task_5ztn80yw2uibcsxr_with_calculation

Student Group

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Exercise E1 Conversions: Battery

1. How many minutes could an ideal battery with $10~{\rm kWh}$ operate a consumer with $3~{\rm W}$?
2. Hard: Why is a real Lithium-ion battery with $10~{\rm kWh}$ not able to provide the given power for the calculated time?

Result

$$t = 200'000~{\rm min}$$

Solution

$$\begin{align*} W &= 10~{\rm kWh} &&= 10'000~{\rm Wh}\\ \\ t &= {{W }\over{P }} &&= {{10'000~{\rm Wh}}\over{3~{\rm W}}} \\ &&&= 3'333~{\rm h}= 200'000~{\rm min} \quad (= 139~{\rm days}) \end{align*}$$

There are additional losses:

- The battery has an internal resistance. Depending on the current provided by the battery, this leads to internal losses.
- The internal resistance of the battery is depending on the state of charge (SoC) of the battery.
- The wires also add additional losses to the system.