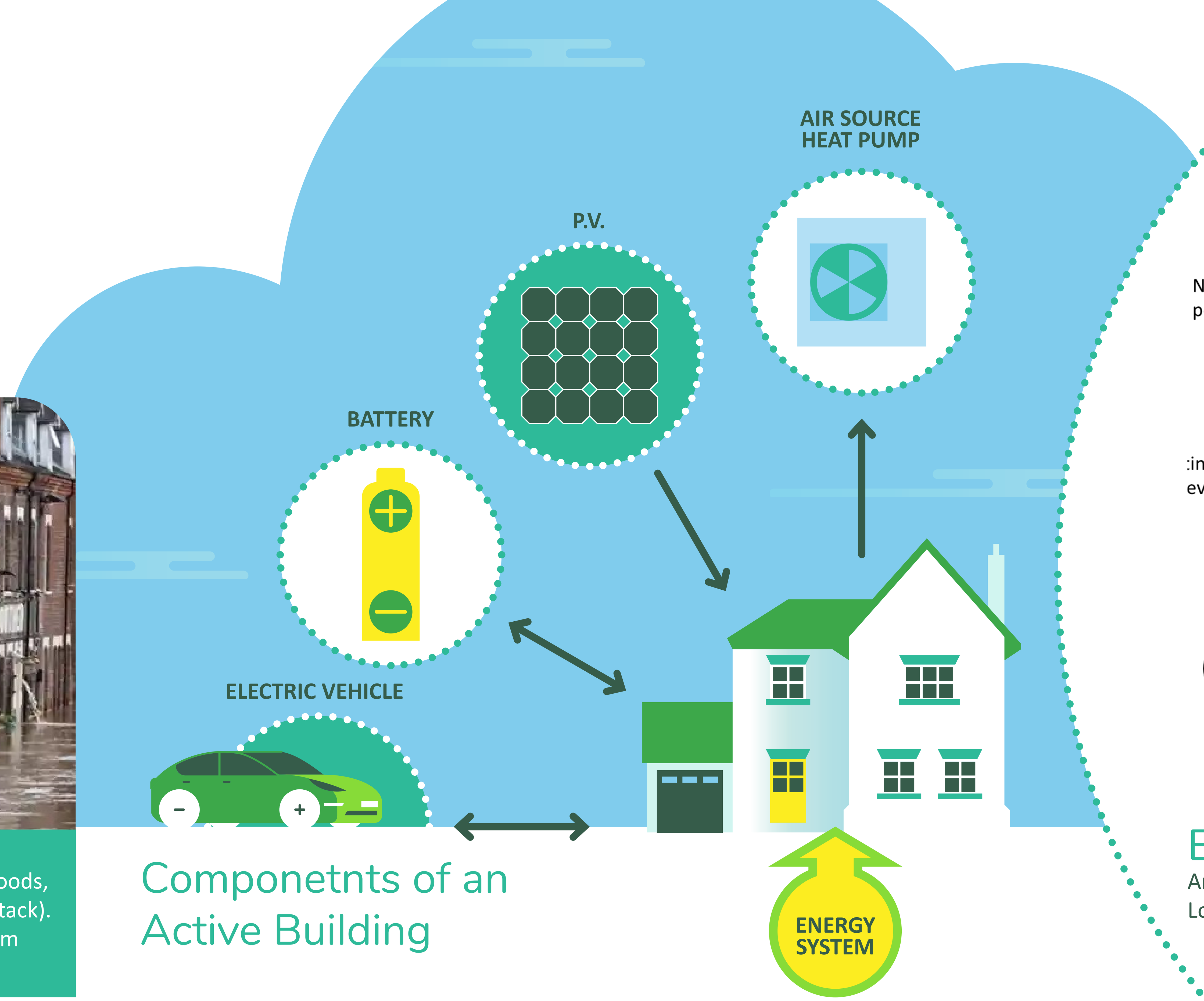
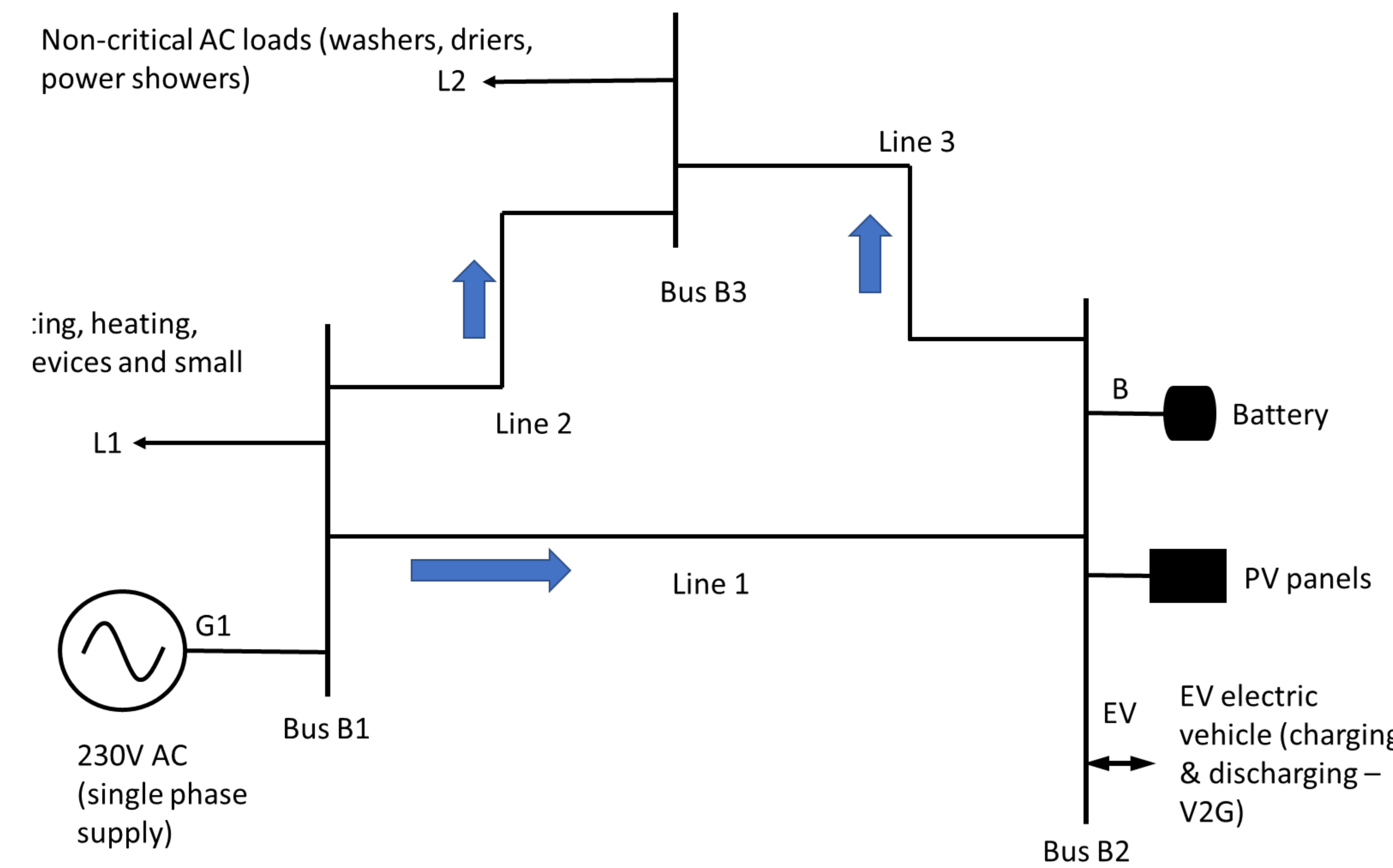
Active Buildings and Resilience

Boxing day floods, North of England 2015

High impact, low frequency events
This type of event can be natural (e.g. floods, heat waves) or man-made (e.g. cyber-attack). Historical data is of little help in long-term prediction of future events.



Componetnts of an Active Building



Electrical system of an AB

An AB is represented by a simple 3 bus network.
Loads are divided into the critical and the non-critical, as shown.

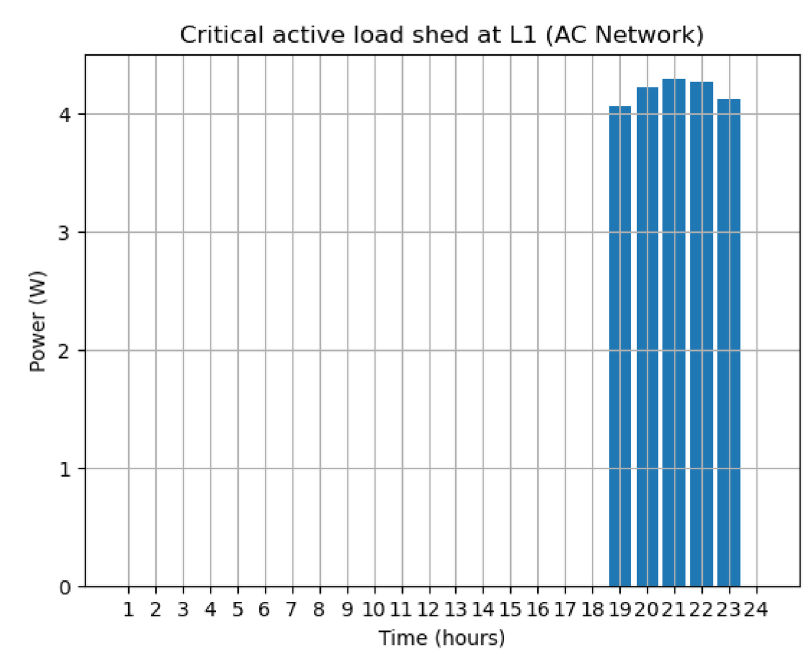
Introduction

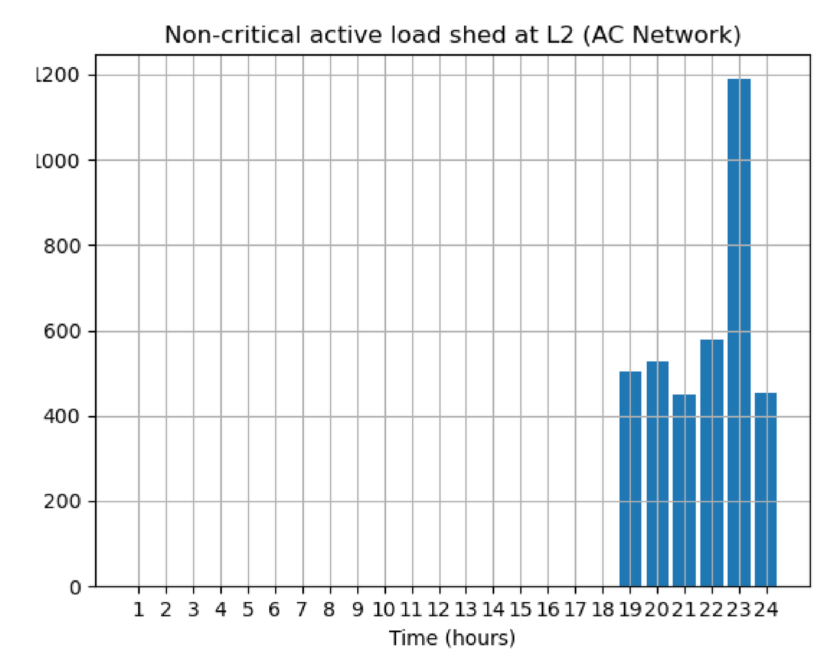
As the energy system is transformed to meet zero emission targets, resilience is becoming of increasing importance. Traditional reinforcement of the energy system to cope with high impact low frequency events may be uneconomic, so other strategies need to be considered. Here we explore how ABs may be used to address this challenge.

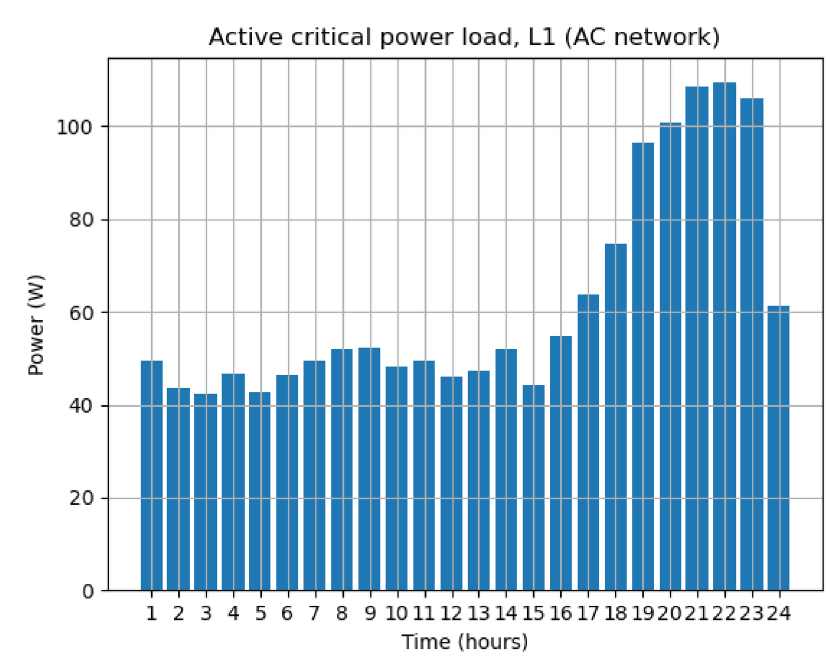
Critical and Non-critical

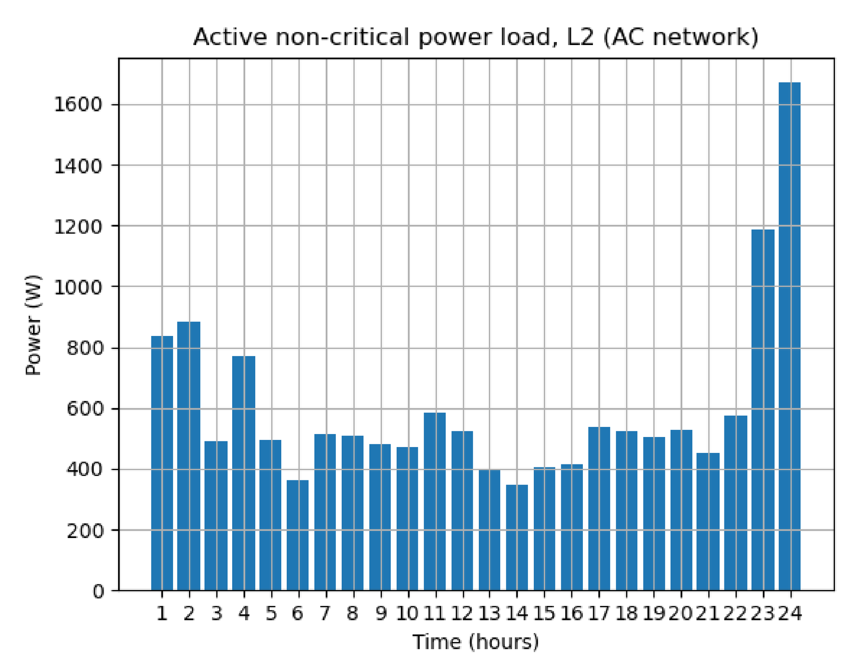
It is possible to split the types of load in an AB into the critical and the non-critical. Then only critical loads need be served during an extreme event, reducing stress on the local system. The plots (right) show OPF model output for a day on which there is an evening outage. Though much of the non-critical load is shed, very little critical load is. The model shows that this can be achieved by imposing different VOLL* for critical and non-critical loads and what levels of VOLL are needed.

*Value of Lost Load



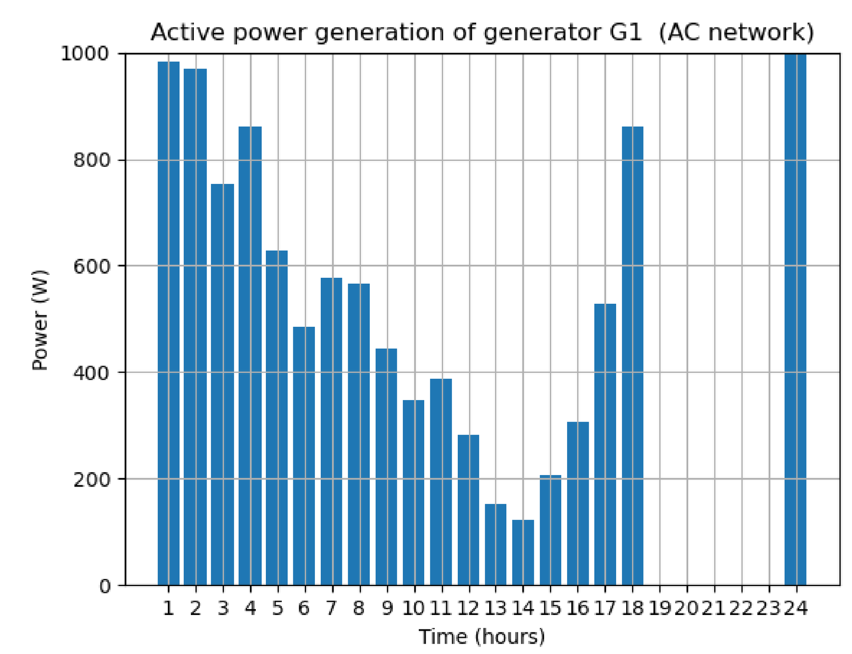


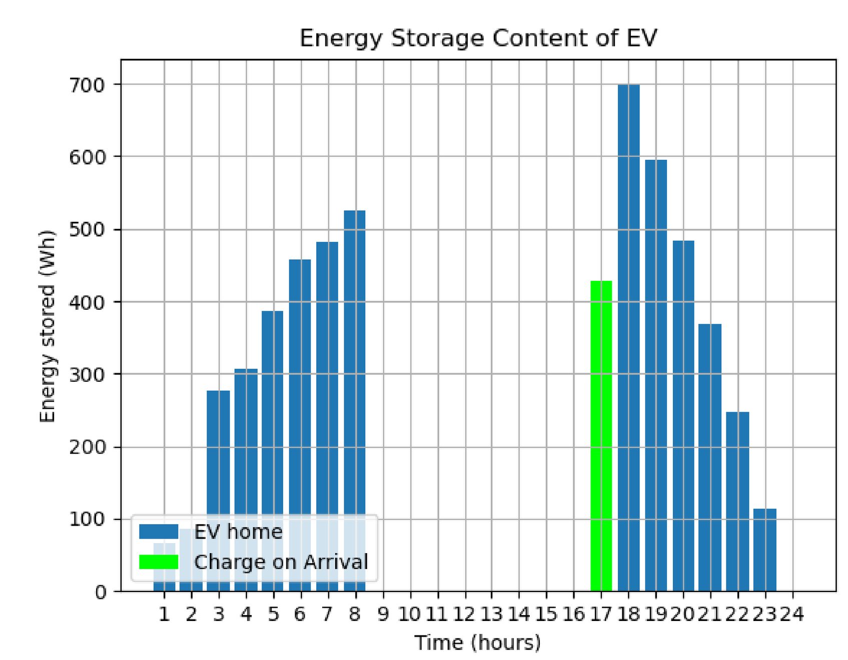


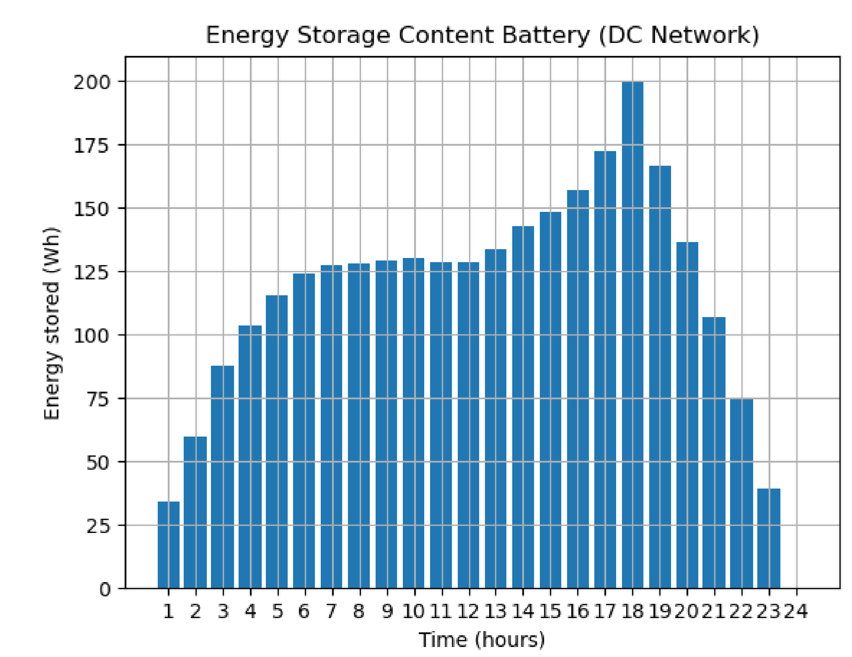


Energy storage during an outage

First plot shows power taken from the grid. Note the long outage between 19:00 and 23:00. The battery is charged to a peak value prior to the outage, then discharged to cover the outage. The EV behaves similarly, but has the additional requirement to be 75% full on leaving at 09:00 and 62.5% full on returning at 17:00







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