

## [2] Battery Model

Tuesday, May 10, 2022 4:48 PM

Objective Functions

$$J = \omega R - (1 - \omega) D$$

$\omega \rightarrow$  weighting factor  $[0 \rightarrow 1]$

$D \rightarrow$  total degradation in market period  $[Ah]$

$R \rightarrow$  revenue  $[€]$

$$R = \sum_t [\lambda_t \cdot (p_t^{dis,m} - p_t^{ch,m})] \cdot \Delta T$$

$R \rightarrow$  revenue  $[€]$

$\lambda_t \rightarrow$  market clearing price  $[€/Wh]$

$p_t^{dis,m} \rightarrow$  max power input to battery in trading interval  $[W]$

$p_t^{ch,m} \rightarrow$  " " output from " " " "  $[W]$

$\Delta T \rightarrow$  duration of trading interval  $[hr]$

$$D = \sum_t d_t$$

$D \rightarrow$  total battery degradation in market period  $[Ah]$

$d_t \rightarrow$  degradation incurred in each period  $[Ah]$

Updates state of battery

$$SOC = SOC_{t-1} + \frac{(p_t^{ch,b} - p_t^{dis,b}) \cdot \Delta T}{V_{nom} \cdot I_{ic}}$$

$SOC_t \rightarrow$  state of charge, % measure of remaining capacity  $[0 \rightarrow 100\%]$

$p_t^{dis,m} \rightarrow$  max power input to battery in trading interval  $[W]$

$p_t^{ch,m} \rightarrow$  " " output from " " " "  $[W]$

$\Delta T \rightarrow$  duration of trading interval  $[hr]$

$V_{nom} \rightarrow$  nominal battery voltage  $[V]$

$I_{ic} \rightarrow$  IC current  $[A]$

Constraints on battery updates

$$0 \leq p_t^{ch,b} \leq p_t^{ch,max} \cdot u_t$$

$p_t^{dis,m} \rightarrow$  max power input to battery in trading interval  $[W]$

$p_t^{ch,m} \rightarrow$  " " output from " " " "  $[W]$

$$0 \leq p_t^{dis,b} \leq p_t^{dis,max} \cdot (1 - u_t)$$

$p_t^{dis,b} \rightarrow$  current power input to battery in trading interval  $[W]$

$p_t^{ch,b} \rightarrow$  " " output from " " " "  $[W]$

$$u_t = \underbrace{0 \text{ or } 1}_{\text{binary}}$$

Inefficiencies in battery system

$$p_t^{ch,b} = p_t^{ch,m} \cdot \eta$$

$p_t^{dis,m} \rightarrow$  max power input to battery in trading interval  $[W]$

$p_t^{ch,m} \rightarrow$  " " output from " " " "  $[W]$

$$\eta p_t^{dis,b} = p_t^{dis,max}$$

$p_t^{dis,b} \rightarrow$  current power input to battery in trading interval  $[W]$

$p_t^{ch,b} \rightarrow$  " " output from " " " "  $[W]$

$$\eta > 0$$

l l

$$\eta > 0$$

$p_t^{ch}$  > " " " output from " " " " " "

Sets bounds on SOC

$$0 \leq SOC_t \leq 100$$

$SOC_t \rightarrow$  state of charge, % measure of remaining capacity [0  $\rightarrow$  100%]

\* DOME: Charging model

\* TO DO: Regeneration model