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Technologies for Net Zero: Energy Storage

Florian Mayr, Partner at Strategy&
EPRG Winter Seminar

Cambridge, December 12, 2025

Driven by a continued growth of renewable energy penetration, the energy transition has entered "the Age of Flexibility"

Map of German energy transition

The drivers

"The new ESG" (Economics, Security and Geopolitics)
- Sensitivity of energy cost
- Lack of captive fossil fuel resources
- Deglobalization and supply chain threats

1 Electricity is the "new king of energy": Electrification of all sectors (transport, heat); growth of new applications fueled by electricity (AI, Air conditioning,…)

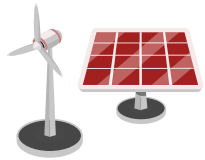
2 Growing electricity demand – the rise of "electrostates" (China, Europe)

3 Demand served by electricity sources that are clean, affordable, modular/rapidly deployable, captive: **Renewable energy**

Climate related ("pragmatic climate reset")
- Decarbonization targets
- Resiliency against climate change and extreme weather events

Generation and use of clean energy
Opportunity cluster 1

Front of the meter (utility scale)



Wind on/off-shore

Solar PV

Other (bio-mass)

Loads based on clean electricity
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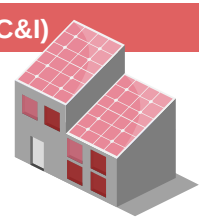
Electrified homes and prosumership



Resulting challenges
1 Intermittency ("Dunkelflaute"…)
2 Market impact (vol./neg. prices, decreasing capture rates…)
3 Grid strain (voltage, frequency, inertia,…)

Enablers of clean energy penetration
Opportunity cluster 2

The age of flexibility

Traditional flex
- CCGT
- …

Energy storage
- BESS
- LDES (incl. low carbon H_2)
- …

Grid improvements
- New grid lines
- Power equipment (transformers, voltage control, …)
- Smart grid enabler
  - "Energy intelligence" (Smart meter, sensors, software, comms. netw.)
  - Dynamic line rating

V2X
- V2X service providers
- BiDi charging tech and platforms
- Mobility service integration

Demand side mgmt.
- Demand response platforms
- Industrial process flexibility
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Main obstacles (across both opportunity clusters)
- Slow regulatory adjustments, red tape
- Slow digitalisation
- NIMBYism, other vested interest groups
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Orchestrated and optimized by AI
- (H)EMS
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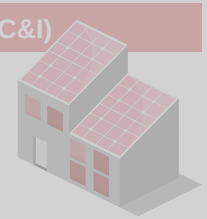

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Source: Strategy& analysis

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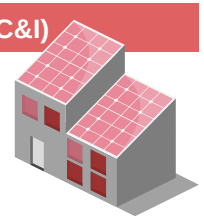

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We are here!

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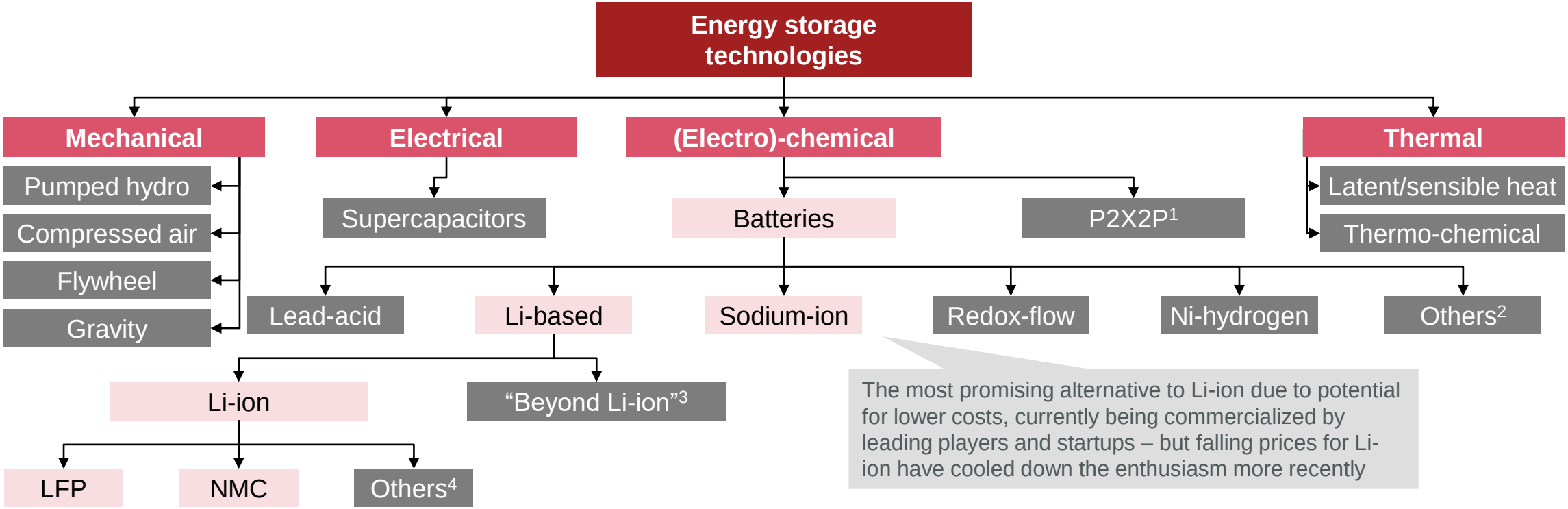
Energy storage can be provided through various technologies, but lithium-ion batteries are dominating the stationary space

Energy storage technology landscape

NON-EXHAUSTIVE



Source: Strategy& analysis; 1) Power-to-X-to-power; 2) E.g., NiCd, NiMH, iron-air, sodium-sulfur; 3) Batteries claiming to offer improved performance and safety over Li-ion (e.g., solid-state, Li-sulfur, Li-air); 4) Novel alternatives to LFP and NMC (e.g., NMx, LMFP) and batteries used for niche applications and consumer electronics (e.g., LTO, LCO)

Battery energy storage systems (BESS) based on LFP are best suited to provide the flexibility needed in the energy system today…

BESS market and relevance for infrastructure investors

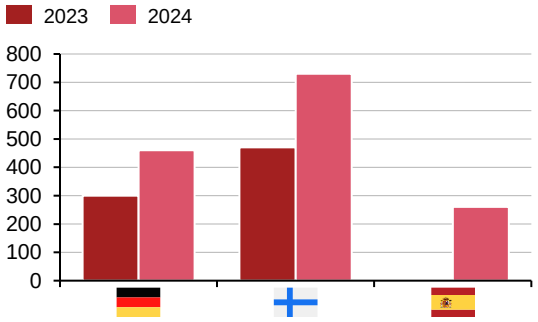
Key drivers of subsegment

1. Increasing penetration of variable renewable energy (e.g., PV and wind power) requires flexibility resources to keep the grid stable and mitigate market volatility, e.g., negative prices
2. Falling cost, low carbon intensity, fast deployment times and overall versatility makes BESS the most competitive flexibility option in most settings
3. In addition, the removal of regulatory barriers and access for BESS to existing and new market schemes allow for attractive monetization options

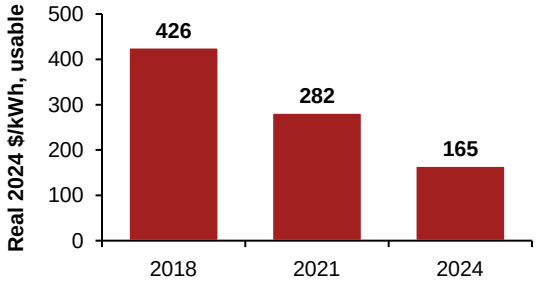
Attractiveness for infrastructure investors (examples)

- Non-cyclical demand as BESS is critical infrastructure
- Improving regulatory conditions as “sense of urgency” increases at authorities
- Next to merchant, also long term stable and diversified cash flows possible (auctions, tolling,…)
- Low technological risk due to mass production by reputable players and overall maturity of the market

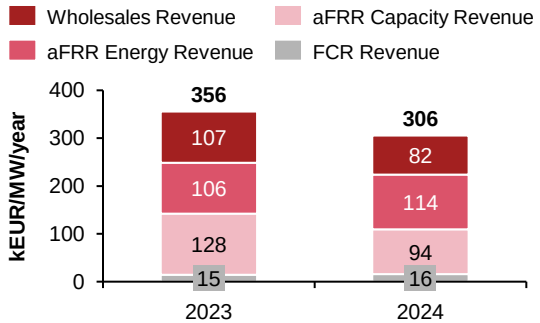
1 Hours with negative day-ahead prices



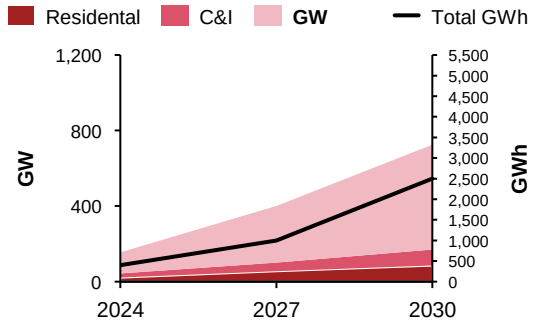
2 BESS cost declines[1)]



3 Battery revenues Germany



Global BESS market growth

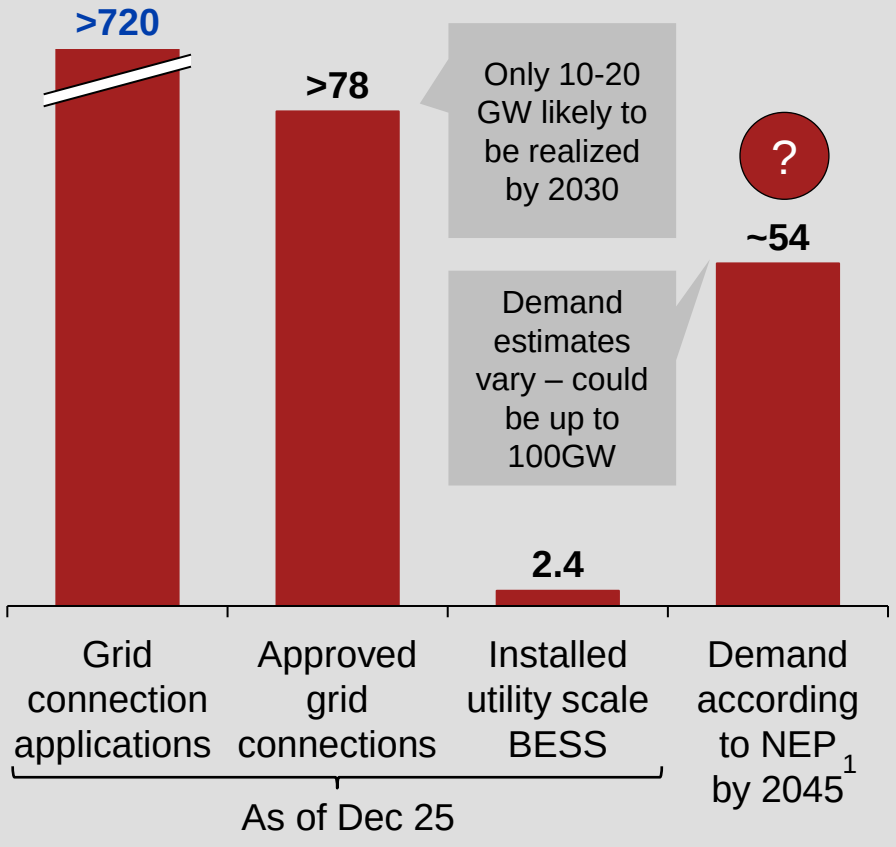


[1)] Source: BloombergNEF. Note: Turnkey systems include all project equipment (DC-side battery system, power conversion system and related installation) excluding EPC and grid connection. Pricing based on usable capacity. Prices in 2024 show all durations and are global volume-weighted averages of survey pricing data based on BNEF's annual regional installation forecast. Prices for 2017-2022 are only for four-hour systems Historical prices have been adjusted using June to June inflation rates based on US Consumer Price Index (CPI) and converted using exchange rates in the end of October each year; Source: Strategy&; entso-e; BNEF; inspired

What's holding back the German "BESS tsunami"? Grid, politics and regulations lagging behind the necessities of "the Age of Flexibility"

Status, targets and challenges of German BESS market

Grid connections less of a bottleneck [GW]…



…but other challenges to realize BESS projects remain

- Lack of digitalization (and fragmented DSO landscape): Leading to ill-designed, oversimplified FCA with charging or discharging restrictions, ramping constraints, restricted access to FCR and aFRR markets, earlier schedule freeze, missing redispatch compensation…
- Political preferences: E.g., non-technology agnostic capacity auctions and cannibalization of flexibility markets due to prioritized gas power plants
- Remaining unfavourable regulations/processes: "First come, first serve principle", confirmation of BKZ[2] by Supreme Court, U-turn for recently decided permitting privilege for BESS, **looming end of grid fee exemption after 2029…**

Grid fees	54.6	41	27.3	13.7	0	No LP[3]
IRR	-11%	-2%	5%	9%	14%	19%
	unprofitable		(?)	profitable		

1) Grid Development Plan; 2) Grid Construction Surcharge; 3) No capacity-based grid fees (LP stands for Leistungspreis)
Source: Startegy& analysis, enervis, BDEW

Let’s discuss how we could support you

Florian Mayr

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