Photovoltaics, Battery Storage and Intelligent Energy Management: Opportunities for Tomorrow‘s Energy Supply System

Volker Wachenfeld, SMA Solar Technology AG

Capital Markets Day

Niestetal, January 20, 2014

Disclaimer

The information contained in this presentation is subject to amendment, revision and updating. Certain statements contained in this presentation may be statements of future expectations and other forward-looking statements that are based on the management's current views and assumptions and involve known and unknown risks and uncertainties. Actual results, performance or events may differ materially from those in such statements as a result of, among others, factors, changing business or other market conditions and the prospects for growth anticipated by the management of the Company. These and other factors could adversely affect the outcome and financial effects of the plans and events described herein. The Company does not undertake any obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. You should not place undue reliance on forward-looking statements which speak only as of the date of this presentation.

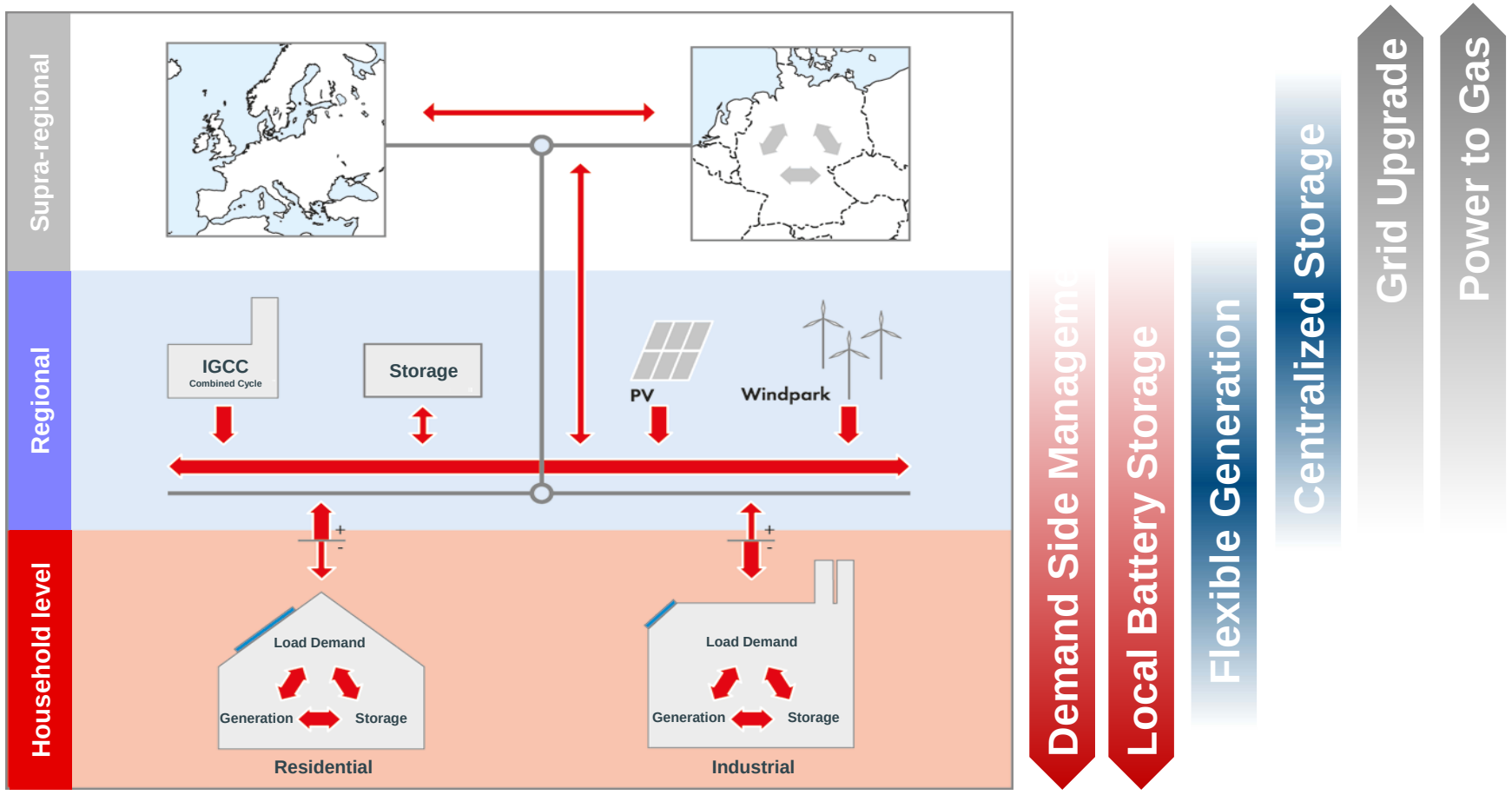
All information contained herein has been carefully prepared. Nevertheless, we do not guarantee its accuracy or completeness and nothing herein shall be construed to be a representation of such guarantee.

The information contained in this presentation is subject to amendment, revision and updating. Certain statements contained in this presentation may be statements of future expectations and other forward-looking statements that are based on the management's current views and assumptions and involve known and unknown risks and uncertainties. Actual results, performance or events may differ materially from those in such statements as a result of, among others, factors, changing business or other market conditions and the prospects for growth anticipated by the management of the Company. These and other factors could adversely affect the outcome and financial effects of the plans and events described herein. The Company does not undertake any obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. You should not place undue reliance on forward-looking statements which speak only as of the date of this presentation.

This presentation is for information purposes only and may not be further distributed or passed on to any party which is not the addressee of this presentation. No part of this presentation must be copied, reproduced or cited by the addressees hereof other than for the purpose for which it has been provided to the addressee.

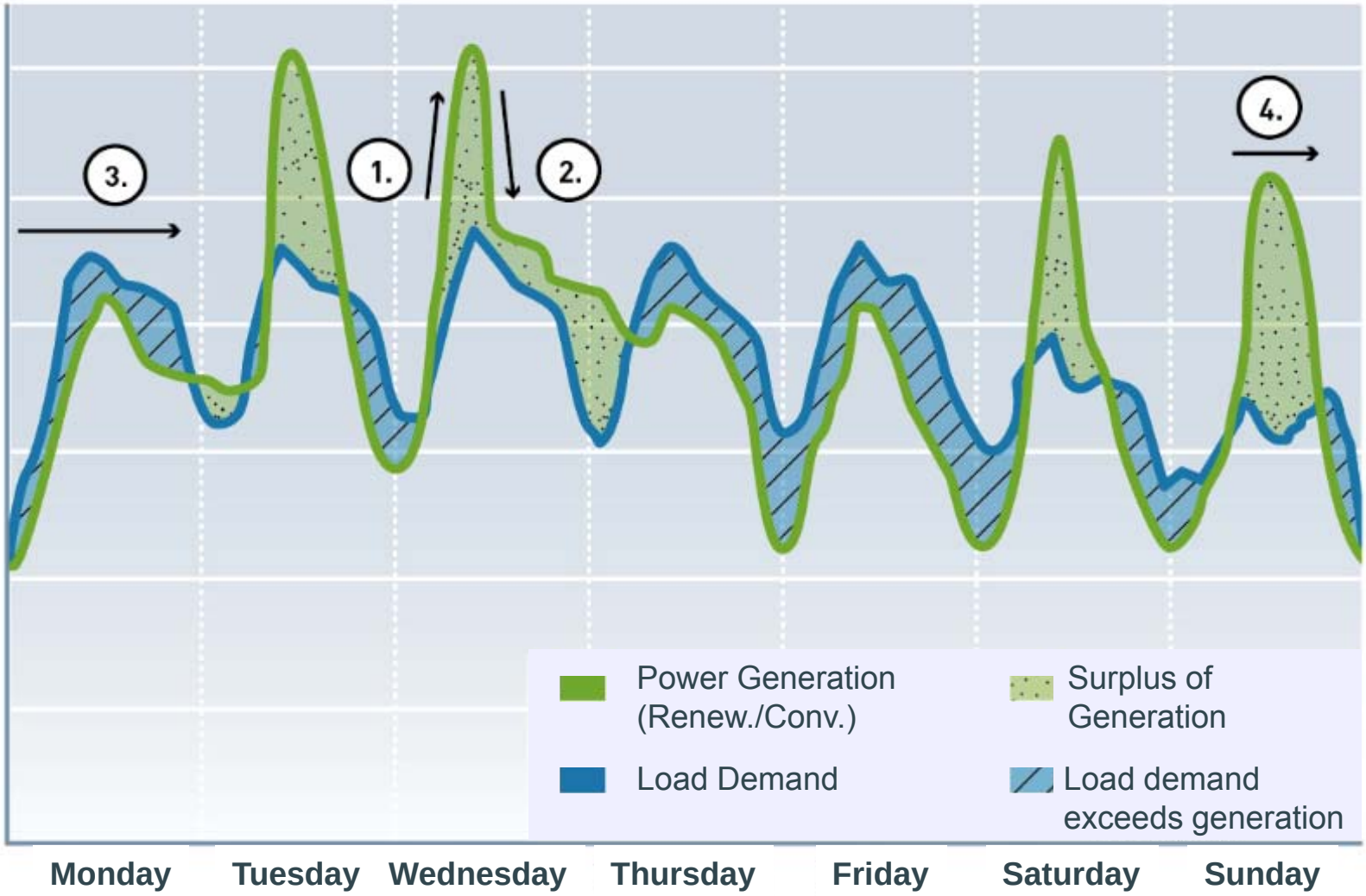
This document is not an offer of securities for sale in the United States of America. Securities may not be offered or sold in the United States of America absent registration or an exemption from registration under the U.S. Securities Act of 1933 as amended.

Different Options to Improve the Flexibility of Energy Supply



- **Utilizing any option to improve flexibility is reasonable and thus mandatory on each level of energy supply**

Matching generation and consumption



Quelle: www.unendlich-viel-energie.de - Stromlastgang Smart Grid

Matching generation and consumption with energy storage

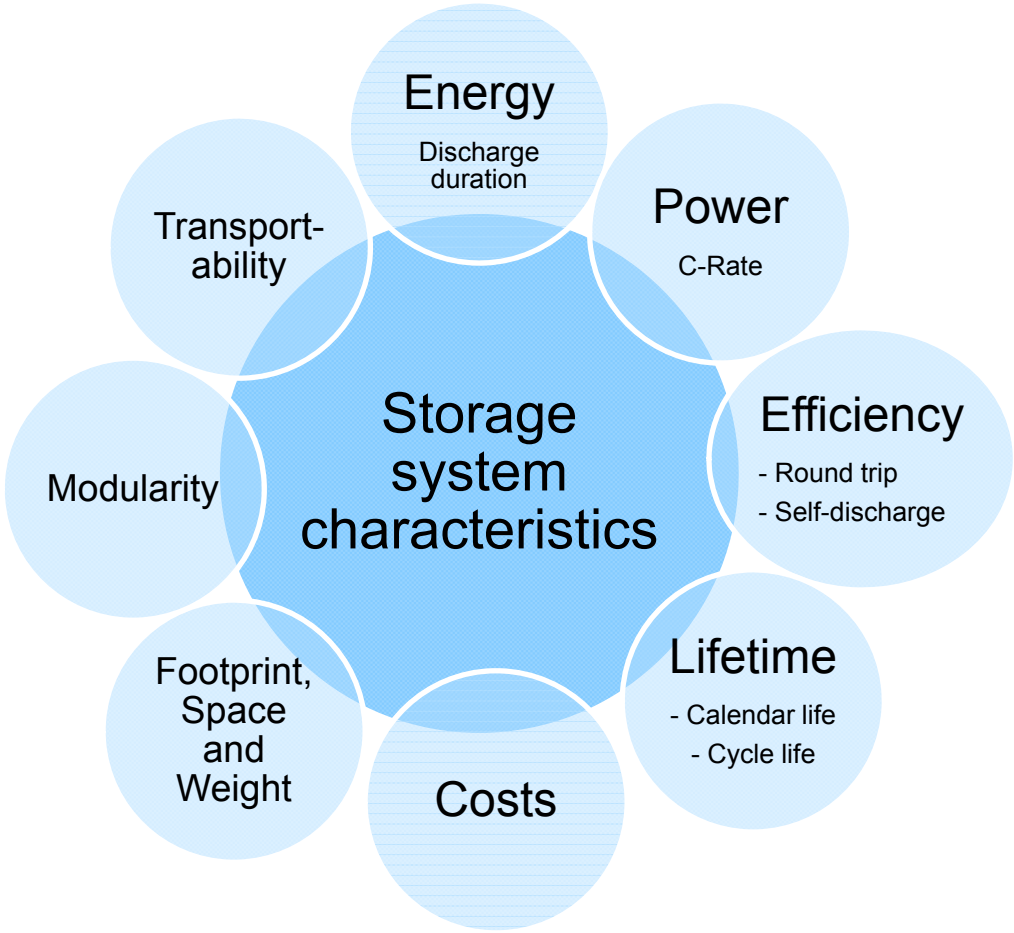
Quelle: www.mein-elektroauto.com

Quelle: http://www.akkusys.de/shop/bilder/produkte/gross/OPzS-6-OPzS400.2V400Ah-10C-geschlossene-bleiBlockbatterie-mehruebsigem-Elektrolyt.jpg

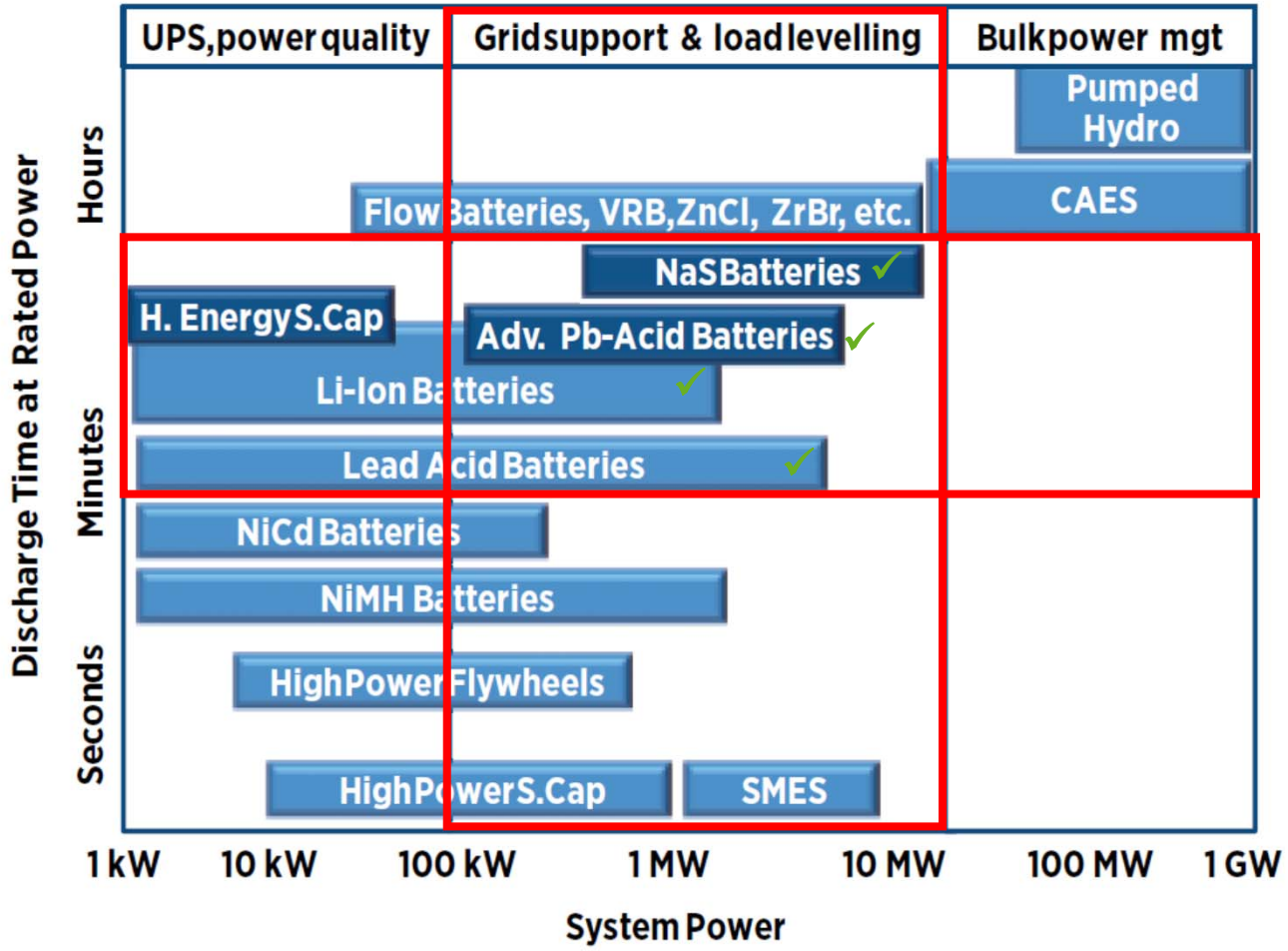
Quelle: NGK Referenz Substation USA

- Different **time scales**:
  - Instantaneous reaction on **changes in frequency**
  - Reaction on **grid congestions**
  - **Arbitrage** with energy storage
  - Using solar energy as a **dispatchable source**
  - …
- Different sizes of storage and requirements for **different applications:**
  - Small scale storage solutions for **residential usage**
  - Large scale storage solutions for **large PV-Plants**
  - **Power** optimized solutions
  - **Energy** optimized solutions

Energy Storage System Characteristics

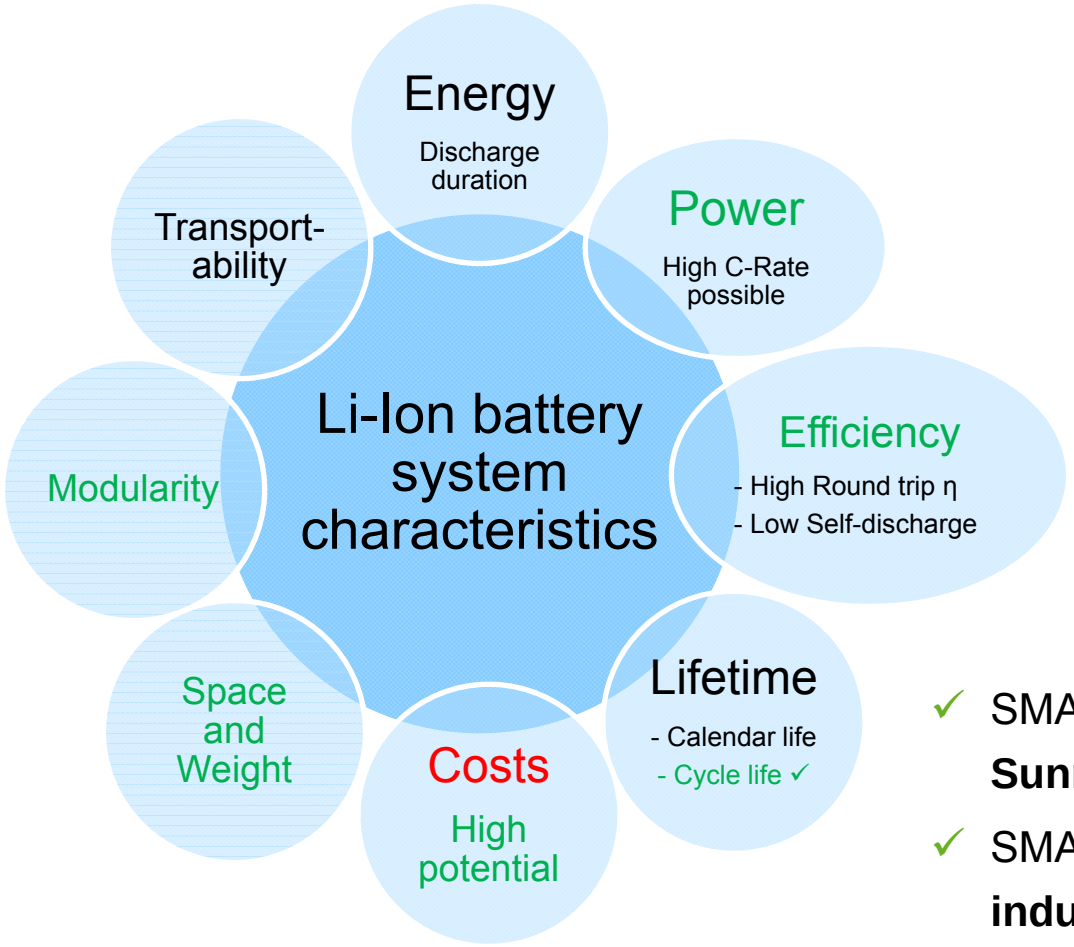


Energy storage technologies



Source: IEA-ETSAP and IRENA© Technology Policy Brief E18 – April 2012

Li-Ion batteries: Automotive-driven Solution



> **High development potential**

both in technical and economical terms due to variety of materials used and the competition between them!

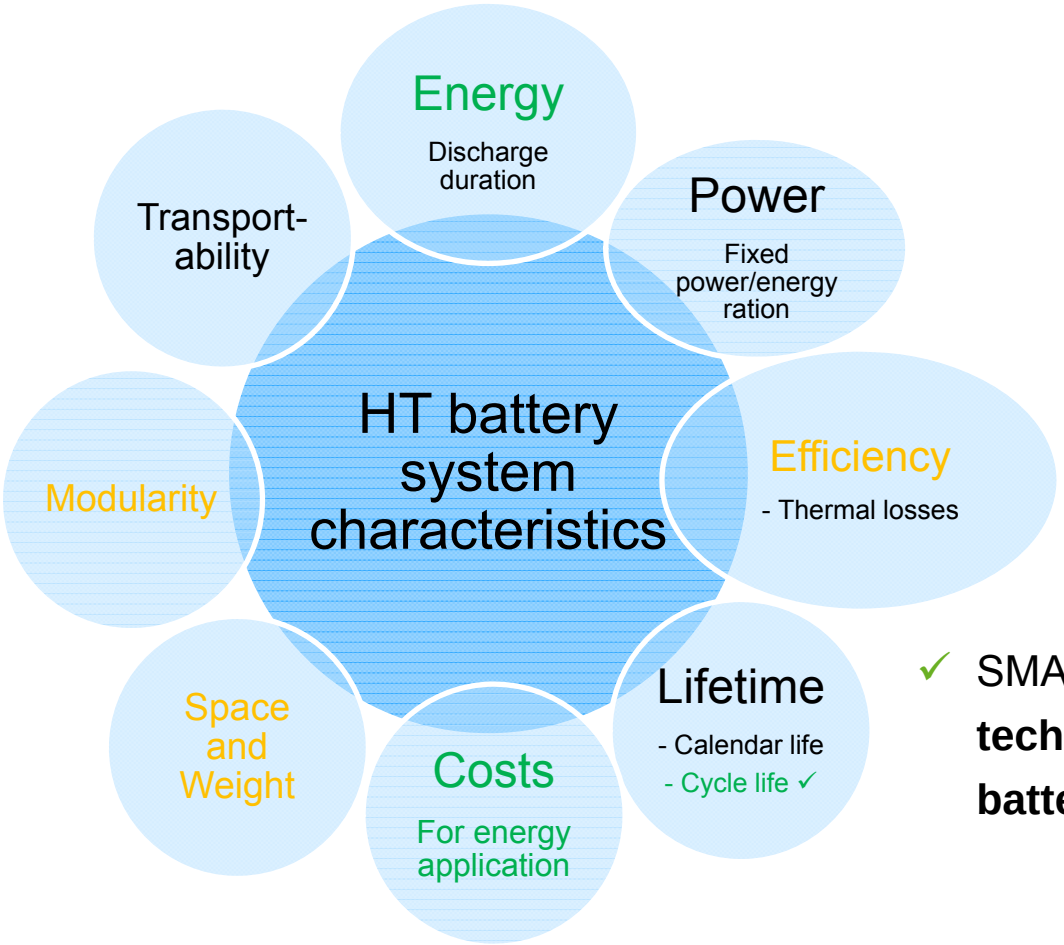
> **As of today: costs**

still high prices on a cell level (approx. 500 EUR/kWh), even higher on a system level due to needed management for safety reasons

✓ SMA applies **Li-Ion batteries** in the **Sunny Boy Smart Energy**

✓ SMA supports **Li-Ion technology** with **industrial scale battery inverters**

High-temperature batteries: Best cost structure for energy applications

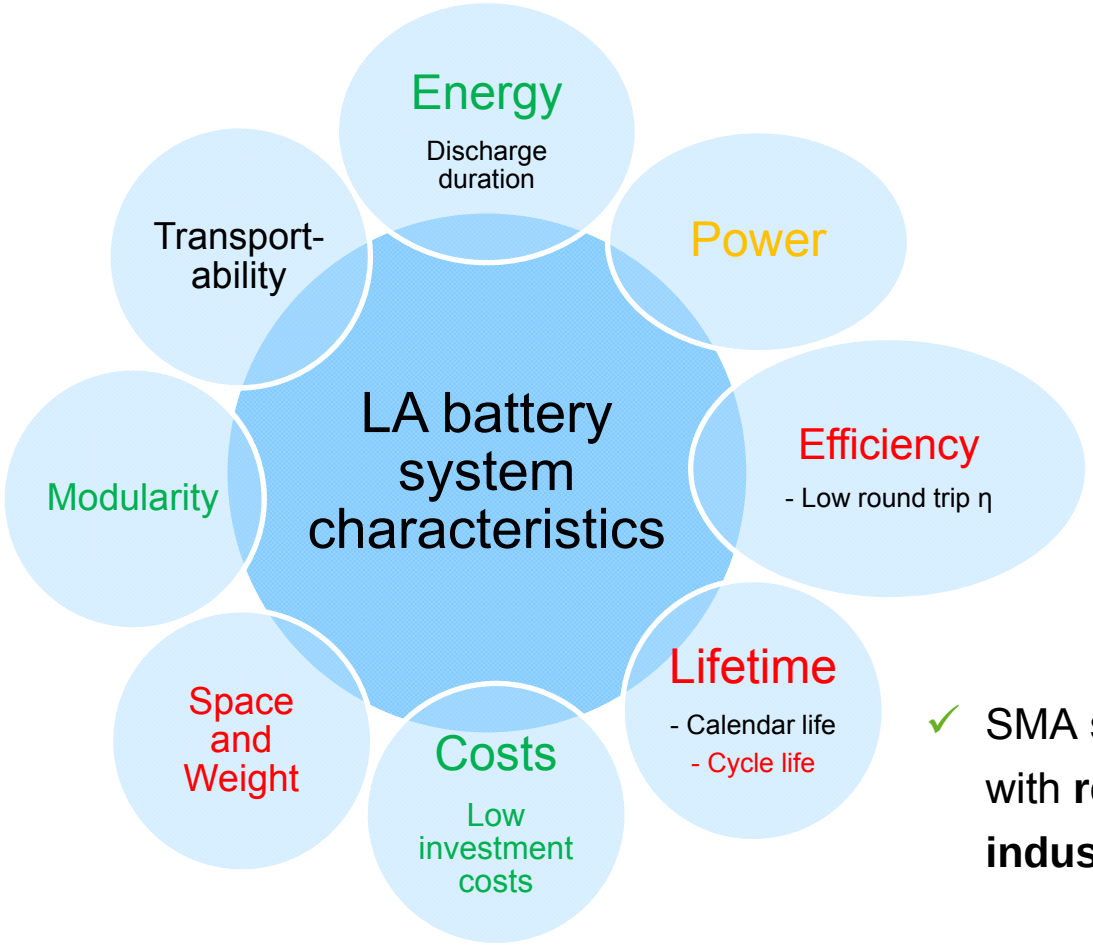


> **Specific costs achievable:**
technology specific high cost reduction potential

> **Not matching all applications:**
Power applications are better served by other technologies, Hybridising it with other technologies can improve the dynamics

✓ SMA supports **high temperature technology** with **industrial scale battery inverters**

Lead-Acid Batteries: Old-fashioned but with potential!



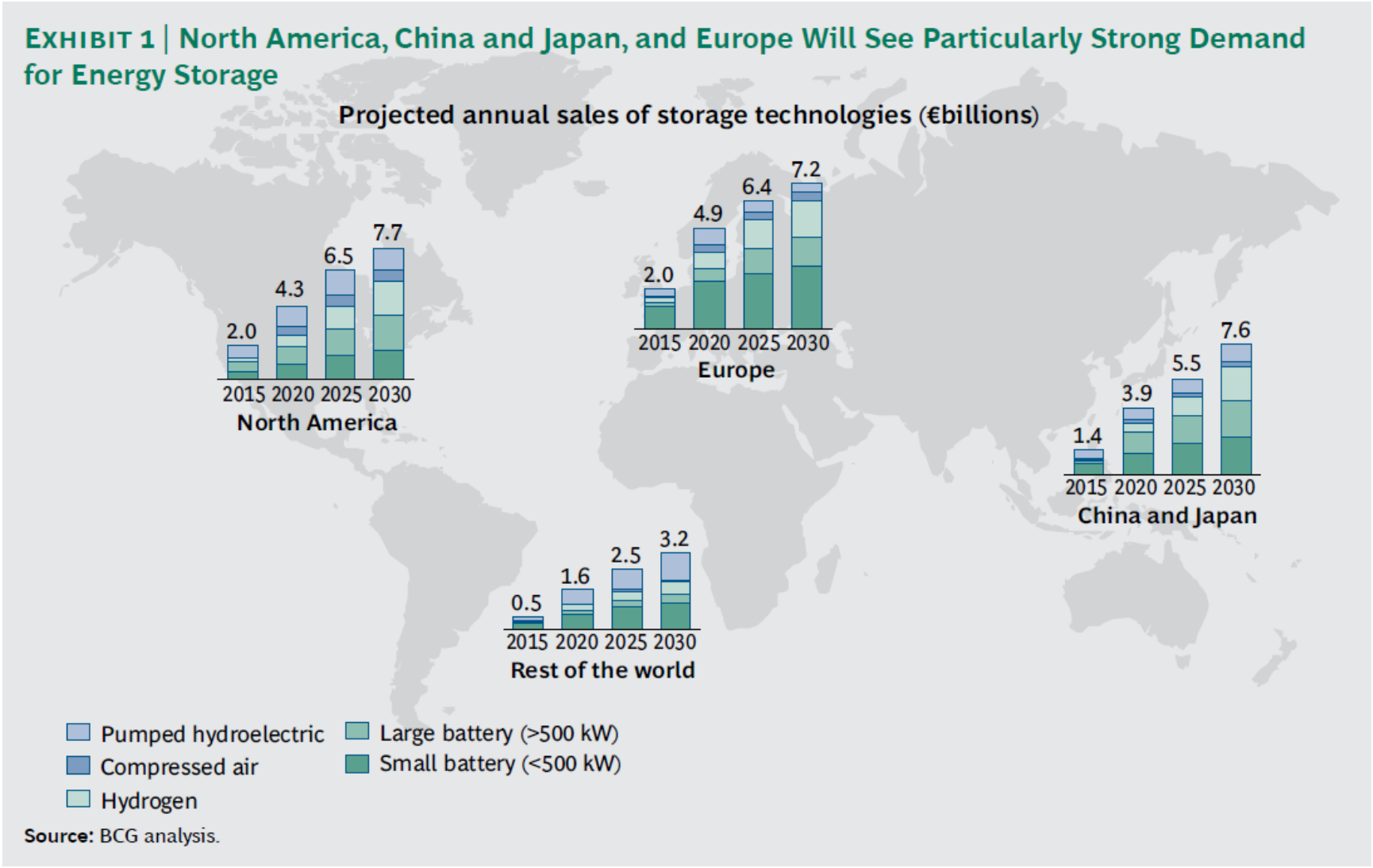
> **Investment costs**
>
> Still the most cost-effective battery on the market in terms of €/kWh, Competition with Li-Ion drives the innovation

> **Electrical parameters**
>
> low efficiency, low cycle performance

> Manufacturers are worldwide **well represented** and can support any targeted market

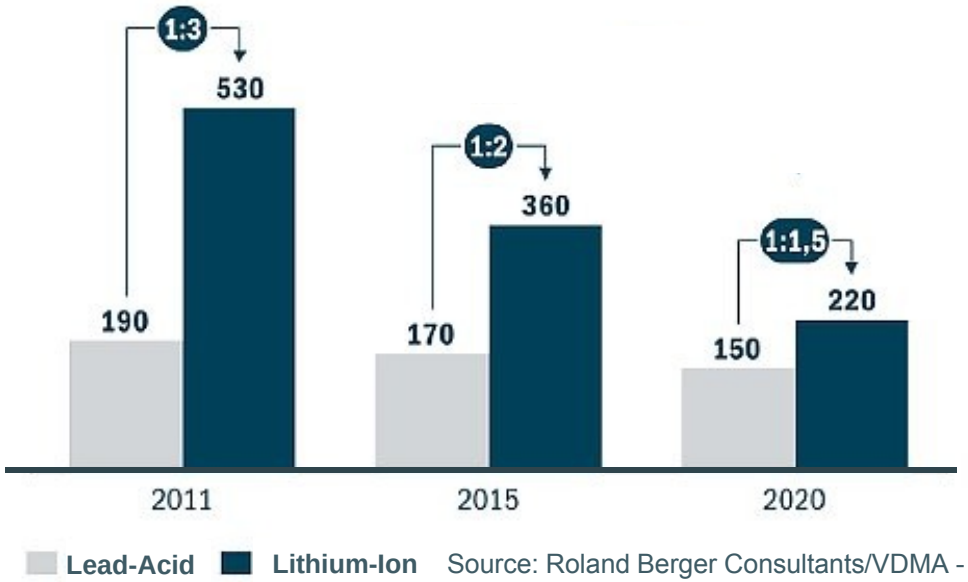
✓ SMA supports **Lead Acid technology** with **residential, commercial and industrial scale battery inverters**

Energy Storage: 250% growth from 2015 to 2020



Cost Trend for Batteries in Stationary Applications

Expected development of costs for Lead-Acid and Lithium-Ion batteries [EUR/kWh]



Source: Roland Berger Consultants/VDMA - Zukunftsfeld Energiespeicher

Source:www. maurelma.ch

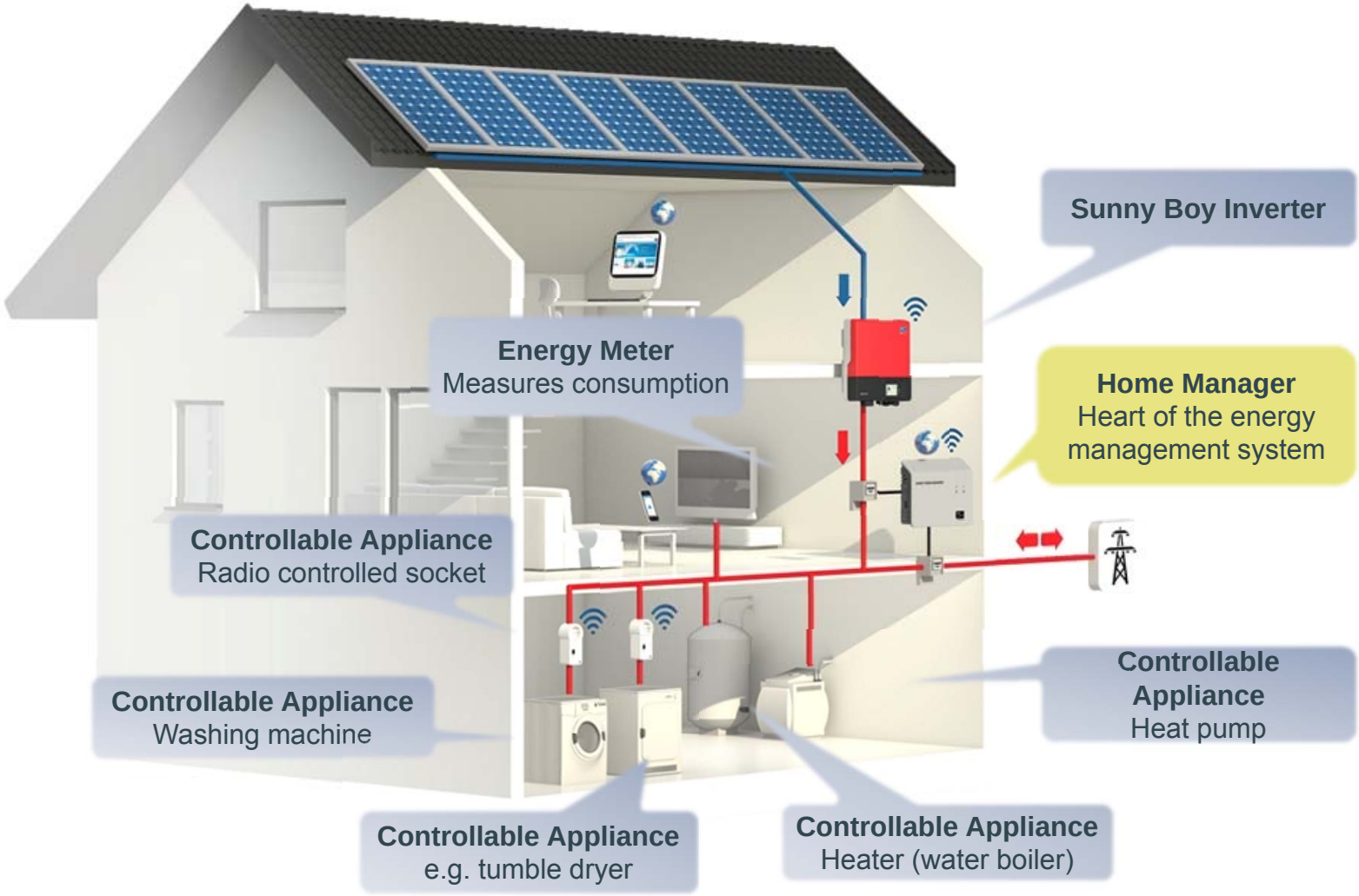
Lead-Acid battery
- developed: 1854
- First plant: VARTA 1887

Source:www.mein-elektroauto.com

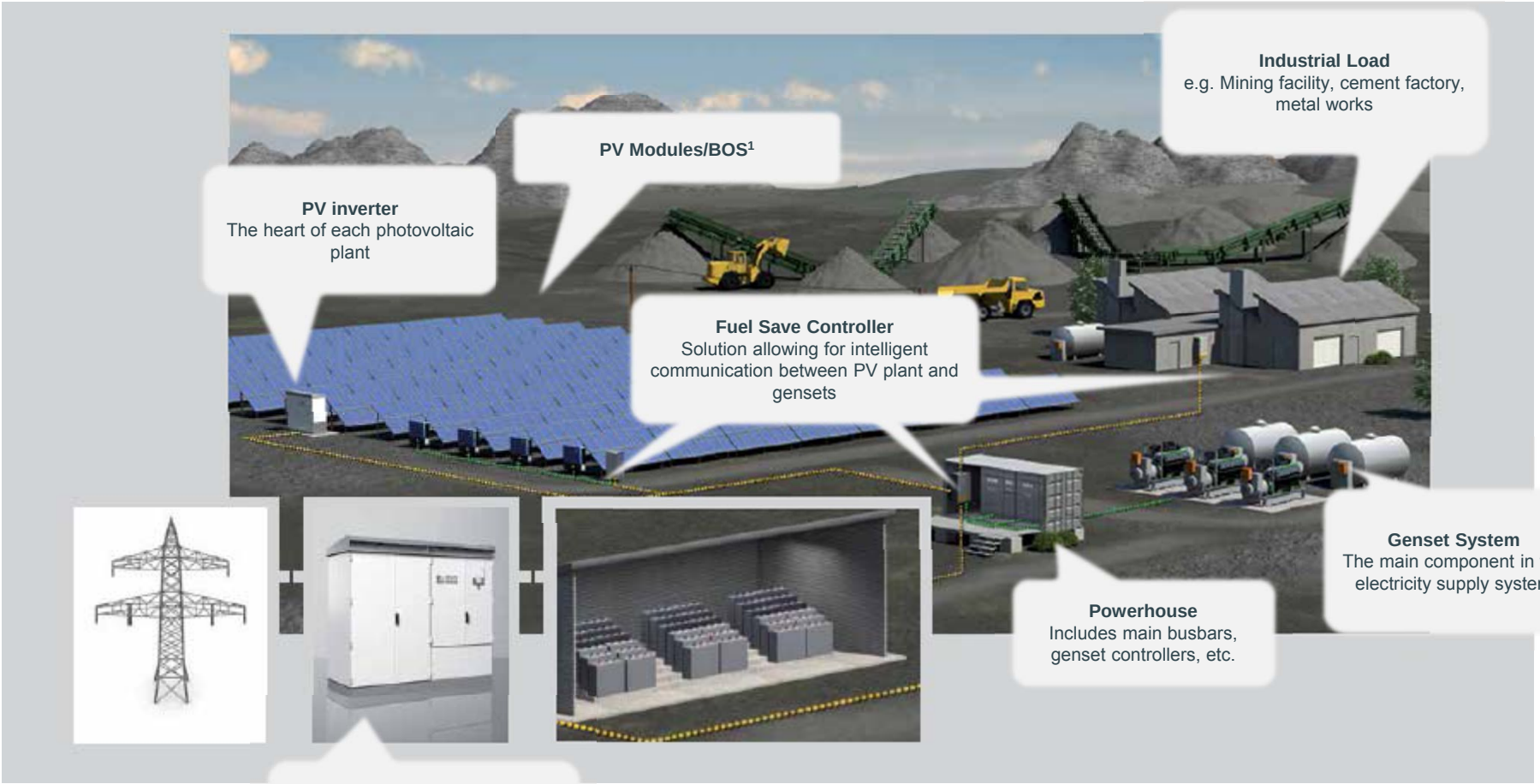
Li-Ion-Battery
- developed: 1970 .. 1980
- First commercial cell: Sony 1991

- Investment costs of Lead-Acid batteries are still much lower than for Li-Ion, however the (expected) learning curve of Li-Ion technology is very promising!

Our Solution for Residential Applications:
SMA Smart Home



Our Solution for Industrial Applications: Professional Energy Management Industry Scale Battery Inverter



Intelligent System Technology is the Key Success Factor

> Storage integration allows to meet any kind **of requirements of renewable integration**!

> Different applications require **specific system solutions** – integrating specific battery technologies!

> **Understanding the application** is mandatory to define the technological as well as the economic **optimum**!

- **SMA has a clear focus to utilize battery system technology to add value to PV applications**
- **SMA is the first player on the market to provide battery system technology for residential and industrial applications!**

Energy that Changes