

# Why energy storage is not about energy storage

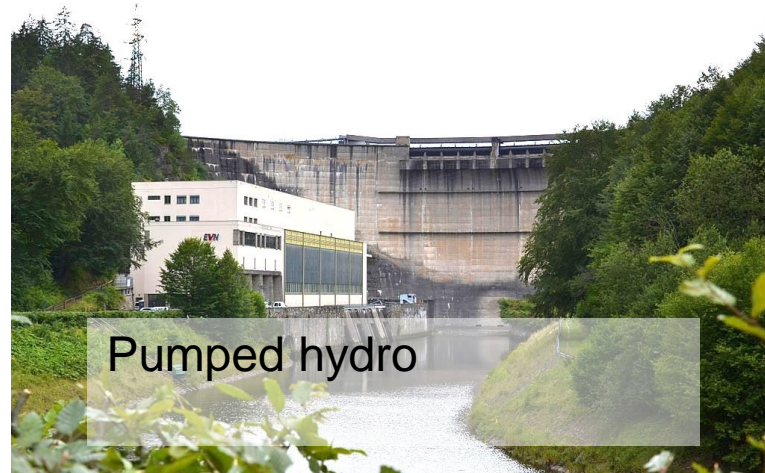
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Major findings from existing multi-megawatt stationary storage projects



Source: Younicos AG

# Industrial energy storage technology overview



# Current usage of battery power plants



Battery power plants are use for ancillary services, not for energy shifting!

# Storage reduces must-run: Fast frequency response

- Example for the interconnected EU entso-e grid: 3'000 MW of fast frequency response
- Conventional plant (e.g. coal, nuclear): 2% - 5% of current power available for FFR:

1'000 MW active power = 20 – 50 MW FFR



- Battery power plant: 100% of installed power available for FFR

-20 MW      +20 MW

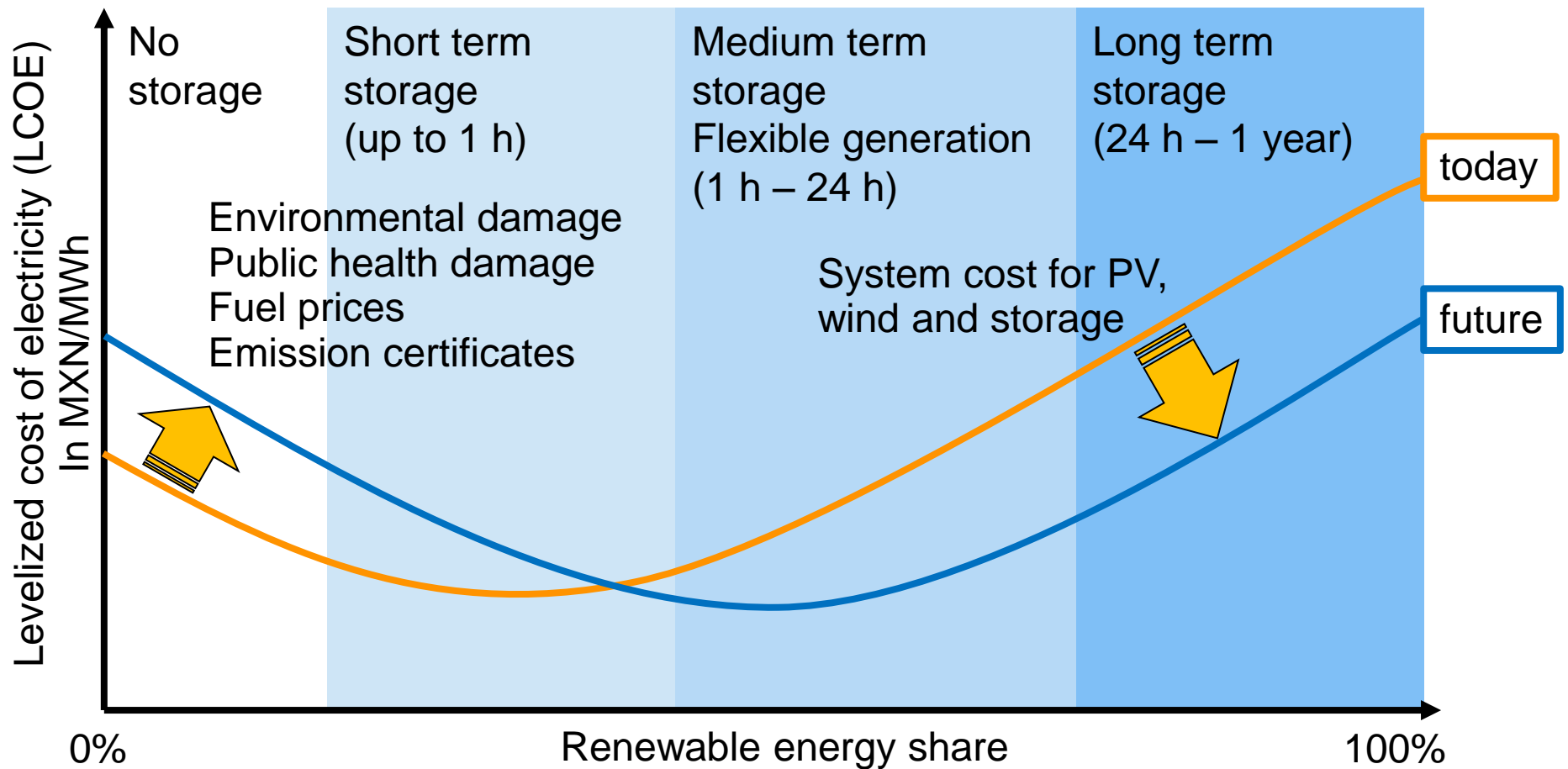


- 3000 MW of FFR battery power plants reduce the must-run capacity required for FFR delivered by conventional power plants by 60'000 MW – 150'000 MW

# Application to ancillary services: Use cases by reimbursement

Service	per kW	per kWh	per kVAr	Batt. comp.
Rotating Masses (Island/Microgrid)	x			x
Fast Frequency Response	x			x
Secondary Frequency Response	x	x		
Minute Reserve	x	x		
Congestion Management / Investment deferral	x			x
Blackstart	x			x
UPS	x	x		x
Ramp rate control	x			x
Trading / price arbitrage		x		
Excess energy		x		
Voltage control (reactive power)			x	x
Short circuit current			x	x

# Development of levelized cost of electricity (LCOE) vs. renewables



# Thank you for your attention

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# Enabling fair competition for renewables and storage

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- Energy storage subsidies: only for first-of-a-kind projects and/or reducing subsidies
  - Heavy impact on public acceptance!
- Technology neutral market access for energy markets and ancillary services market
  - Option a) Keep the ancillary services with the generators (e.g. Puerto Rico / PREPA) - attractive for small-scale grids
  - Option b) Liberalized market for grid services (e.g. US, Germany, UK) – attractive for large-scale grids
- Update of grid codes and grid access regulations to mirror the characteristics of the new electricity grid topology
  - Formulation on functional requirements instead of constructional requirements
  - Grid code compliance requirements for generators AND loads
  - Regulations for power electronics (state of the art) and virtual inertia (future)



# Consumo de electricidad en Alemania

