# Life Cycle Assessment of a large-scale battery system for primary control provision

Jan Christian Koj[a] (j.koj@fz-juelich.de), Andrea Schreiber[a], Peter Stenzel[a], Petra Zapp[a], Johannes Fleer[a], Ina Hahndorf[b]
[a] Forschungszentrum Jülich GmbH, Institute of Energy and Climate Research – Systems Analysis and Technology Evaluation (IEK-STE)
[b] Younicos AG

## Research Topic

Battery energy storage systems (BESS) are a promising alternative for primary control provision (PCP). Rapid-response characteristics, the ability to reduce must-run capacity of fossil fired power plants and the possibility to base PCP on renewable electricity are key advantages of BESS. Currently Younicos AG is building a 5 MW / 5 MWh BESS for PCP for the German utility WEMAG AG in Schwerin. Here we present different environmental impacts caused by the set up of this system.

## Methodology

In a Life Cycle Assessment (LCA) environmental impacts of the construction of a 5 MW / 5 MWh system for PCP (Figure 1) are investigated. Figure 2 describes the components considered in the assessment. Most of the components data for the BESS are provided by Younicos AG. For background data GaBi 6.0 and ecoinvent database (2.2) are used. The data will later be combined with BESS operation data for PCP, to show the relative influence of the construction phase in the entire life cycle.

**Fig. 1: Schematic interior view of 5 MW / 5 MWh BESS for PCP at Schwerin (Germany)**

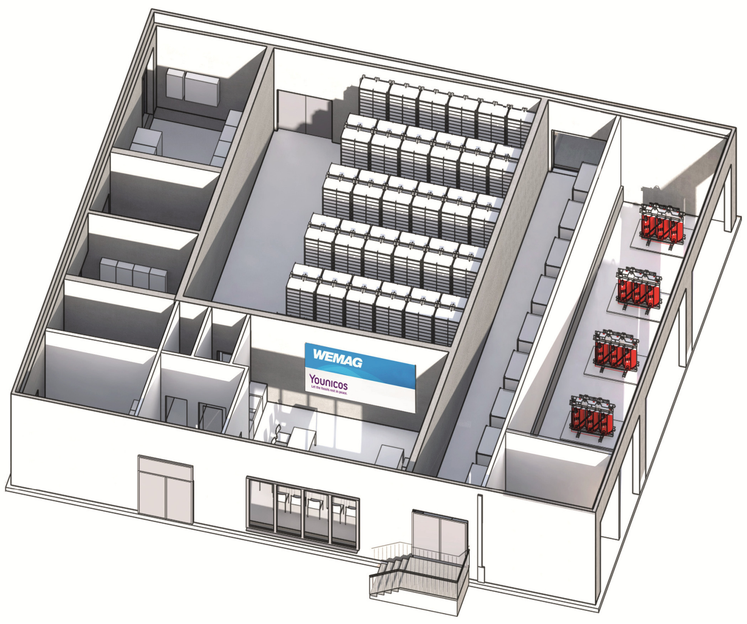
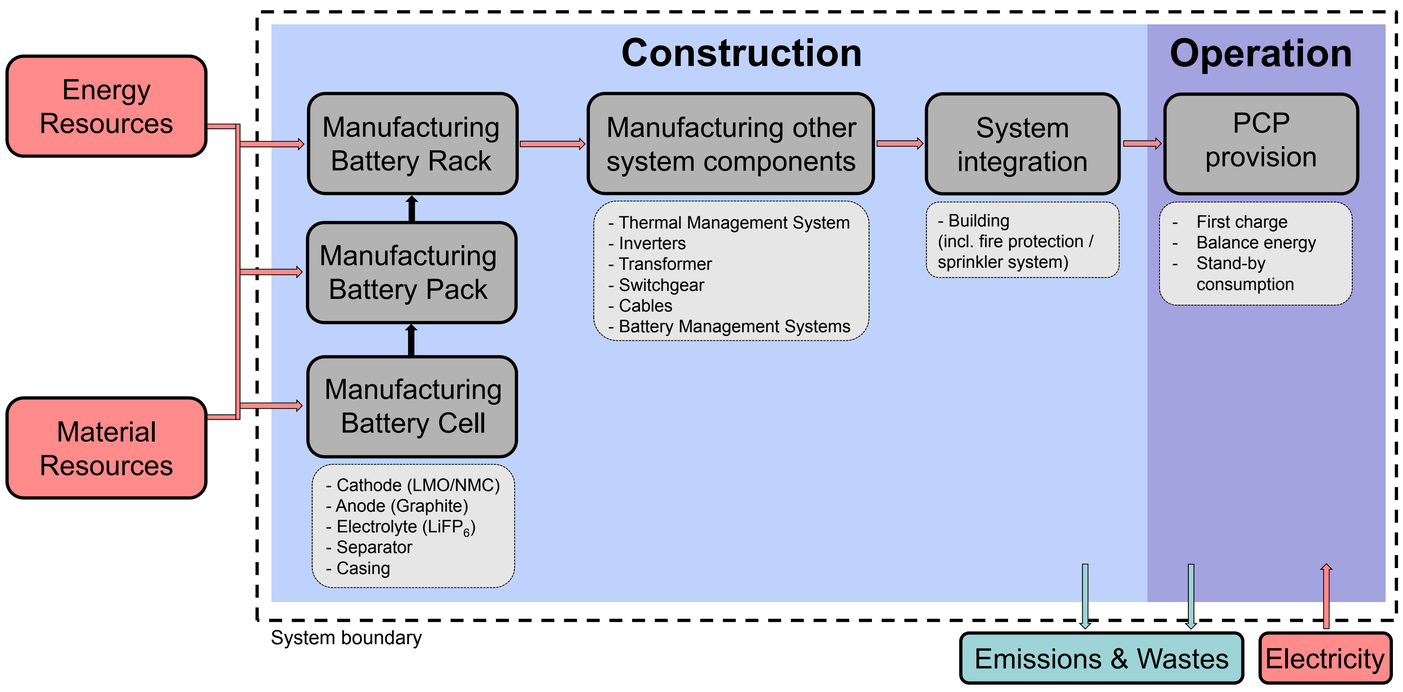


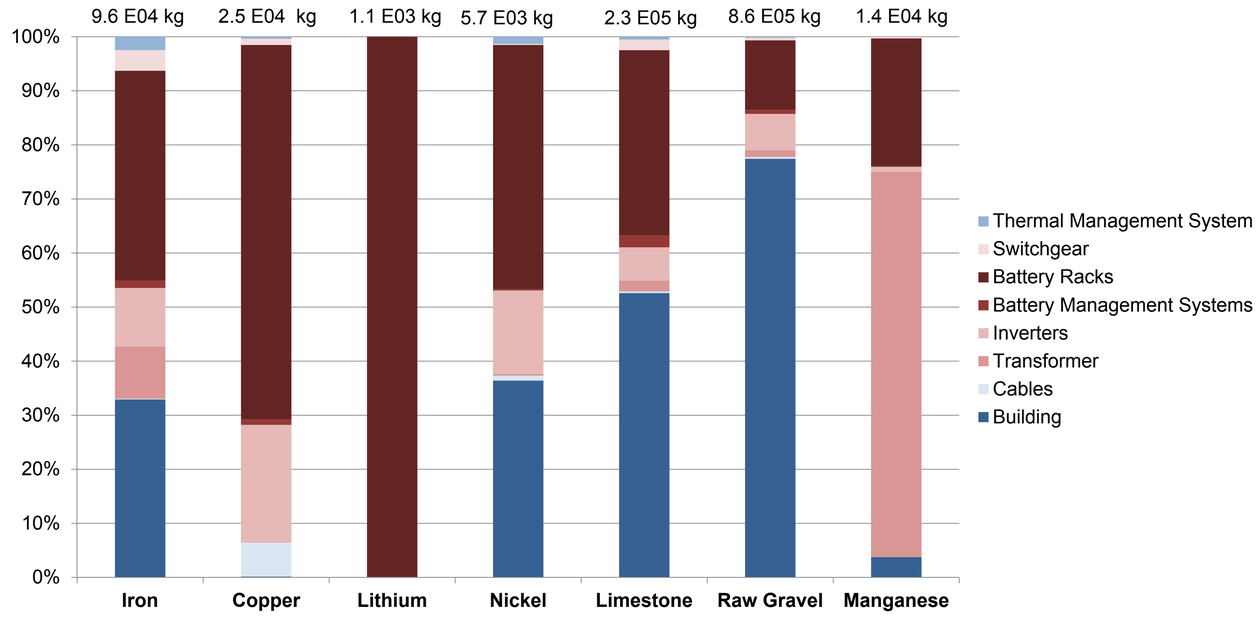

**Fig. 2: BESS system boundary for Life Cycle Assessment**




## Results

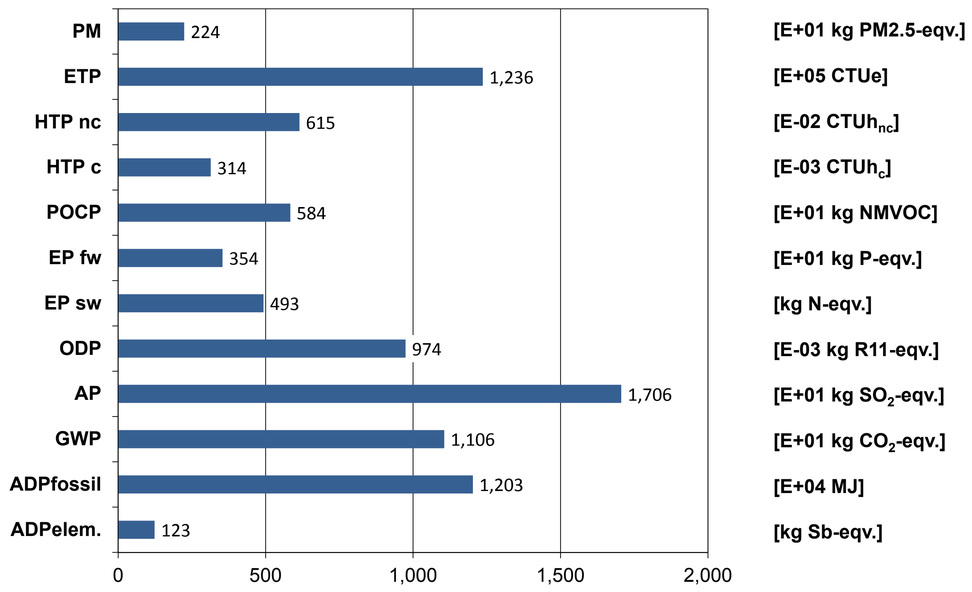
### Life cycle inventory

**Fig 3: Main material inputs per BESS**




### Life cycle impact assessment

**Fig. 4: Environmental impacts caused by the construction of BESS**




### Share of components on selected environmental impacts

**Fig. 5: $ADP_{elem.}$**

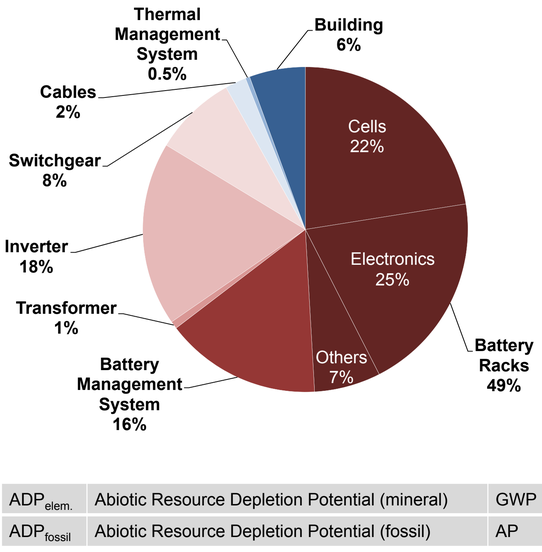



**Fig. 6: GWP**

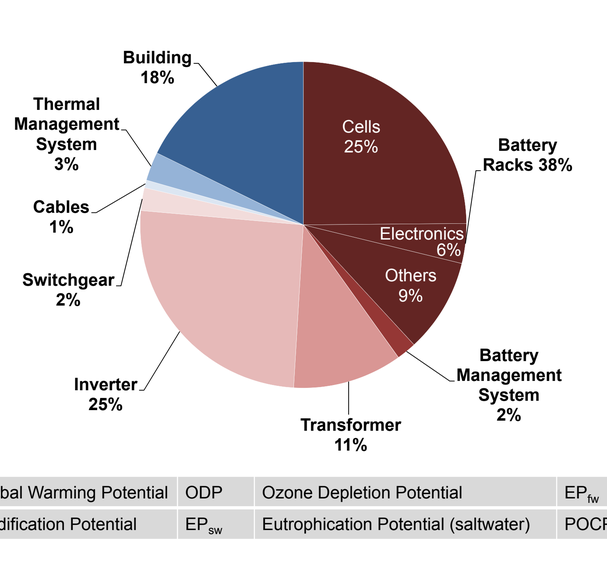



**Fig. 7: $HTP_c$**

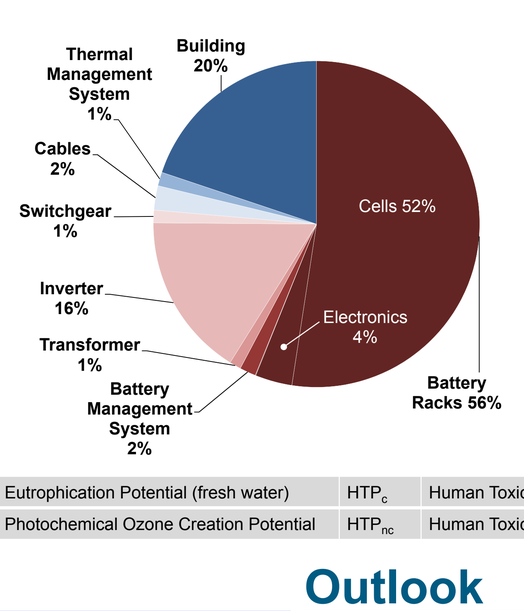
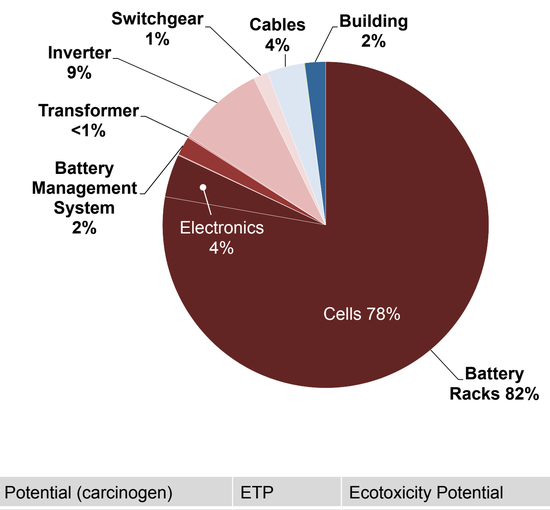



**Fig. 8: ETP**

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| $ADP_{elem.}$ | Abiotic Resource Depletion Potential (mineral) | GWP | Global Warming Potential | ODP | Ozone Depletion Potential | $EP_{fw}$ | Eutrophication Potential (fresh water) | $HTP_c$ | Human Toxicity Potential (carcinogen) | ETP | Ecotoxicity Potential |
| $ADP_{fossil}$ | Abiotic Resource Depletion Potential (fossil) | AP | Acidification Potential | $EP_{sw}$ | Eutrophication Potential (saltwater) | POCP | Photochemical Ozone Creation Potential | $HTP_{nc}$ | Human Toxicity Potential (non carcinogen) | PM | Particulate Matter |

## Conclusions

- Different environmental impacts are dominated by different components
- Battery Racks are biggest contributor to almost all environmental impacts (except ODP)
- Main components for the input related $ADP_{elem.}$ are Battery Racks, Battery Management System and Inverter
- The GWP is influenced by Battery Racks, Inverter and the Building
- For Ecotoxicity the Battery Racks are dominating (>80%), for Human Toxicity also the setting up of the Building and its materials as well as the Inverter are relevant
- In the Battery Rack the Cells are the main contributor to the impacts

## Outlook

- Consideration of BESS operation phase in LCA
- Assessment of the relative influence of construction and operation for PCP
- Comparison of environmental impacts of PCP supplied by new BESS and coal power plants
- Determination of coal power plant efficiency loss, attributable power plant segment for PCP and possible reductions of must-run capacities