



# Life cycle assessment of the second use of Li-ion batteries from hybrid and electric vehicles

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## 1. Motivation

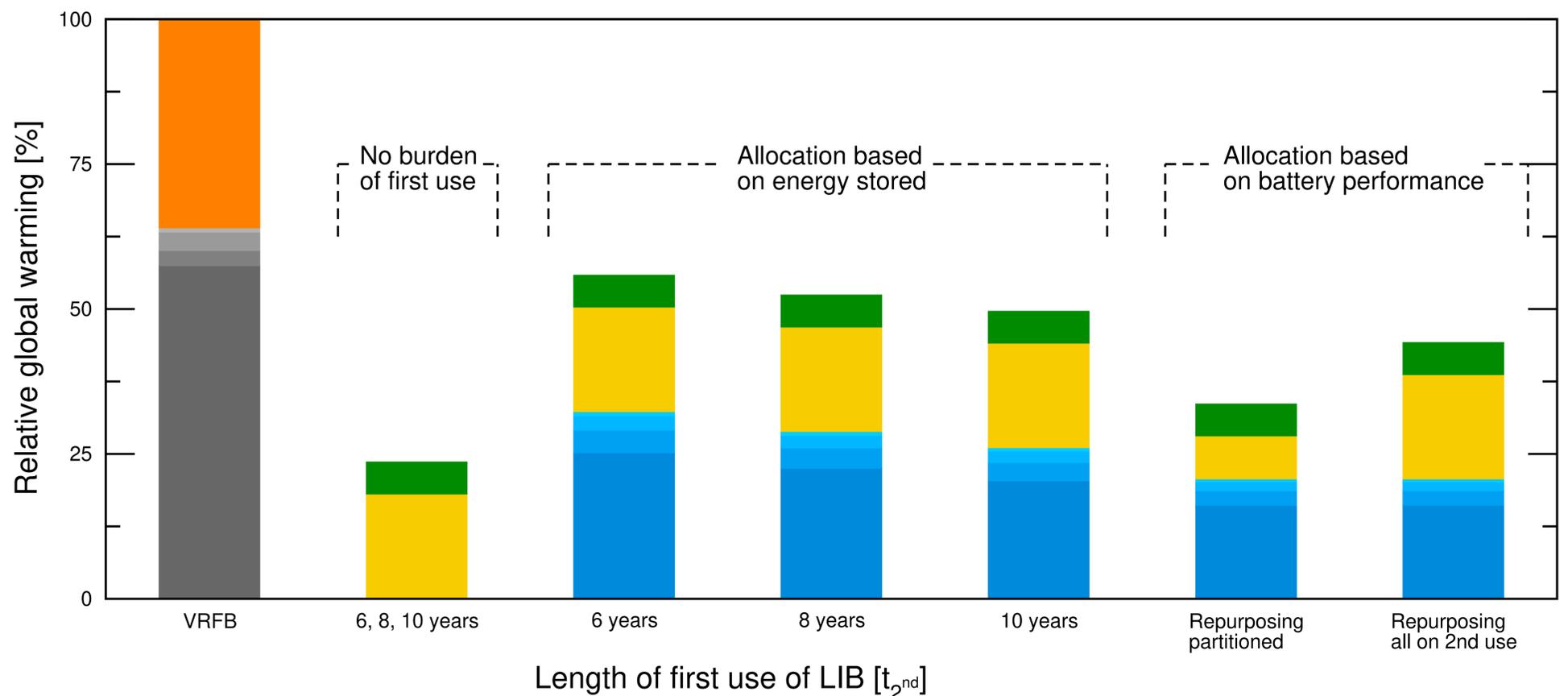
- There is an increased use of vehicles with Li-ion batteries (LIBs)<sup>1</sup>
- Storage of energy is needed in a future energy system with more intermittent generation from renewables<sup>2</sup>
- Second use is desirable from a resource point of view<sup>3</sup>

## 2. Goals of the LCA

- To determine which are the environmental hotspots in the assessed system
- To explore under which conditions second use of LIBs is most beneficial such as length of 1<sup>st</sup> and 2<sup>nd</sup> use
- To compare the 2<sup>nd</sup> use of LIBs with a dedicated battery storage system such as a vanadium redox flow battery (VRFB)

## 4. Results

- Dedicated VRFBs have a larger GWP than 2<sup>nd</sup> use LIBs
- Battery manufacturing (VRFB and LIB) and repurposing (LIB only) contribute significantly to GWP



### Vanadium redox flow battery (VRFB)

█	Electrolyte
█	Electrolyte tank
█	Other
█	Battery frame
█	Electricity storage

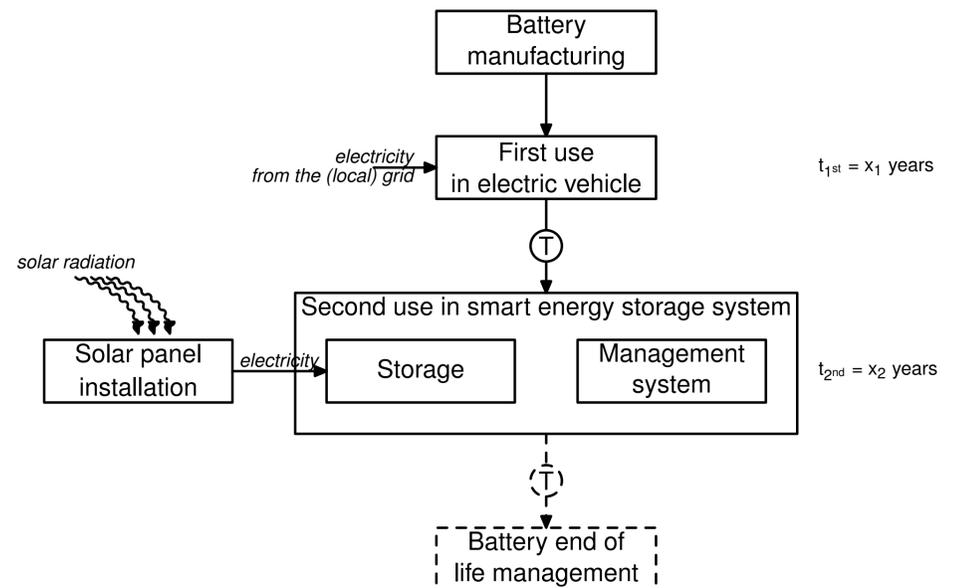
### Li-ion battery (LIB)

█	Battery cell
█	Battery packaging
█	Battery management system
█	Battery cooling
█	Battery repurposing
█	Second use electricity storage

Total life time of the stationary storage service is 20 years

An LIB can be used for 4 years in second use (stationary) storage

## 3. System flow chart and modelling



- Inventories for manufacturing, 1<sup>st</sup> and 2<sup>nd</sup> use of Li-ion batteries<sup>4</sup> and for dedicated storage batteries (VRFB)<sup>5</sup> were used
- Battery end-of-life management was not included
- Batteries are assumed to be used in Sweden

## 5. Discussion and conclusion

- Allocation may have a significant influence on the outcome of the LCA → What is an useful way and how can it be interpreted?
- The inventories used were for very different scales of storage → Influence needs to be further investigated
- LCA model needs more detail to study trade-offs in the system

## References

- [1] M. A. Aasness and J. Odeck. *Eur Transp Res Rev* 7 (2015), p. 34.
- [2] X. Luo et al. *Appl Energy* 137 (2015), pp. 511–536.
- [3] L. Ahmadi et al. *Int J Life Cycle Assess* 22.1 (2017), pp. 111–124.
- [4] S. Bobba et al. Tech. rep. JRC112543. Luxembourg: JRC, 2018.
- [5] S. Weber et al. *Environ Sci Technol* 52.18 (2018), pp. 10864–10873.