Integrated energy storage at fast charging stations.

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Flexible Electric Vehicle Charging Infrastructure
FlexChEV

- Connection a EV to a fast charger cause a power drop (30 seconds) transferred to the grid that may be alleviated with a flywheel.
- With increasing intermittent renewable energy, storage in both micro grids at distribution level and at transmission level for large scale will reduce system cost.
- The load on individual branches of the distribution grid from fast charging of EVs may be dispersed using a node network model.
- Fast charging at stations with MW total capacity will cause peaks with high power demand. Using Li-Ion battery to buffer will reduce demand for grid capacity and reduce cost.

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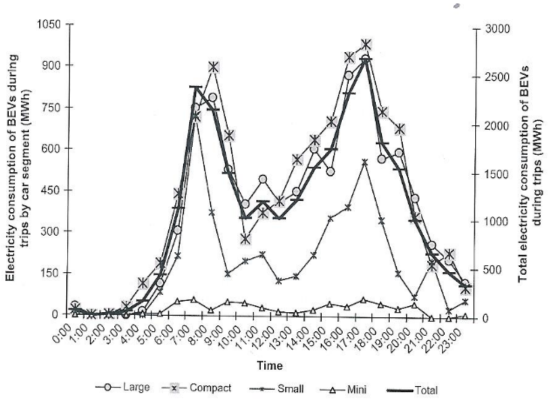
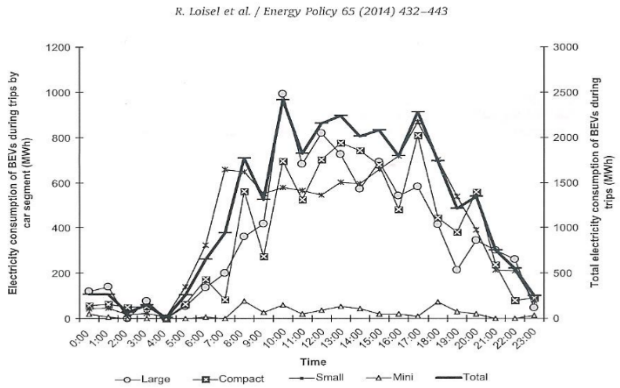
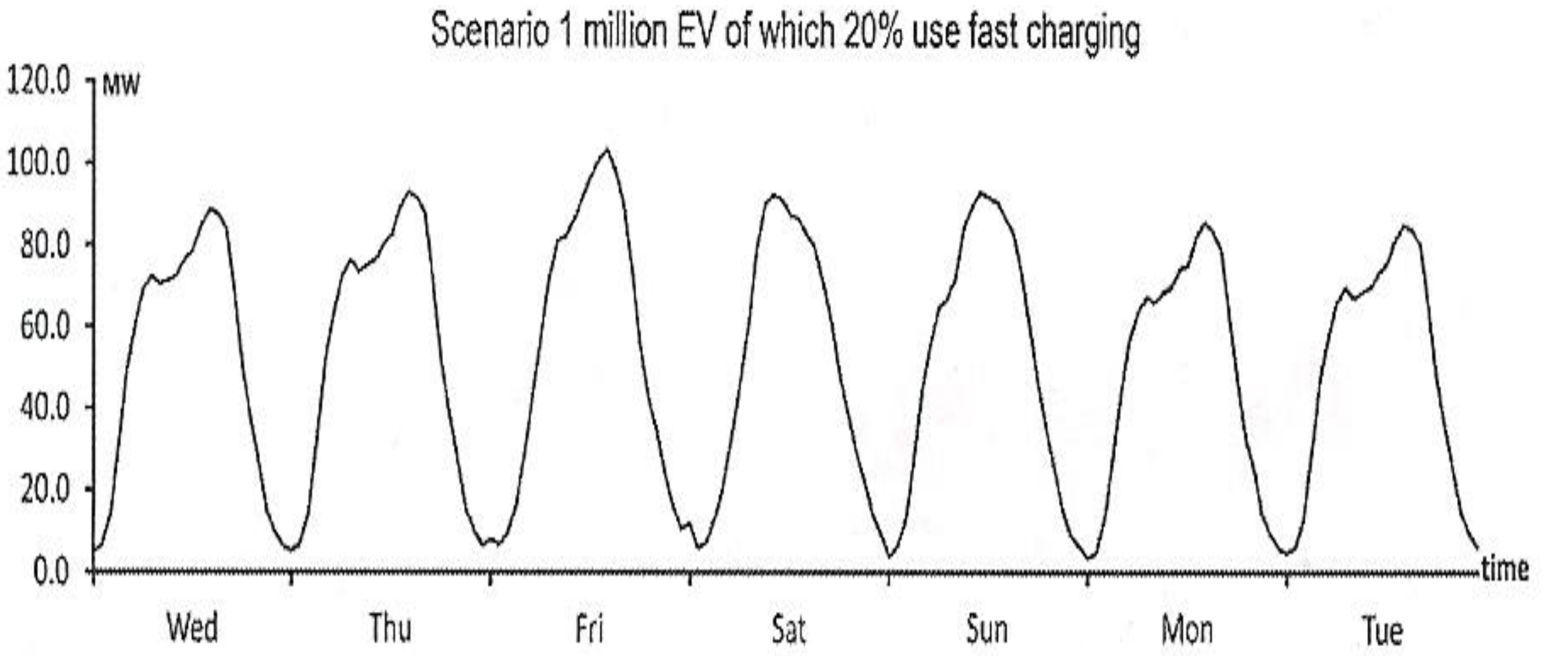
Estimated electricity consumption for EVs





(Loisel, Pasaoglu et al. 2014)



Source: Schroeder and Traber 2012, based on Barnes 2008

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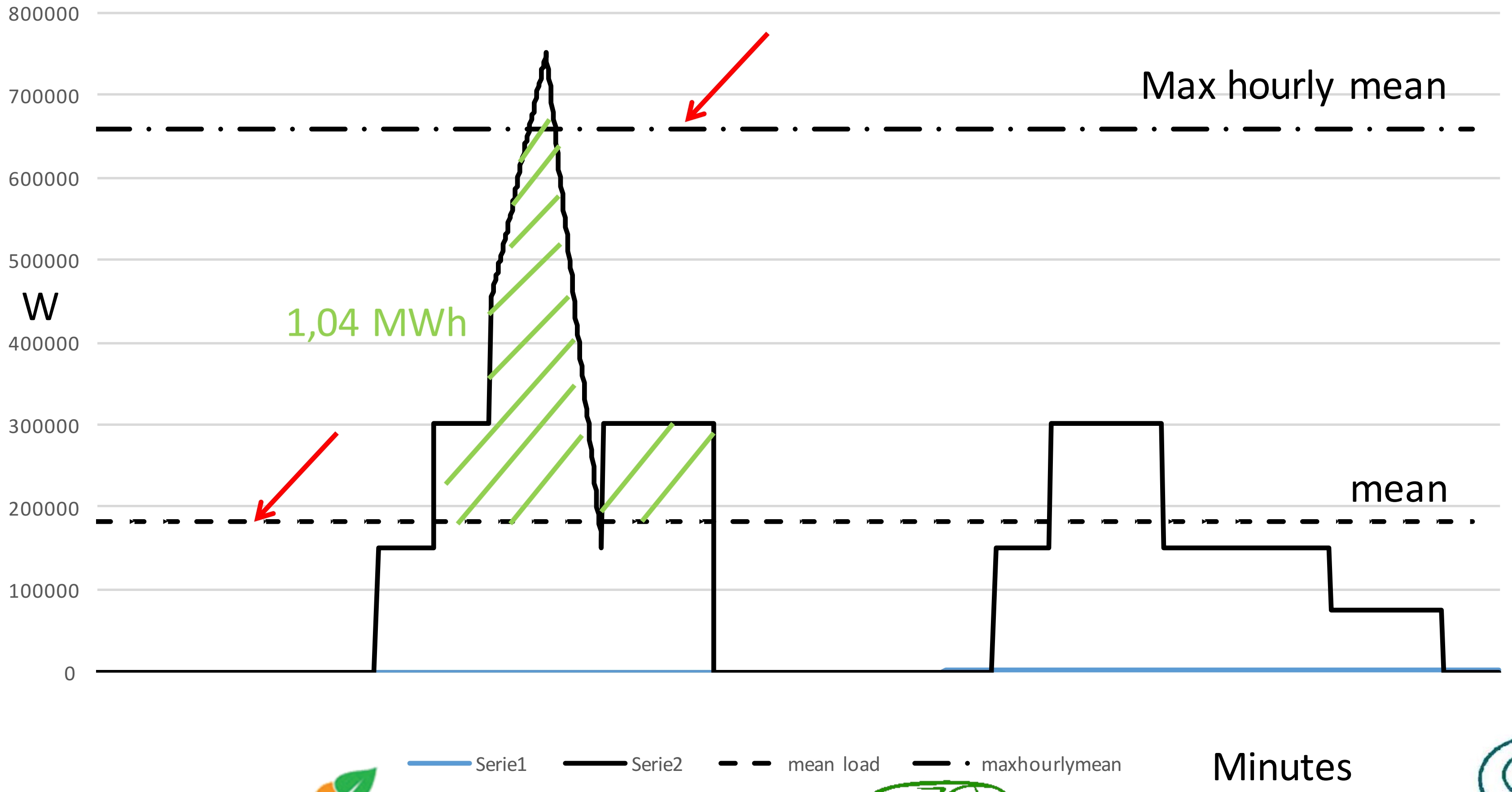
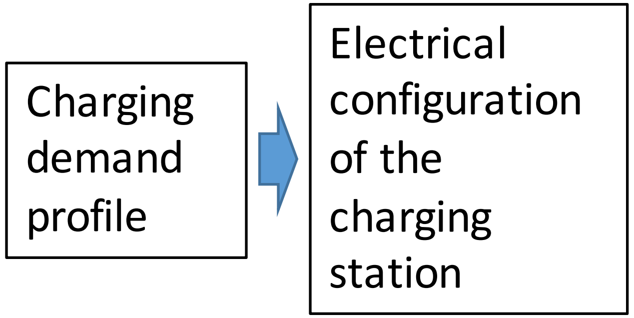
Demand profile (schematic)

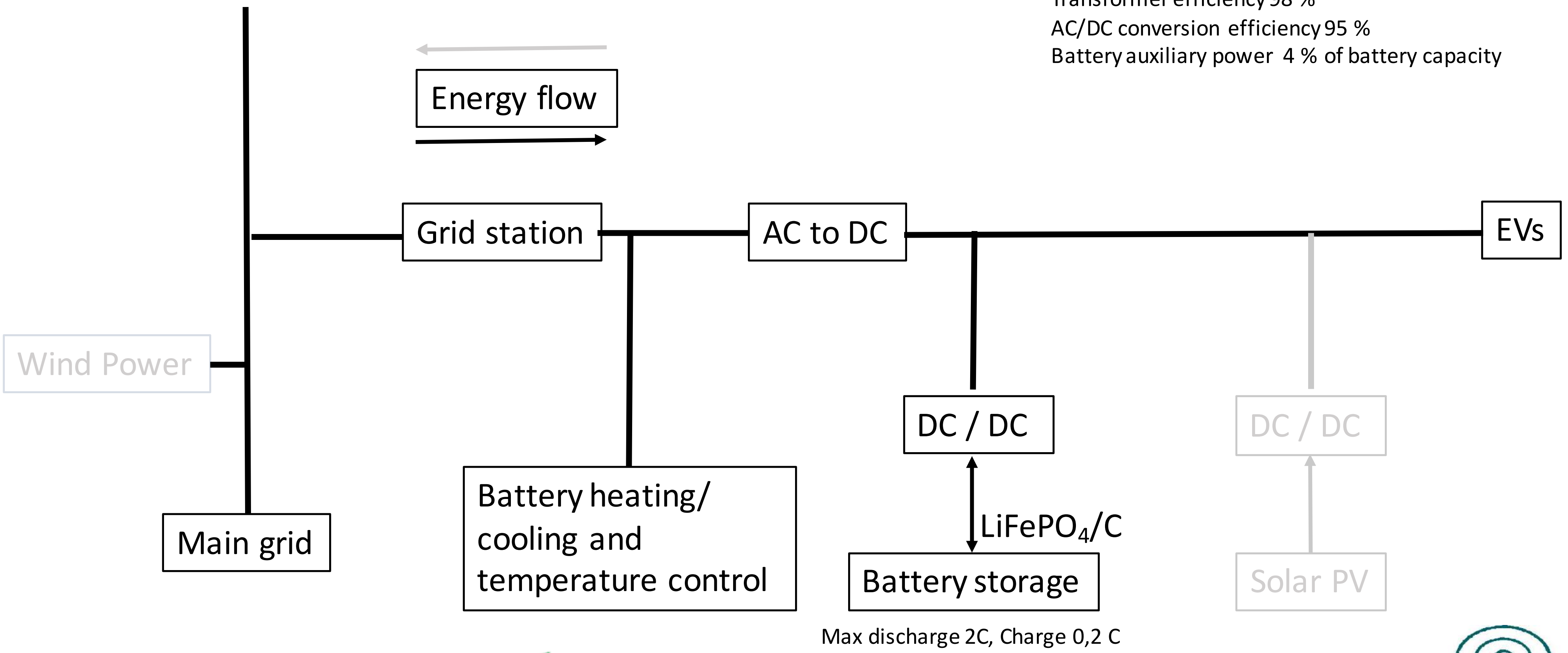


Model structure and operation

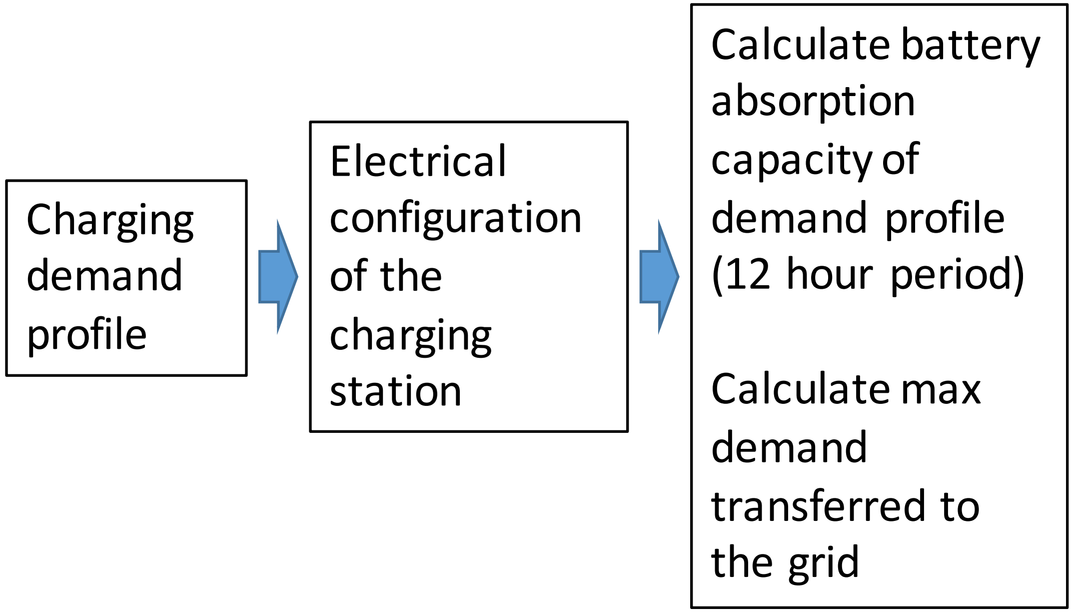


Main electric elements of the charging station

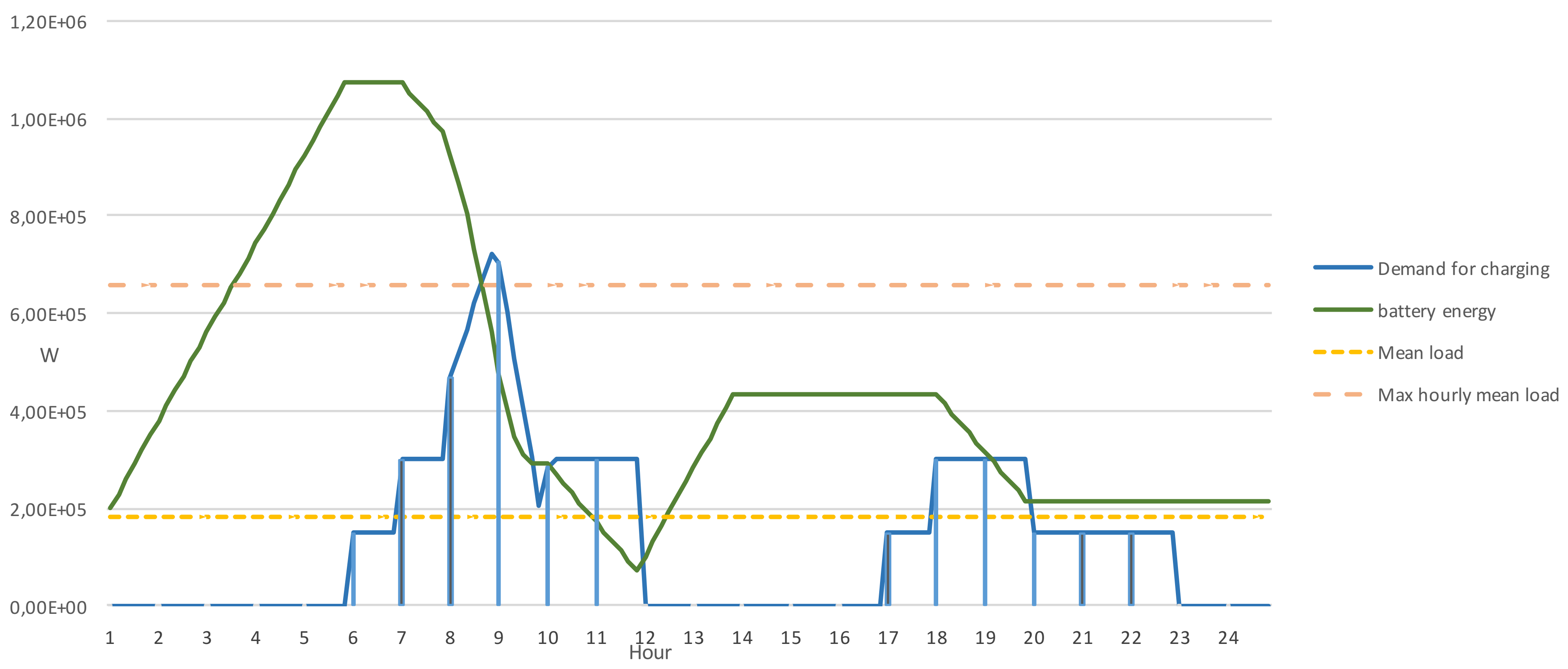
Transformer efficiency 98 %
AC/DC conversion efficiency 95 %
Battery auxiliary power 4 % of battery capacity



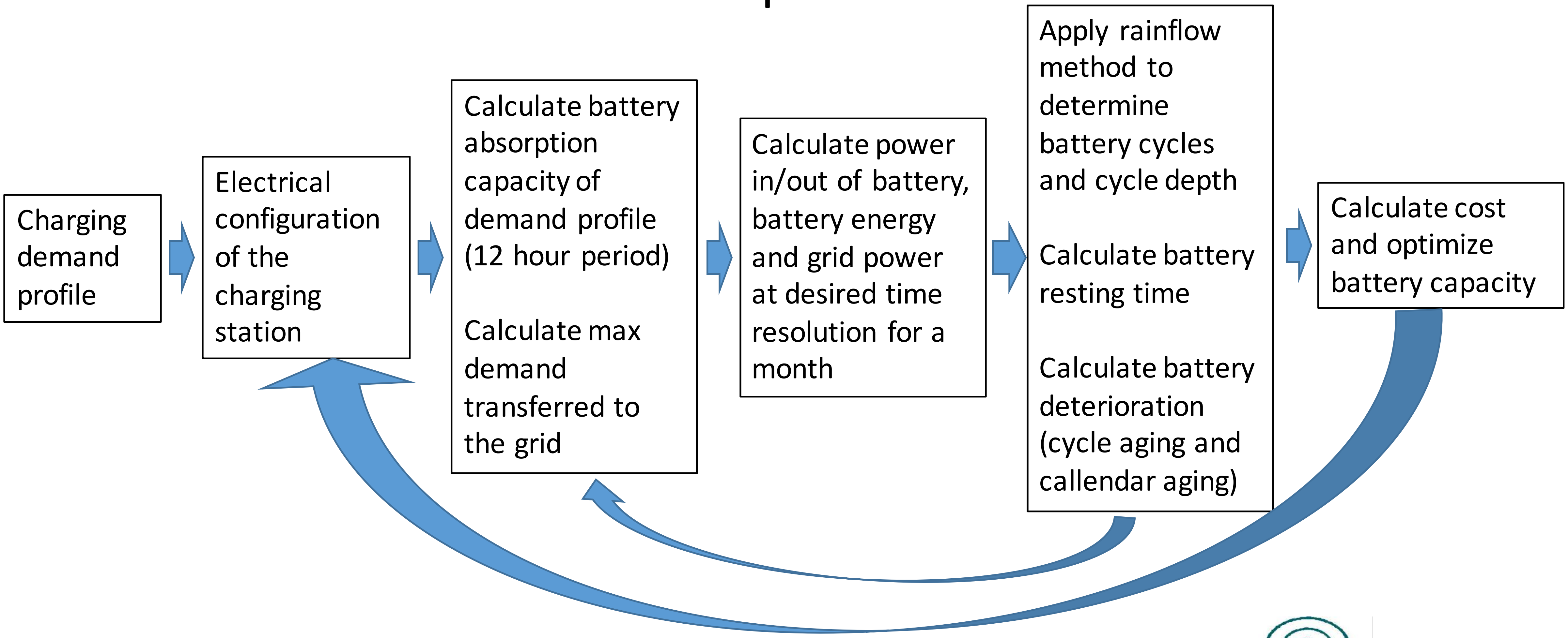
Model structure and operation



System operation during a 24 hour period

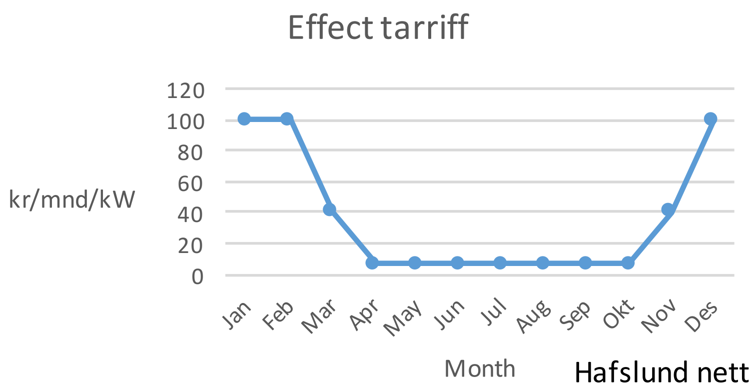


Model structure and operation



Preliminary annual cost estimate

- Assumptions
  - Grid station cost 0,8 MW   0,4 Million Nkr
  - Grid station cost 0,315 MW   0,28 Million Nkr
  - Battery cost 1,2 MWh   5,0 Million Nkr
  - Interest rate 6 %
  - Life time 20 years



Hafslund nett

Electricity cost 0,17 Nkr

	Without battery	With battery year 1	With battery year 20
Million Nkr	5,18E+05	4,46E+05	4,53E+05

Summary

- Scenarios for EV fast charging demand as input
- A techno-economic model with grid connection, energy storage and optional renewable energy generation.
  - Estimate size of grid- and battery capacity
  - Estimate operation, i.e., a balance between battery deterioration from cycle- and callendar aging and reducing effect charges.
  - Estimates annual cost
- Preliminary calculations with $LiFePO_4/C$ battery show that despite the high cost of the Li-Ion battery, it may still be profitable because of the reduction in effect demand charges.

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