International Renewable Energy Storage Conference IRES

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Institut für Elektrische Energiesysteme Leibniz Universität Hannover

Leibniz Universität Hannover

Hybrid Energy Storage Systems (HESS)

Design approach and cycle reduction capabilities

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About HESS

- Utilization of different storage technologies to combine advantages
- Decrease costs, size, weight or self discharge rate
- Increase efficiency, response rate or lifetime
- Common approach: combine a high energy storage as base load storage (e.g. a battery) and a high power storage to cover peaks and high frequencies (e.g. a super capacitor)

This study

- Offers a transparent design process instead of black box optimizations
- Separates dimensioning process from control strategy, circumventing local optima
- Introduces a unique hybridization diagram for an application to define the potential for hybridization and to quickly identify storage combinations
- Analytically proves cycle reduction capabilities by up to 90%, drastically improving lifetime

Further reading

- *github.com/s-guenther/hybrid* - Ready to use toolbox with documentation and examples
- *github.com/s-guenther/optess* – Generalized toolbox as developer preview
- Günther, S., Bensmann, A., Hanke-Rauschenbach, R. (2018): *Theoretical dimensioning and sizing limits of hybrid energy storage systems.* Applied Energy 210, 127.

In detail

Tablet missing? Get started at

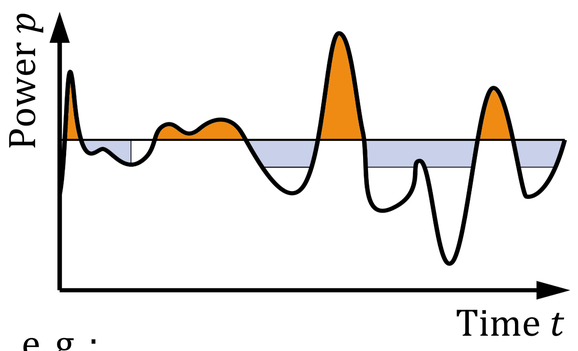
https://github.com/s-guenther/hybrid/blob/master/docs/informal_introduction.md

or use QR code to the right.

https://github.com/s-guenther/hybrid/blob/master/docs/informal_introduction.md

Outline of methodology

Problem definition



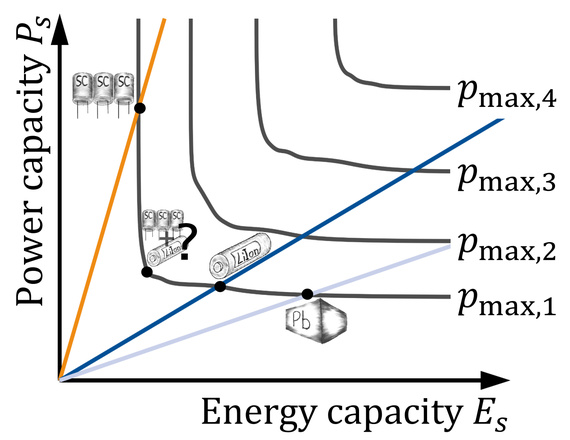
e. g. :

min: E_{Storage}

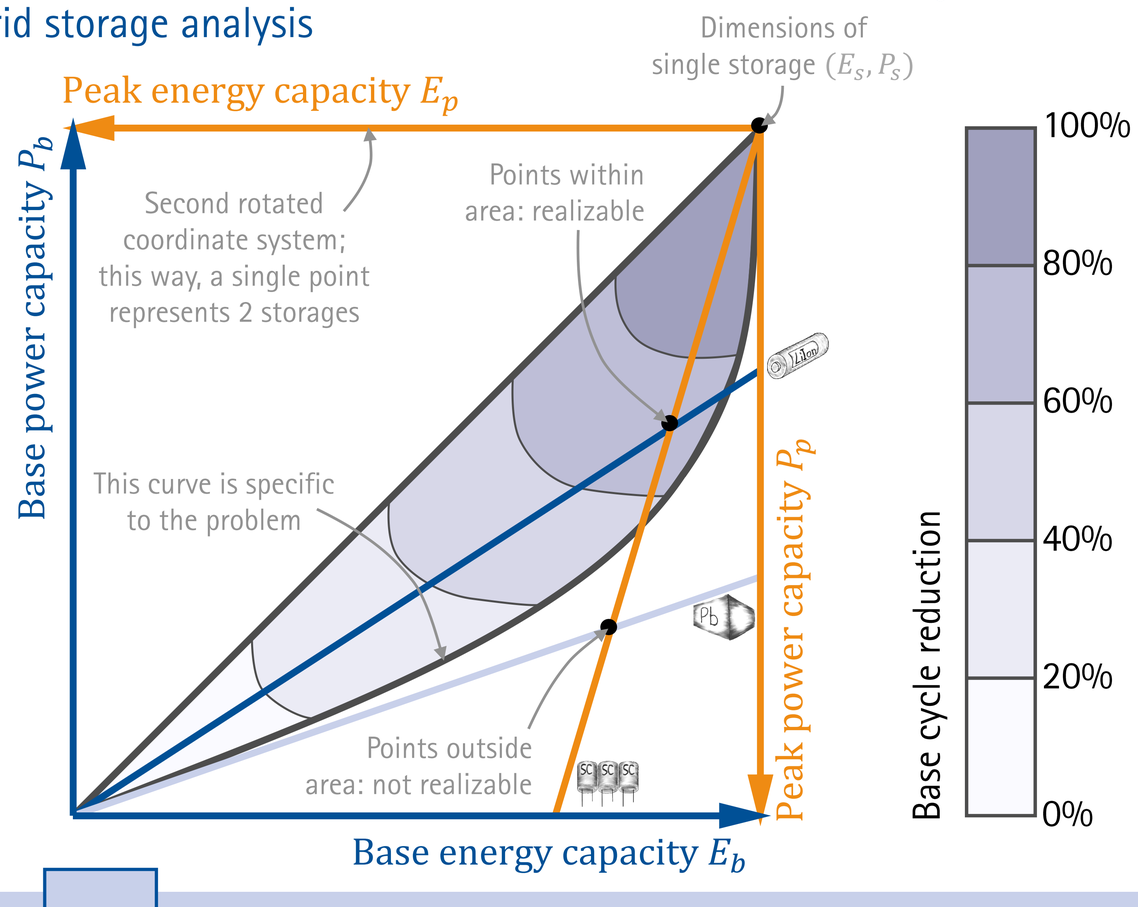
subject to: $p < p_{\max} \quad \forall t$

:

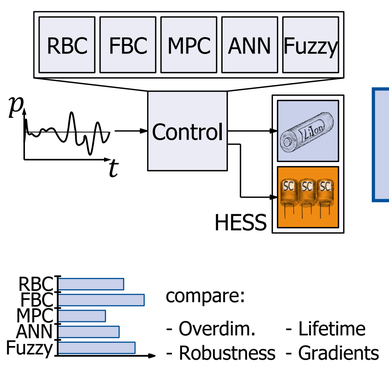
Single storage analysis



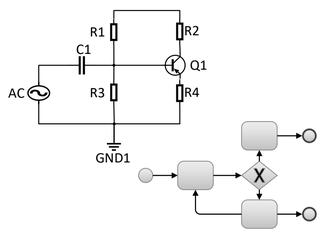
Hybrid storage analysis



Control strategy

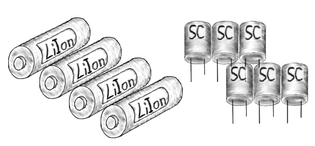


Detailed design



- Topologies
- Power electronics
- Nonlin. models/simulations
- …

Results



- Costs, revenue
- Degree of attainment
- Lifetime
- Control
- Implementation details
- …

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AS PART OF

metro HESS

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