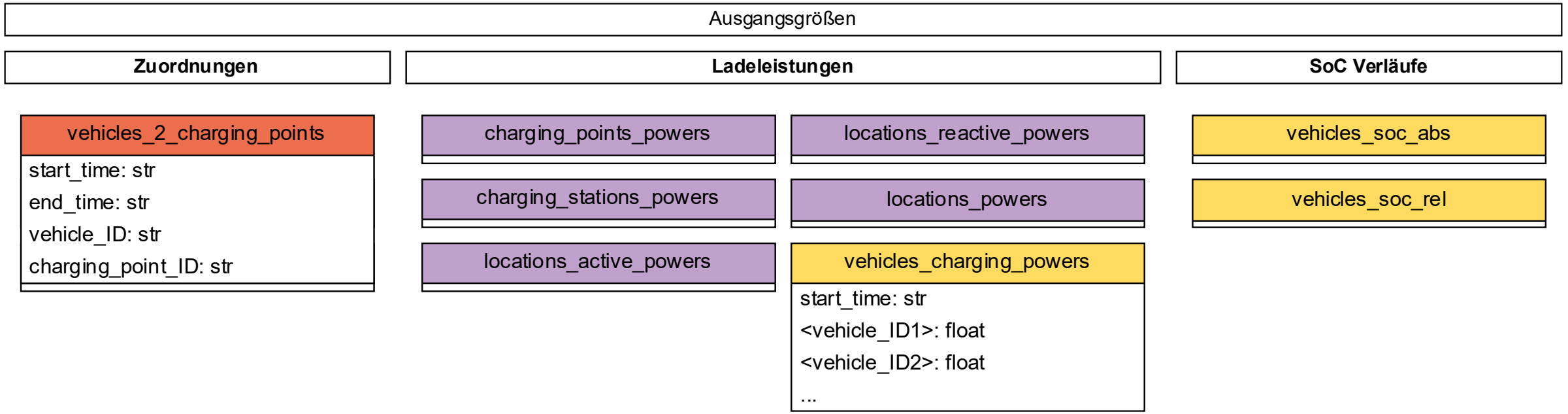
Datenübersicht E-Bus System

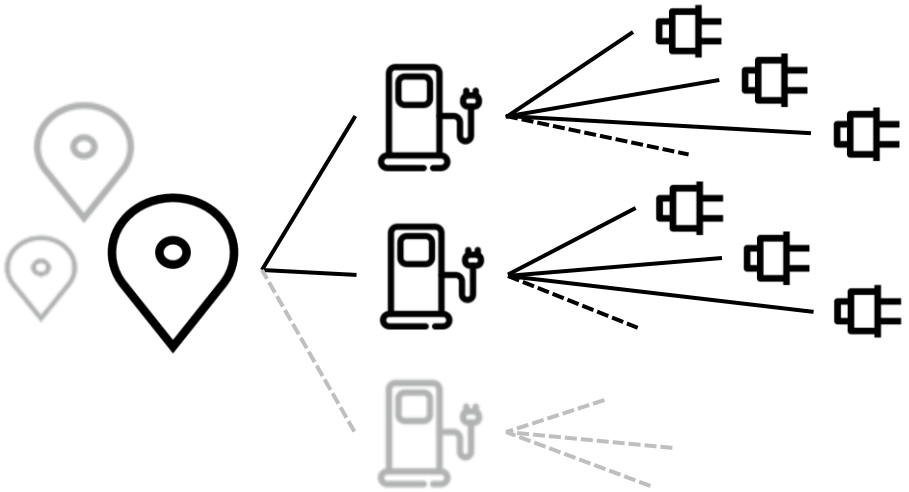



Fahrzeugdaten
vehicles
vehicle_types
Ladeinfrastruktur
locations
charging_stations
charging_points
Eingangsgrößen
trips
tours
schedules
Fahrplan
substations_active_base_loads
substations_reactive_base_loads
grid_nodes_active_base_loads
grid_nodes_reactive_base_loads
locations_active_base_loads
locations_reactive_base_loads
vehicles_2_charging_points
prices
vehicle_types_2_consumptions
preconditioning_types
charging_curves
Optionale Eingangsgrößen


Fahrzeugdaten
vehicles
ID: str
name: str
comment: str
vehicle_type_ID: str
location_ID: str
vehicle_types
ID: str
name: str
comment: str
battery_capacity: float
charging_power_max: float
charging_power_min: float
consumption_per_km: float
consumption_per_h: float
vehicle_length: str
charging_curve_ID: str
preconditioning_type_ID: str
Ladeinfrastruktur
charging_points
Fahrplan
trips
tours
substations_active_base_loads
grid_nodes_active_base_loads
locations_active_base_loads
vehicles_2_charging_points
vehicle_types_2_consumptions
locations_reactive_base_loads
prices
preconditioning_types
charging_curves
Optionale Eingangsgrößen


Ausgangsgrößen
Zuordnungen
Ladeleistungen
SoC Verläufe
vehicles_2_charging_points
vehicles_2_charging_stations
vehicles_2_locations
charging_points_powers
charging_stations_powers
locations_active_powers
locations_reactive_powers
locations_powers
vehicles_charging_powers
vehicles_soc_abs
vehicles_soc_rel


Ausgangsgrößen
Zuordnungen
Ladeleistungen
SoC Verläufe
vehicles_2_charging_points
start_time: str
end_time: str
vehicle_ID: str
charging_point_ID: str
charging_points_powers
charging_stations_powers
locations_active_powers
locations_reactive_powers
locations_powers
vehicles_charging_powers
start_time: str
<vehicle_ID1>: float
<vehicle_ID2>: float
...
vehicles_soc_abs
vehicles_soc_rel



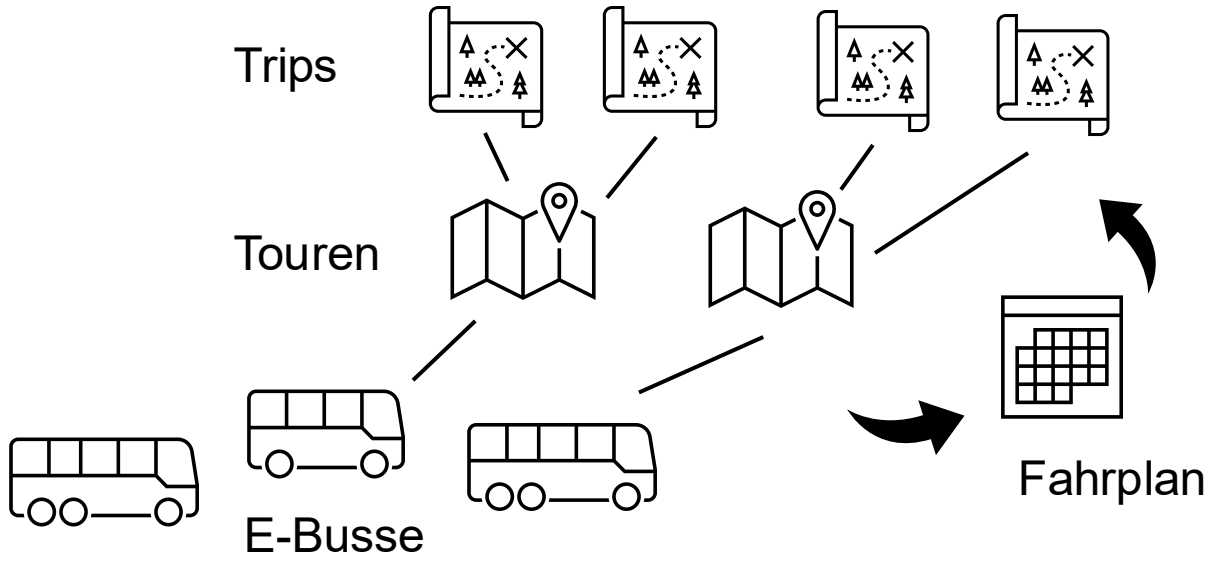
Standorte Ladestationen Ladepunkte

1 Standort	6 Ladestationen „Stromschienen“	70 Ladepunkte
max. 6 MW	max. je 1000 kW	max. 150 kW (35x) max. 100 kW (35x)

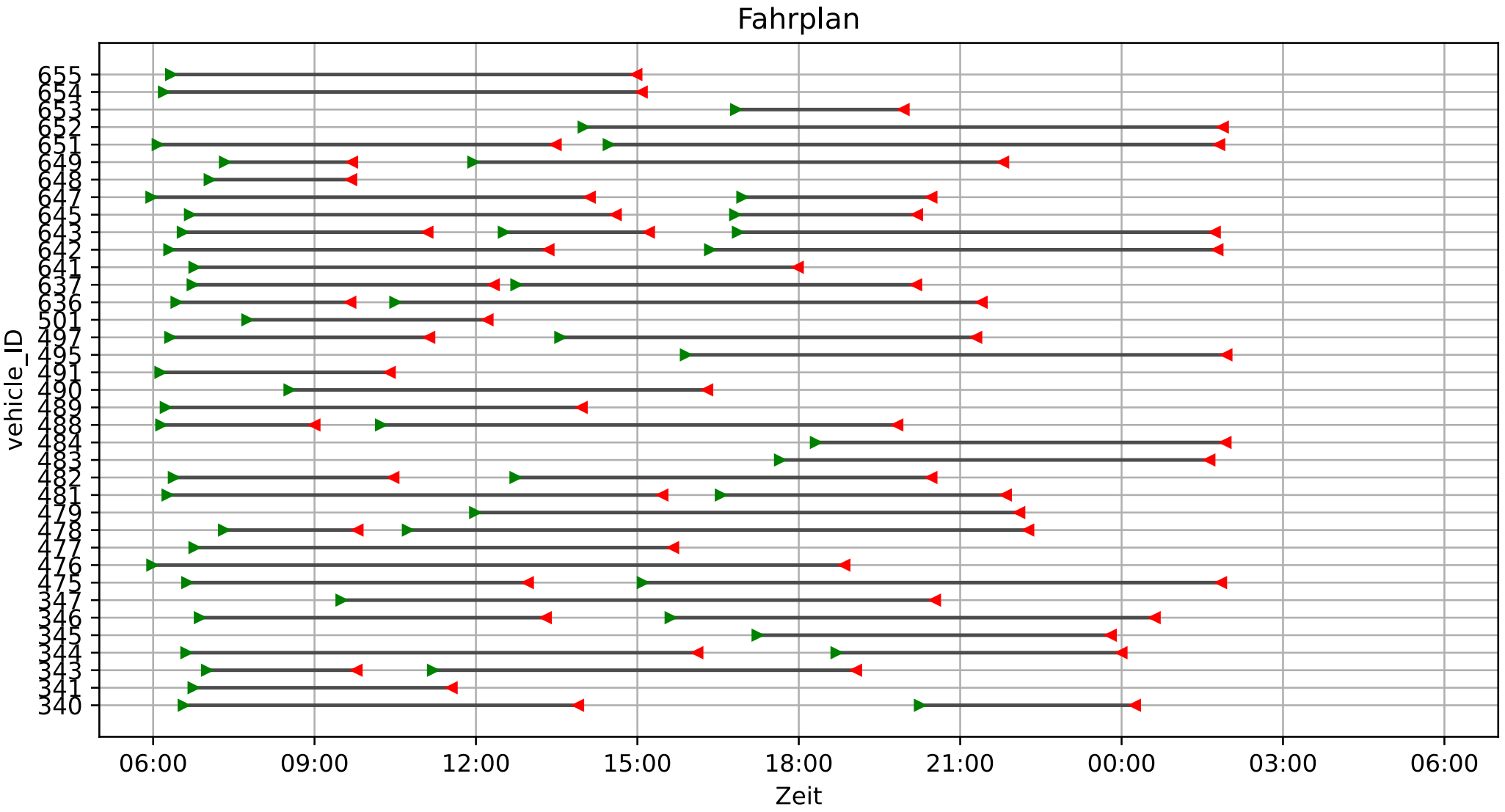
37 Touren über 24h

Zwischenladungen gemäß Fahrplan am Depot möglich

Start- & End SoC: 100%



	18-Meter Bus	12-Meter Bus	10 Meter Bus
Anzahl	15	15	7
Batteriekapazität (netto)	416 kWh	312 kWh	266 kWh
Verbrauch (ø)	1,6 kWh/km	1,2 kWh/km	1,0 kWh/km


Fahrplan
vehicle_ID
655
654
653
652
651
649
648
647
645
643
642
641
637
636
501
497
495
491
490
488
488
484
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347
346
345
344
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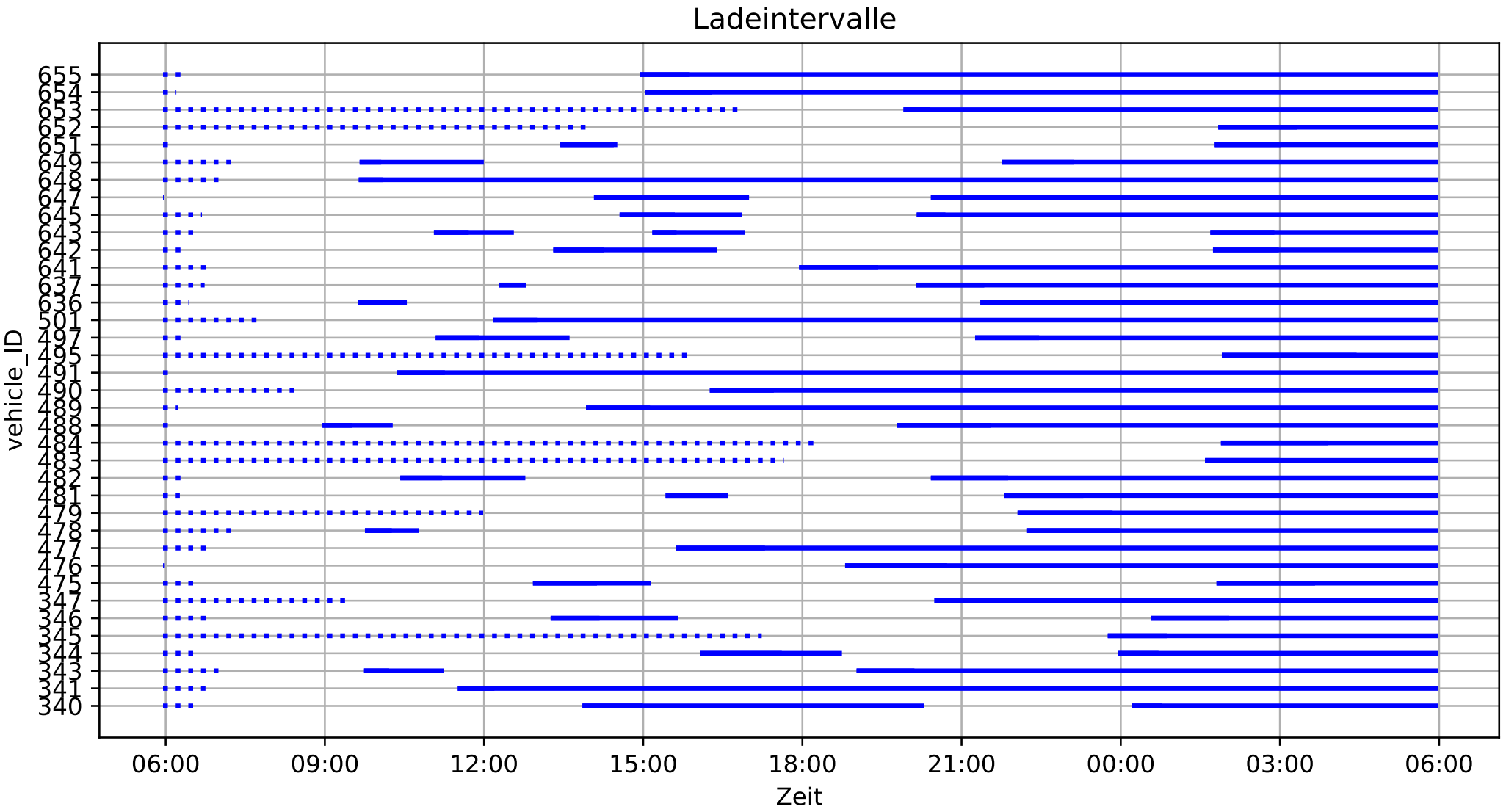
341
340
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
Zeit


Ladeintervalle
vehicle_ID
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15:00
18:00
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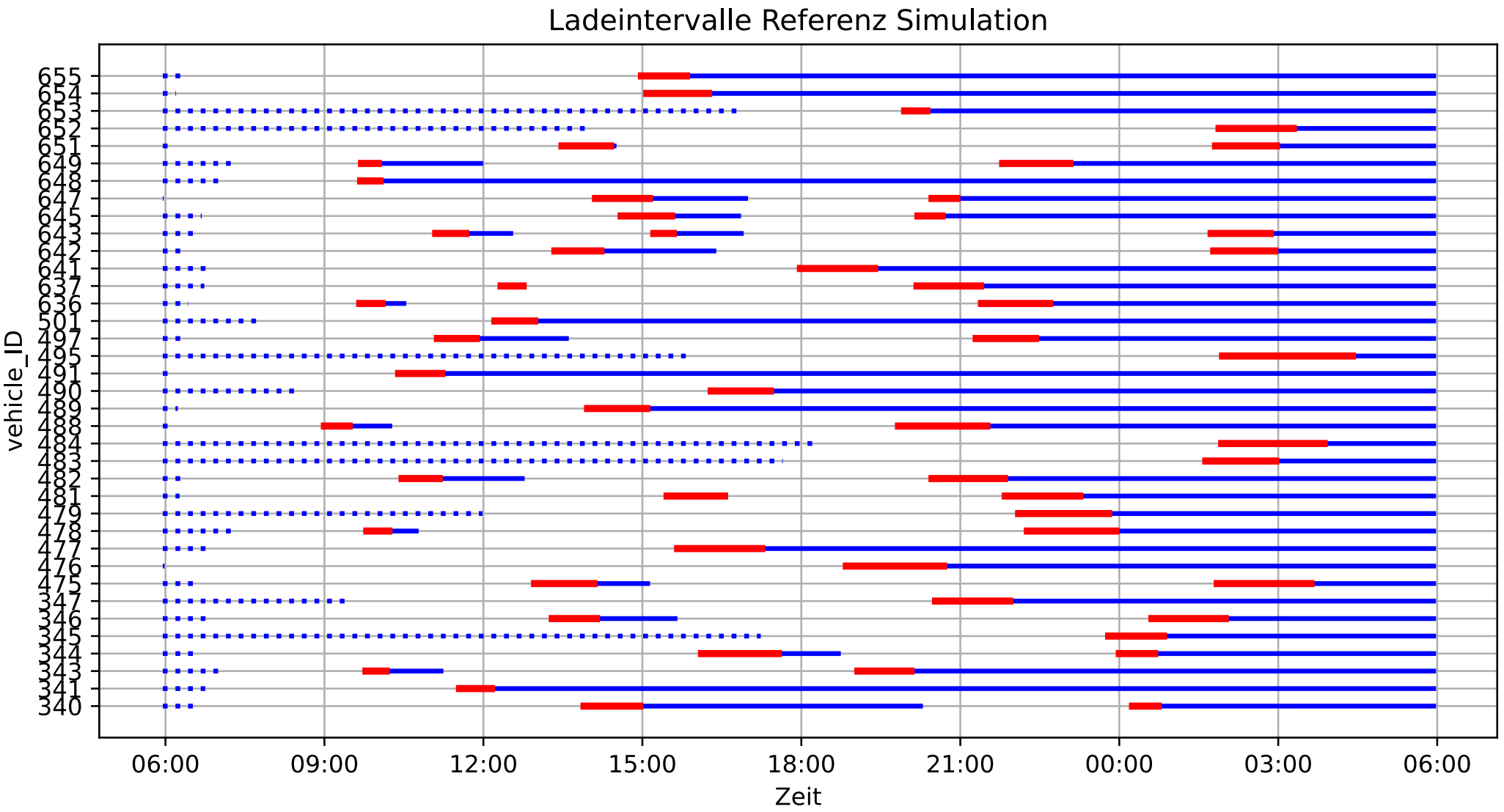
03:00
06:00
Zeit


Ladeintervalle Referenz Simulation
vehicle_ID
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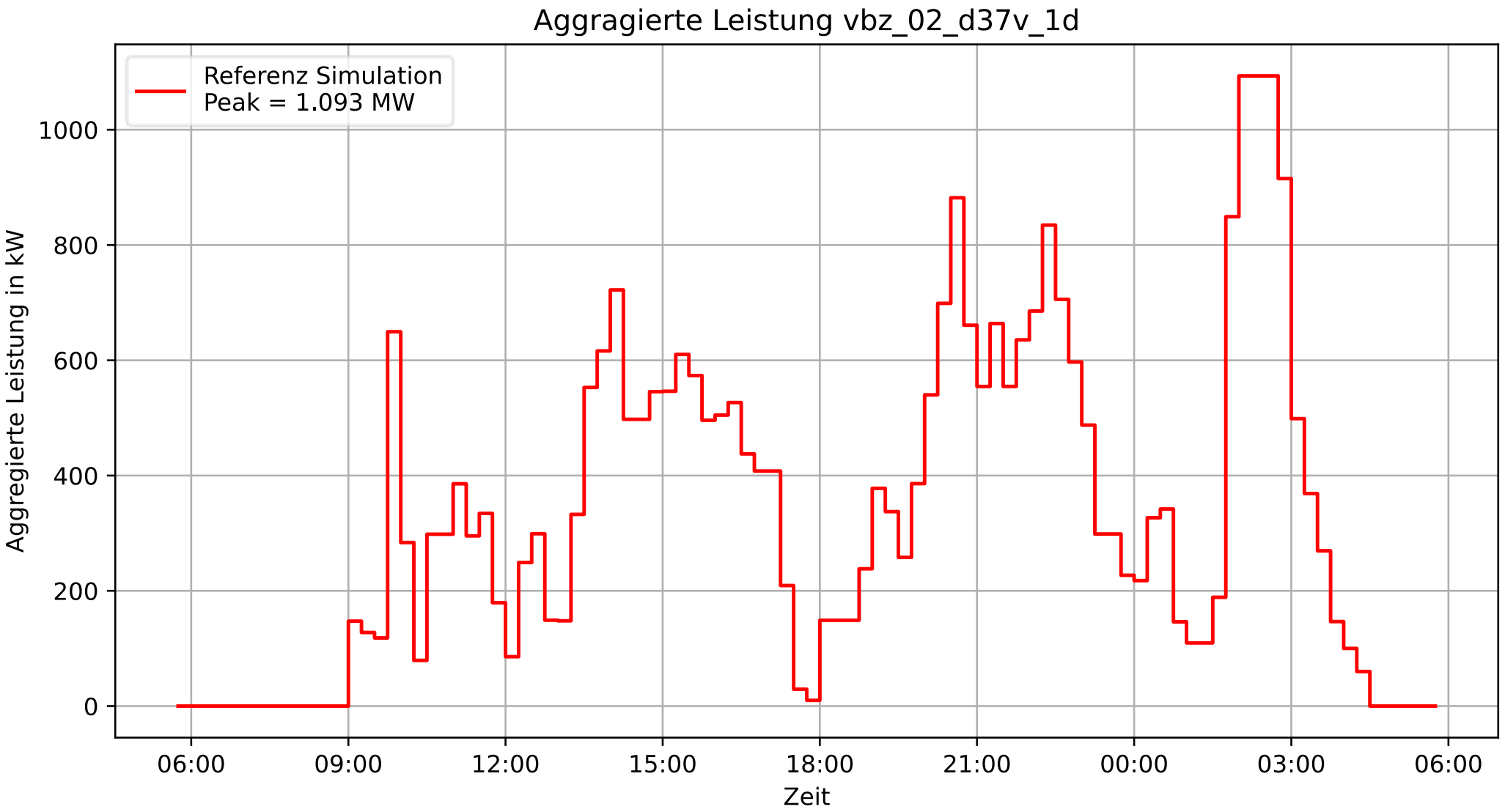
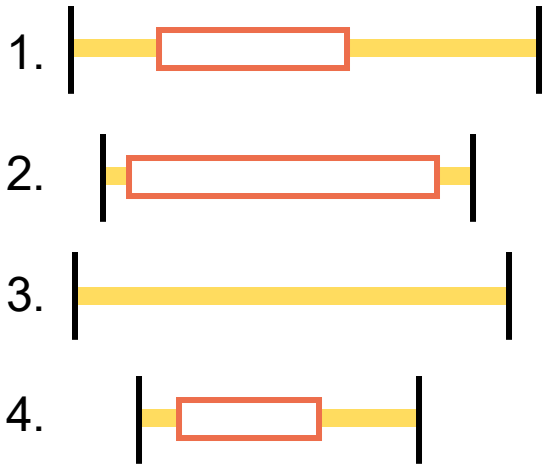
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
Zeit


Aggragierte Leistung vbz_02_d37v_1d
Referenz Simulation
Peak = 1.093 MW
Aggregierte Leistung in kW
0
200
400
600
800
1000
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
Zeit

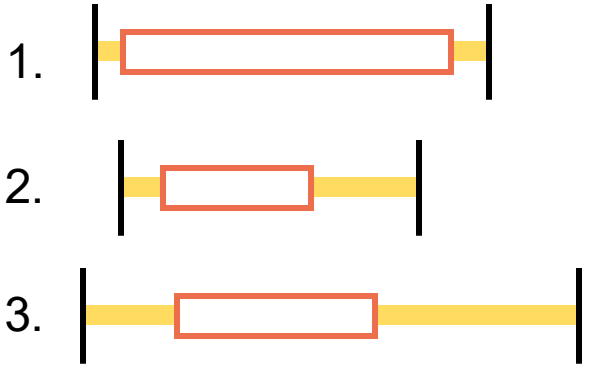
1

ENERGIEMENGE auf Basis der **REFERENZ-SIMULATION** aller Ladefenster **DEFINIEREN**:



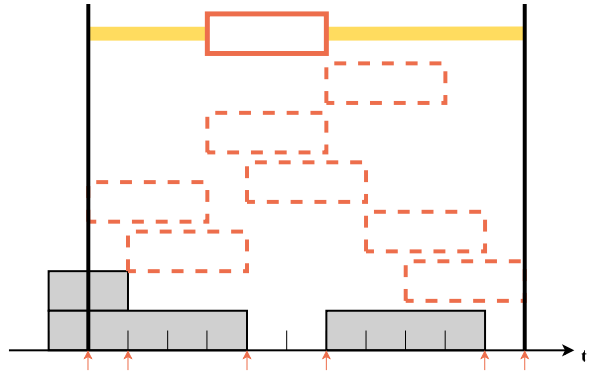
2

Relevante Ladefenster **ORDNEN** nach aufsteigender zeitlicher **FLEXIBILITÄT**:



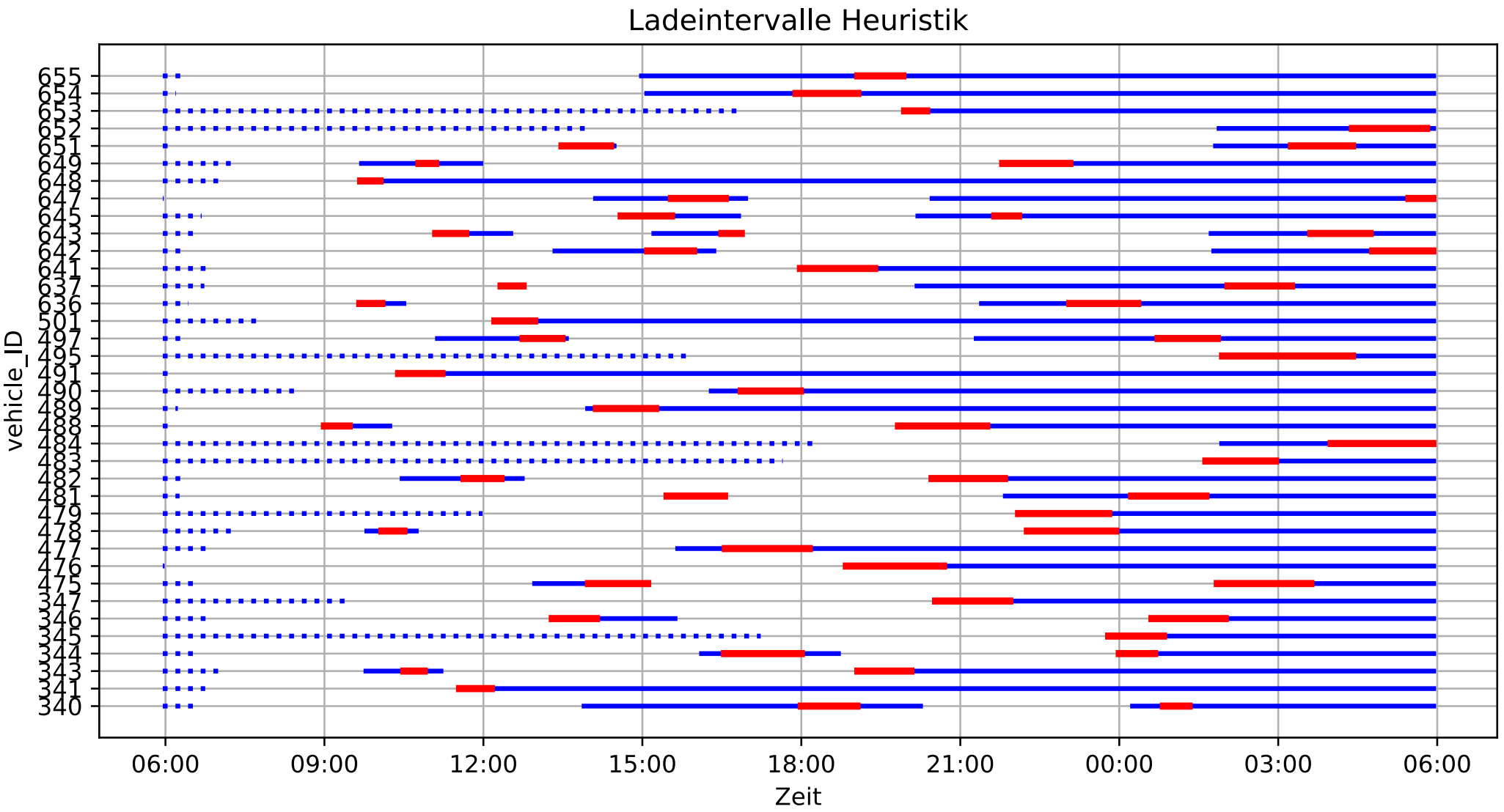
3

Alle Ladeintervalle **EINPLANEN**:



Für alle Möglichkeiten:

1. Resultierende Spitzenlast
2. Überschneidung mit eingeplanten Ladeintervallen
3. Erster Startzeitpunkt


Ladeintervalle Heuristik
vehicle_ID
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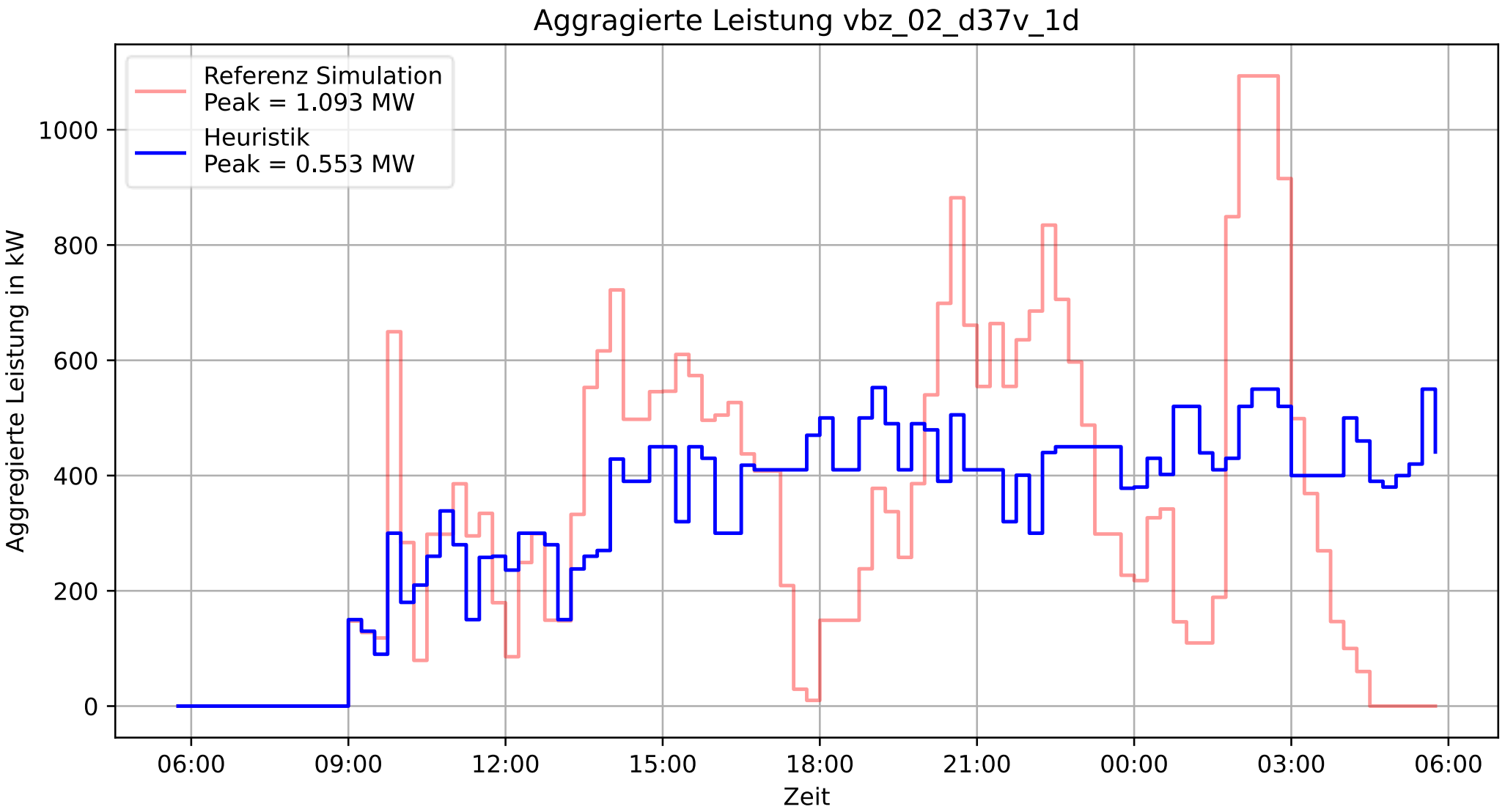
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
Zeit


Aggragierte Leistung vbz_02_d37v_1d
Referenz Simulation
Peak = 1.093 MW
Heuristik
Peak = 0.553 MW
Aggregierte Leistung in kW
0
200
400
600
800
1000
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
Zeit