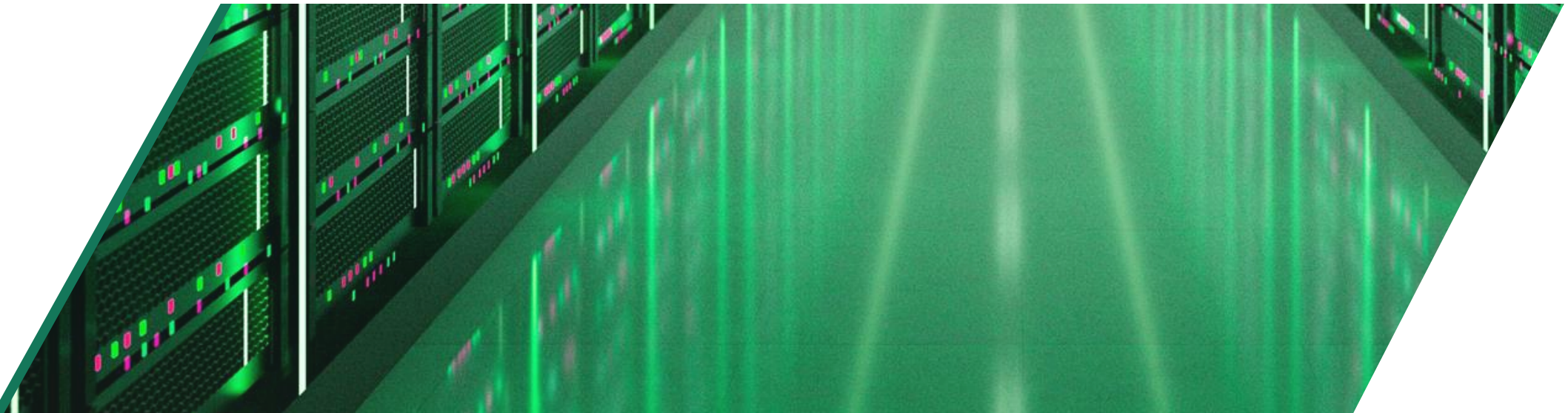
HOPPECKE
POWER FROM INNOVATION

lead or lithium in data center applications.

which battery technology fits best?



THOPP | paper

executive summary

lead or lithium.

HOPPECKE grid | Xtreme VR pure lead batteries have similar lifetime projections like comparable **LFP** solutions.

Lifetime is the most significant factor in comparing invest, reliability, service and sustainability of both technologies.

Conclusion: In the data center environment, grid | Xtreme VR batteries reveal advantages towards LFP battery solutions.

comparison.

How we compared

Lithium solutions in a data center are relatively new compared to lead.

Information on strengths and weaknesses of lithium solutions over a battery lifetime are limited.

Sources of comparison

- manufacturing processes and data
- cost projections over UPS lifetime
- technical data from testing (discharge curves, calendar life, footprint, safety issues, …)
- battery logistics (shipping, trickle charge, …)
- serviceability of different designs

battery requirements
data center

01 instant take over

Must take over instantly and use its stored energy to support the load until power grid is restored, generator has been started, or data center has been shut down safely.

02 power outages

Infrequent (short lasting) power outages in major industrialized countries. Frequent (long lasting) power outages in emerging countries.

03 float charge use

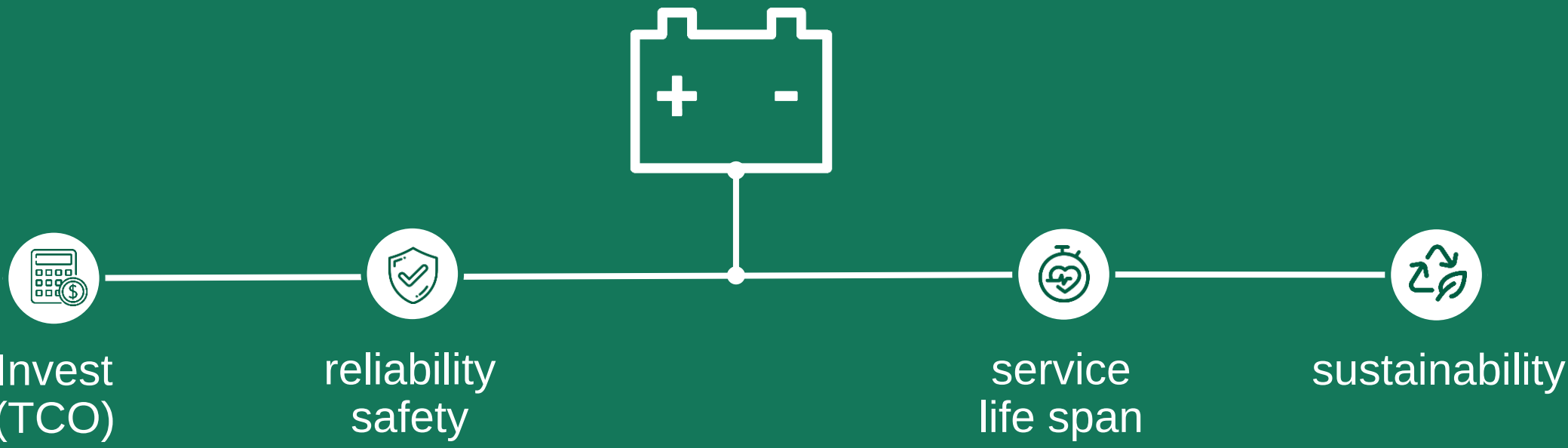
Are used in float charge (fully charged), therefore nearly no cycling.

04 short bridging times

Bridging time ranges from 5 to 15 minutes, which results in high power demand for short time.

strengths // weaknesses.

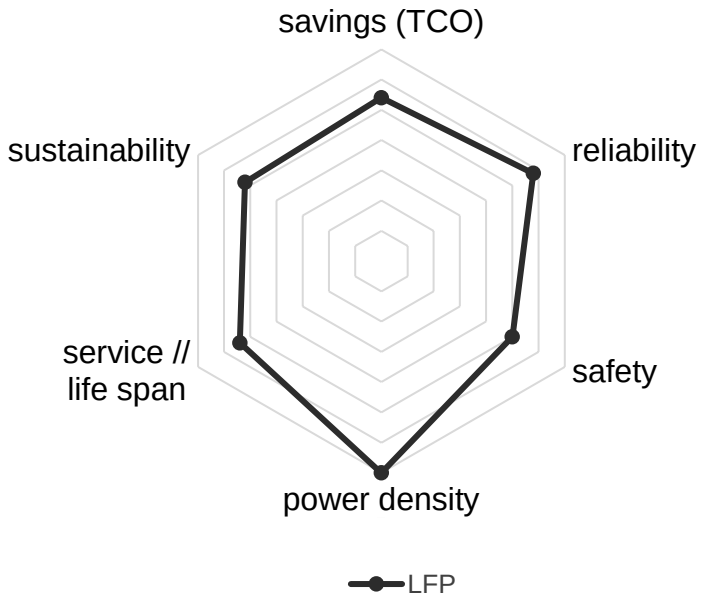
key decision drivers
battery choice



strengths // weaknesses
lithium

lithium

strength radar



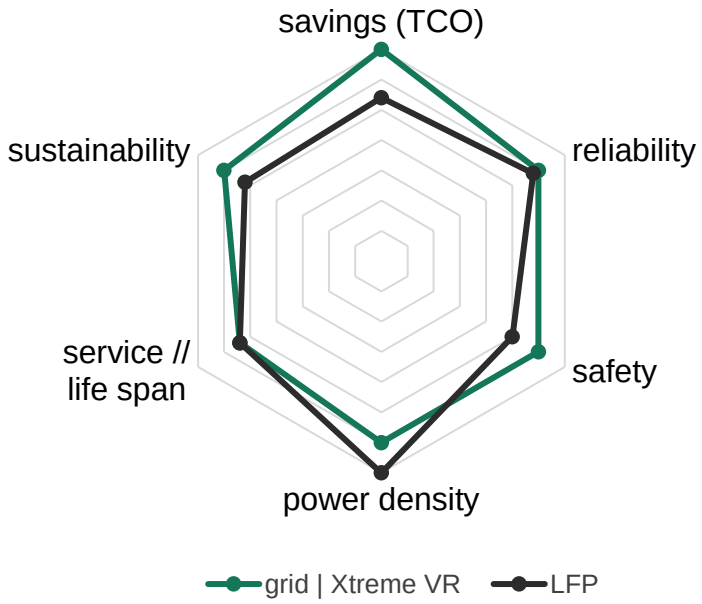
Lithium batteries have revolutionized the concept of personal mobility and have been recently attracting attention as a solution for stationary applications. According to Frost and Sullivan studies, the lithium iron phosphate battery called LFP will be the dominating lithium technology for data center applications by 2025.

- significant for data center applications is the long lifetime, high energy density and the extreme high charging capability of LFP batteries
- 15 years design life at 20°C*
- charging capability - no threshold for float charge solutions
- high power density 400 W/ltr. (P10 min @ 25°C) resulting in low space requirements

*Valid for long discharge times above 3 hours.

strengths // weaknesses
lead

pure lead // lithium
strength radar



VLRA batteries have seen a decade long development. The HPPL high performance pure lead technology has been developed for data center requirements (high/dense packaged power, 15 years design life, less temperature dependencies) and is the latest technology update in the VLRA sector.

- HOPPECKE's product to fulfill data center requirements is the **grid | Xtreme VR – HPPL technology**
- 15 years design life at 20°C – Enhanced Stability Standard (ESS) and Safeguard-tec reduce altering effects*
- charging capability - no threshold for float charge solutions
- high power density 280 W/ltr. (P10 min @ 25°C) resulting in low space requirements
- suitable high operating temperatures without air condition

*Valid for long discharge times above 3 hours.

invest.

invest
LFP

pros

- design life: 15 years
- smaller footprint
- preassembled cabinet solutions

cons

- higher CAPEX against grid | Xtreme VR
- BMS system required for safety
- invest necessary for recycling
- shipping: hazardous cargo
- several communication interfaces

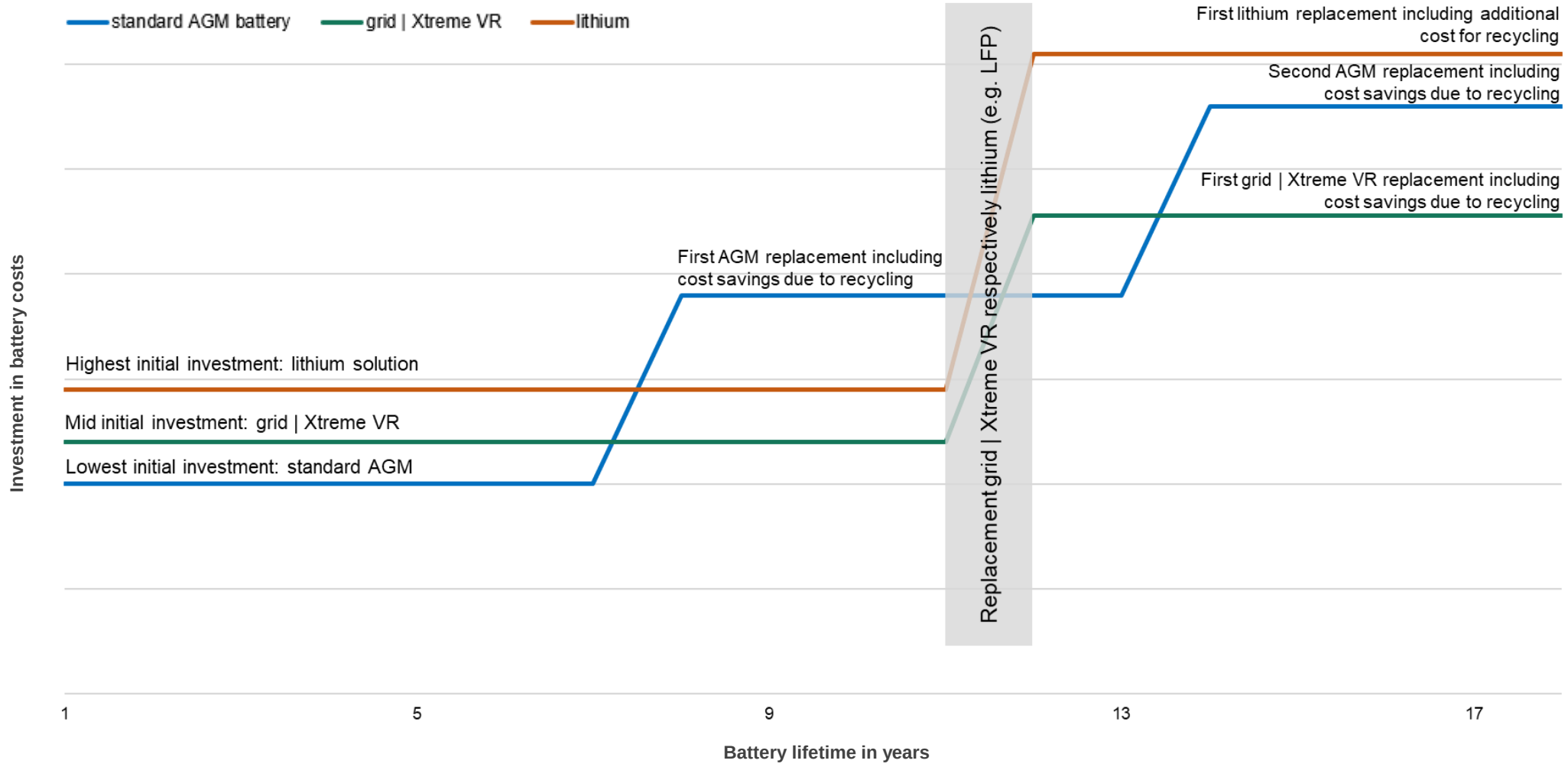
pros

- design life: 15 years ✓
- renumeration for recycling ✓
- lower CAPEX ✓
- BMS not required ✓
- shipping: non-hazardous cargo ✓

cons

- ✗ footprint: 20 - 40% larger (to LFP)
- ✗ local assembly necessary

invest
expenses over lifetime



grid | Xtreme VR / standard AGM lifetime parameters from test results
LFP lifetime parameters from market research

reliability //
safety.

LFP

- complex with low MTBF –
  due to a lot of electrical, electronical parts as well software (update)
- BMS always required
- module exchange in case of faulty cells (>20 cells per module)
- availability of spares: complex

safety

- classified as dangerous goods – class 9
- shipment / transport as hazardous cargo UN3480
- low to medium risk of fire
- fire extinguishing: possible, but difficult
- service: complex, high skilled engineer needed

grid | Xtreme VR

- simple and proven technology
- BMS optional or manual measurement
- easy exchange of faulty blocs
- availability of spares: simple

safety

- classified as dangerous goods – class 8
  (if correctly packaged: non-hazardous cargo)
- very Low risk of fire
- fire extinguishing: possible (water)
- ventilation needed due to hydrogen evolution
- service: simple, electro engineer needed

service //
life span.

service // life span
LFP

pros

- while the main use is cyclic application, a service life of up to 15 years can be achieved according to published data under float charge
- 2 years shelf life
- maintenance by annual visual inspection

cons

- updates of BMS may be necessary
- communication interface for charging technology necessary (updates of the communication protocol maybe necessary)
- fast changing technology with risk of non-availability replacement parts

service // life span
grid | Xtreme VR

pros

- significantly reducing grid corrosion due to pure lead results in stable performance over 15 years of service life
- ESS and the safeguard-tec are reducing ageing effects and support long design life
- 2 years shelf life

cons

- maintenance by annual visual inspection and check of individual cell parameters
(but made easy through innovative pole design)

In data center applications the lifetime of a battery is mainly determined by service life under float charge conditions. The amount of possible battery cycles plays only a subordinate role and can be achieved by both technologies.

sustainability.

sustainability
lead // lithium

recycling

grid | Xtreme VR batteries have an **established and regulated, commercial closed recycling loop**. Worldwide 95% of all the battery components are recycled. **Customers get remunerations** for returned lead from local metal smelters.

ecosystem

LFP batteries are considered disposable, but given **the relative newness of LIBs, the ecosystem for recycling has not yet developed properly**. Today customers are not remunerated for the recycling process, it is not clear if this will be the case in future (or if you even have to pay for it).

global warming

A battery will not see mentionable cycling in a data center application. Since both LFP and grid | Xtreme VR have a similar lifetime, the global warming potential will happen mostly in the manufacturing phase.

CO_2 footprint

The **CO_2 footprint of LFP battery manufacturing** is currently around **six times higher** than the footprint of manufacturing grid | Xtreme VR pure lead batteries.

sources.

sources
lead // lithium

- **Bitkom**

  Blei- und Lithium-Ionen-Batterien in Rechenzentren
- **IEEE Standards Association**

  IEEE 1679.1-2017 - IEEE Guide for the Characterization and Evaluation of Lithium-Based Batteries in Stationary Applications
- **Frost & Sullivan**

  Analysis of the Global Lithium-ion Battery Market: Growth Opportunities and Market Outlook
- **Eurobat/ ILA**

  Comparative Life Cycle Assessment of Batteries

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