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Experiences and challenges for storage in the European energy markets

Gunnar Wrede, Head of Regulatory and Government Relations, Younicos

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Younicos at a Glance

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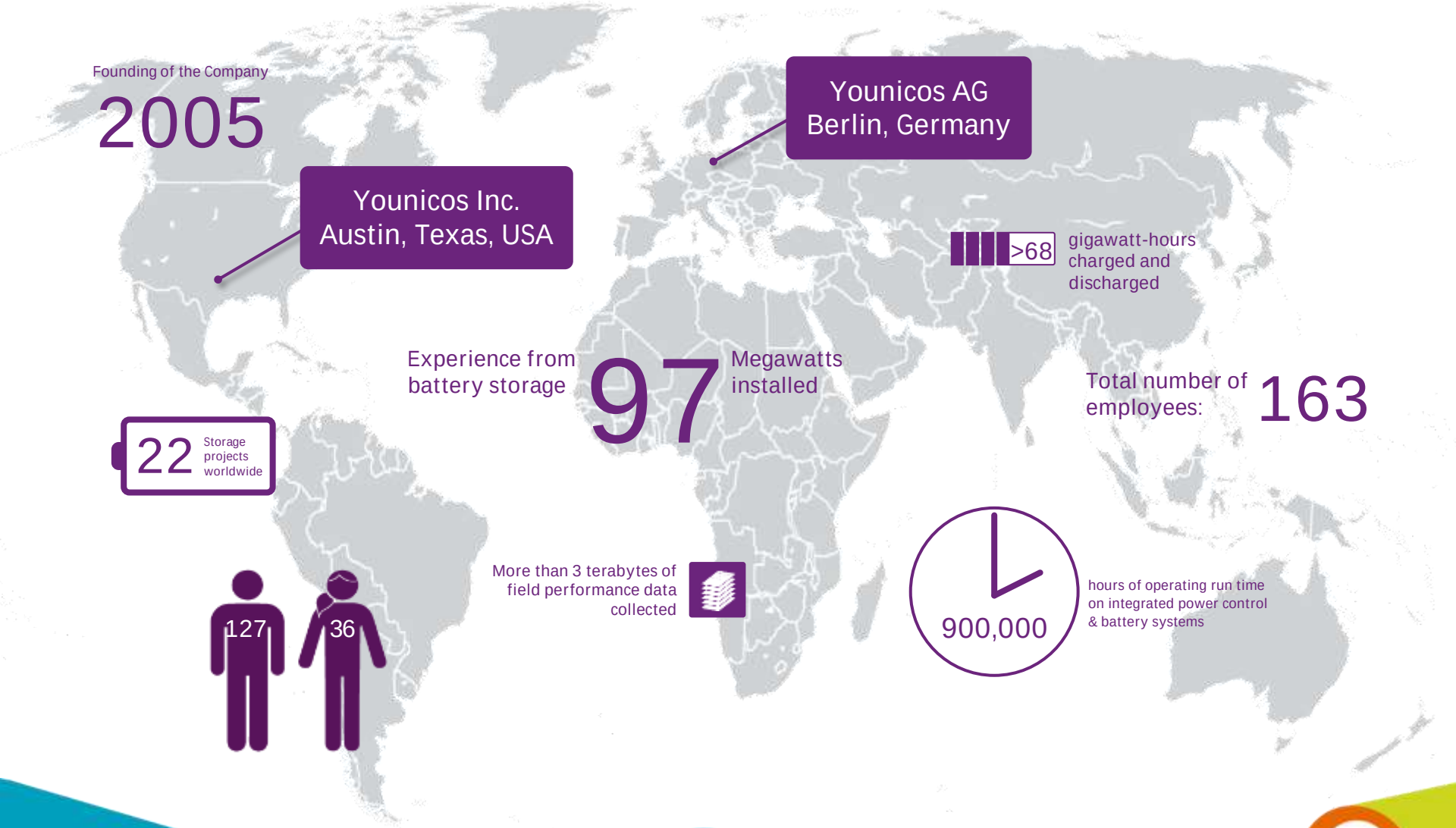

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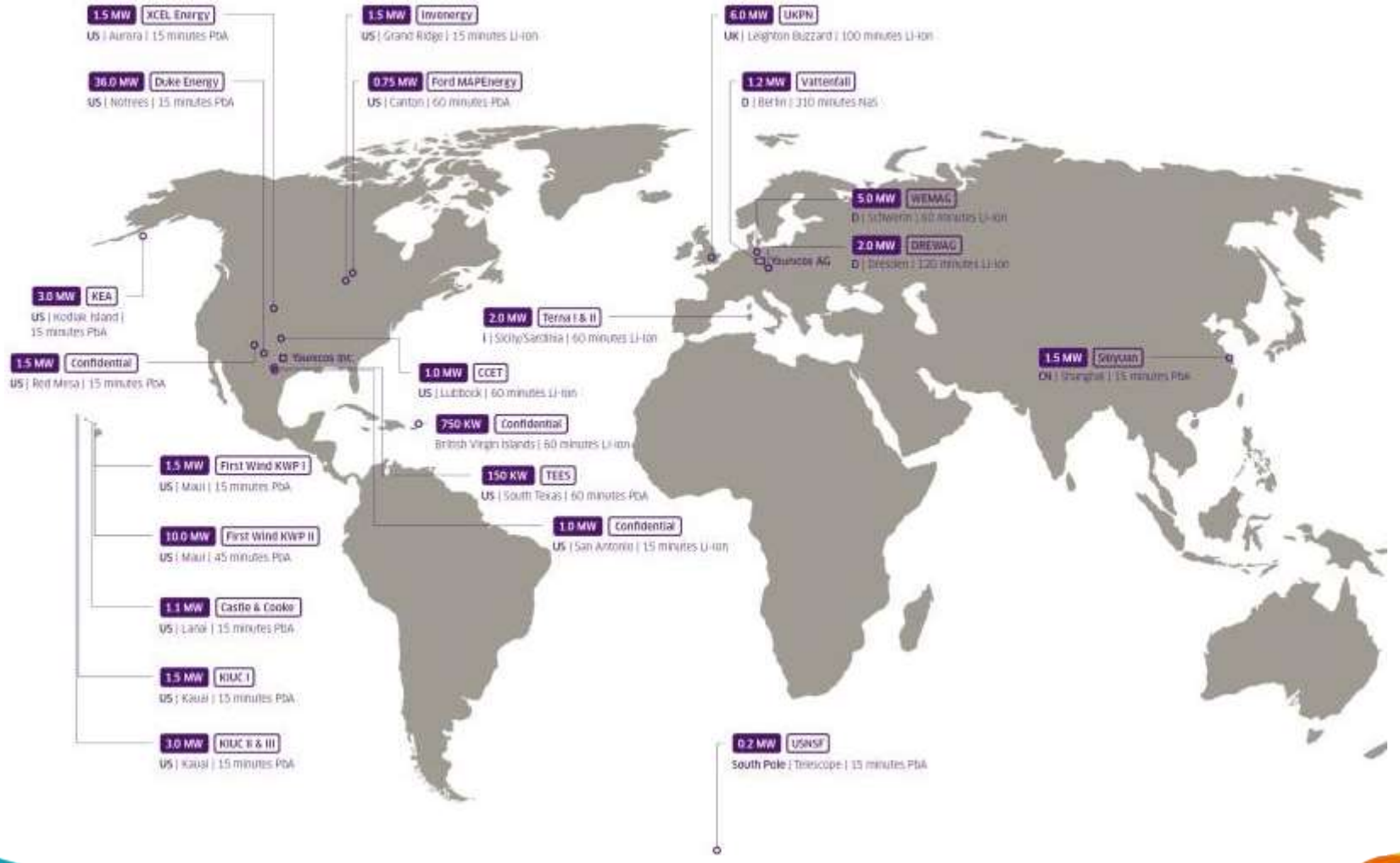
We are a global leader for intelligent storage and grid solutions based on battery technology.

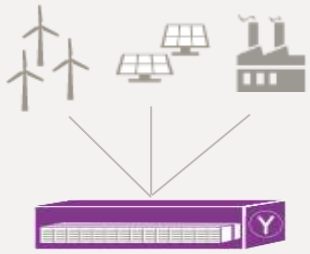
From south pole to Alaska: Experience from over 97 MW in the field



Experiences - Battery solutions are great for solving the energy challenges of every market player

Grid Tied

Power Generation



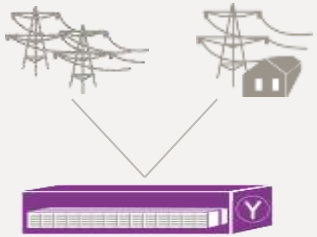
Stabilization of RE feed-in

Modeling of Power Gradients

Peak shaving

Price arbitrage

Power Transmission & Distribution



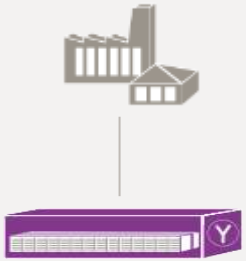
Ancillary Services, e.g. Frequency Regulation

Voltage control

Black start capability

Short circuit capability

Commercial and Industrial



Price arbitrage

Black start capability

Short-circuit capability

Microgrids

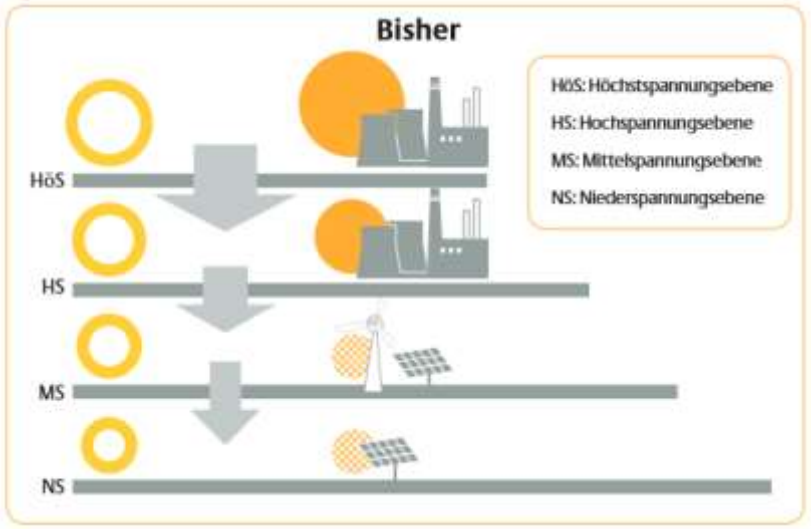
Diesel Abatement or 100% Renewables

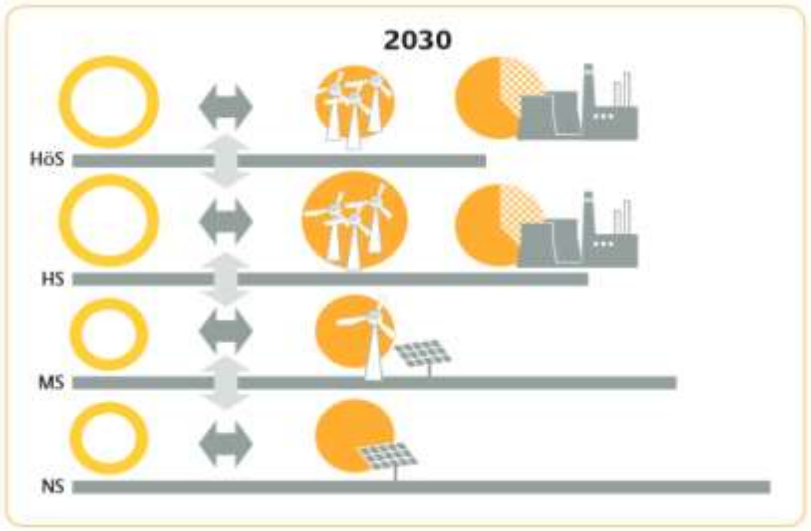
Off Grid or Grid-connected

Battery storage – quality gate of a European smart grid

Key challenges - The transformation of the energy system

Location of generation chances to all levels





Location of provision of ancillary services must chances to all levels

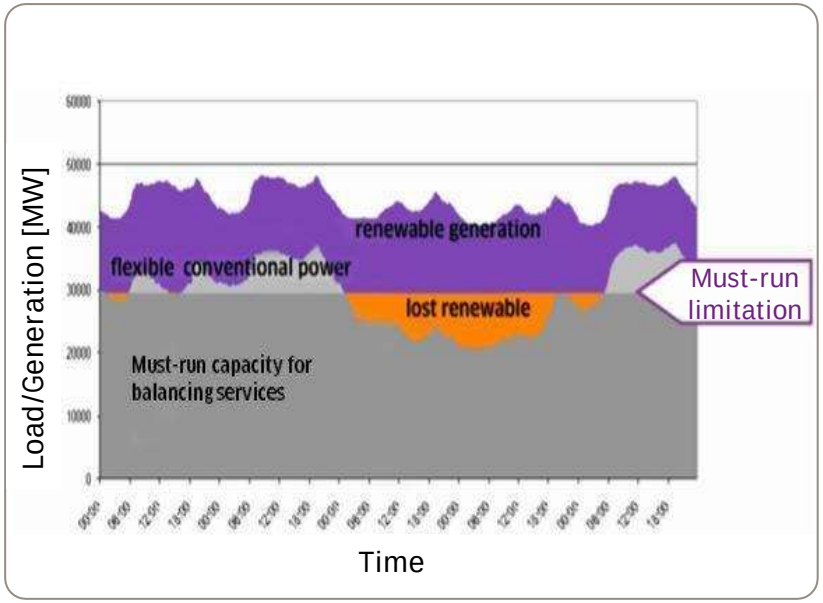
→ Ancillary services are provided on all voltage levels

→ Partially all ancillary services will have to come from the distribution grid

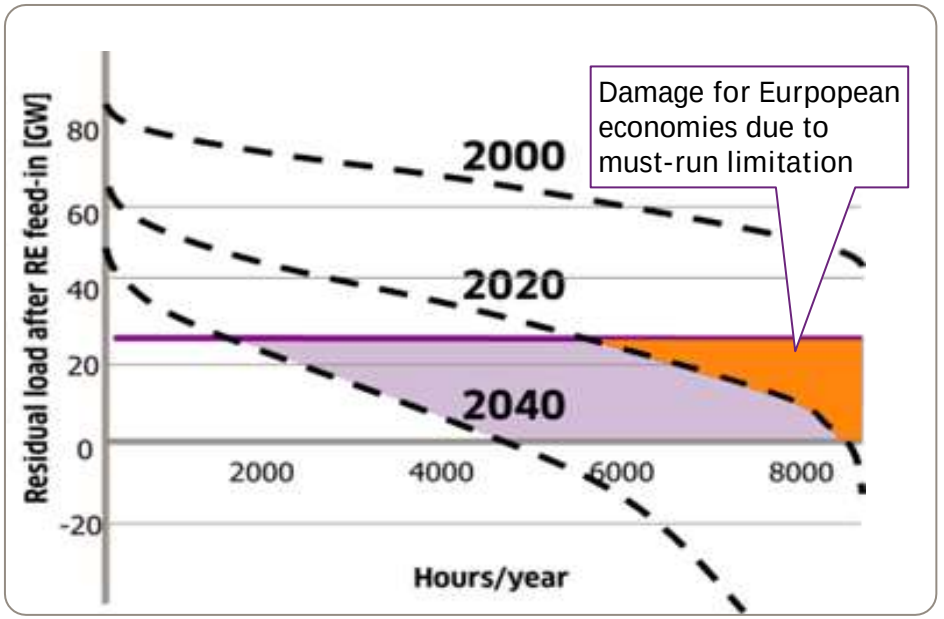
Quelle: dena-Studie Systemdienstleistungen 2030

Problem: Must-run limitation restrict the integration of Renewables

Must-run losses over a 24 h-period



Must-run losses over a year

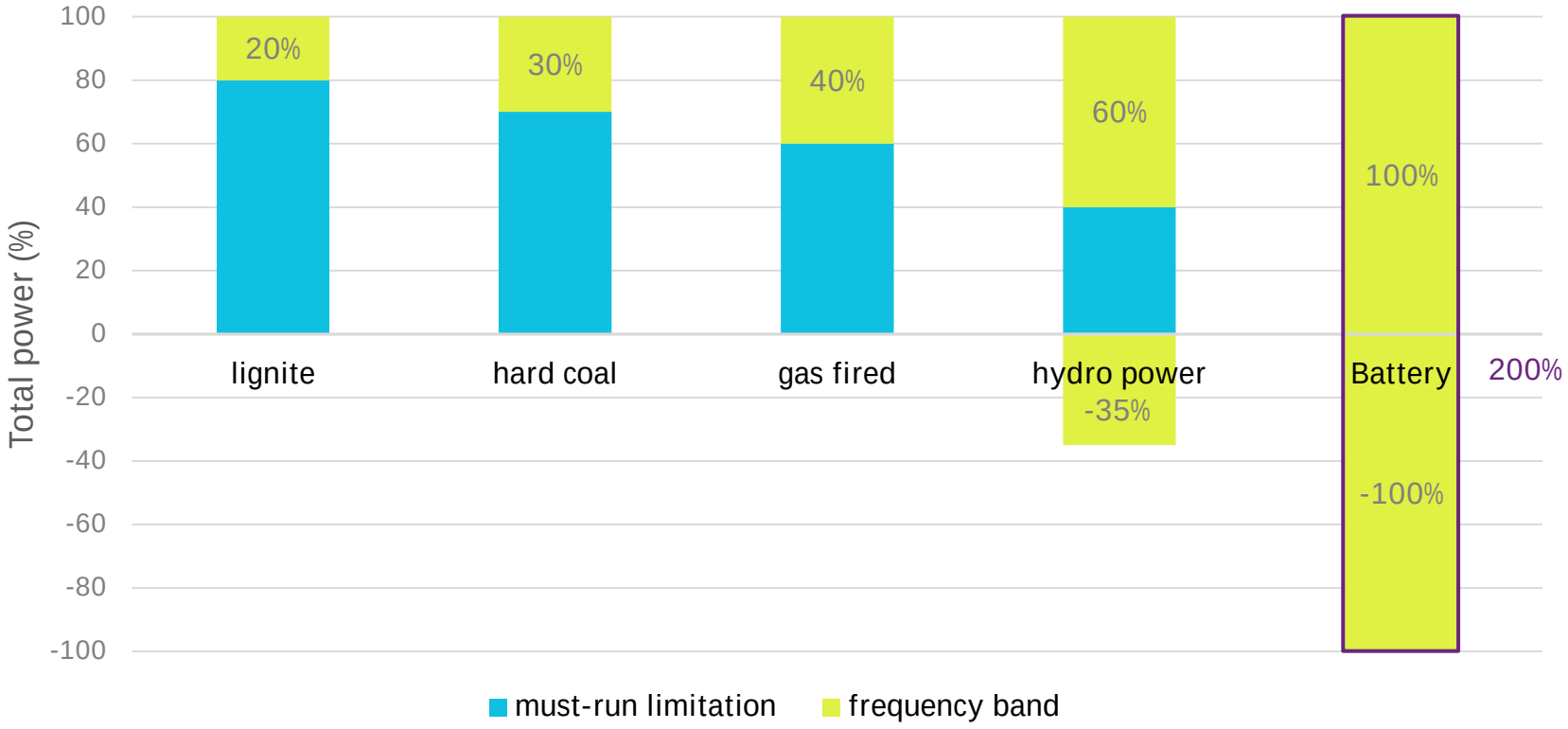


In Germany, ~ 600 MW primary frequency control, equivalent to ~ 20 GW must run, creating damage of ~€5.25 bn. in 2017*
Europe requires 3,000 MW of primary frequency control

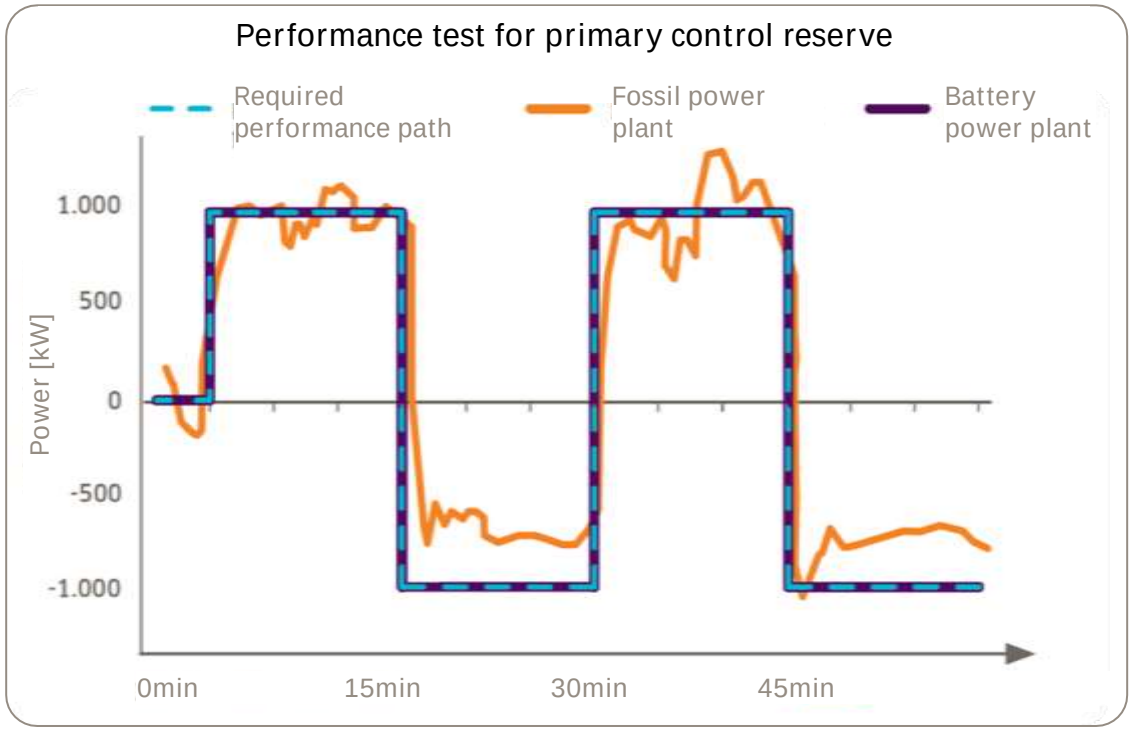
* SRU, Systemkonflikt in der Transformation der Stromerzeugung, 2010
Deutrsch Übertragungsnetzbetreiber, Aauswirkungen reduzierter Schwungmasse auf einen stabilen Netzbetrieb, 2014

Technical balance - Batteries offer higher efficiency in the provision of frequency containment

Control bands of different power plants in % of overall power
(Frequency Containment Reserve and Frequency Restoration Reserve)



Technical balance - Batteries are more flexible and accurate than conventional power plants

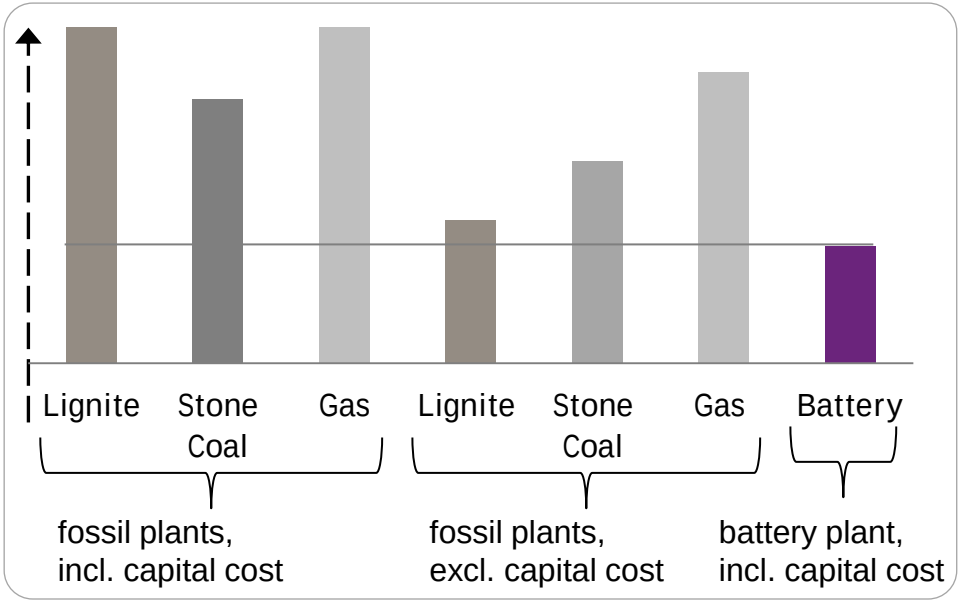


Faster and more accurate response of batteries make balancing more efficient and lowers the need for frequency regulation

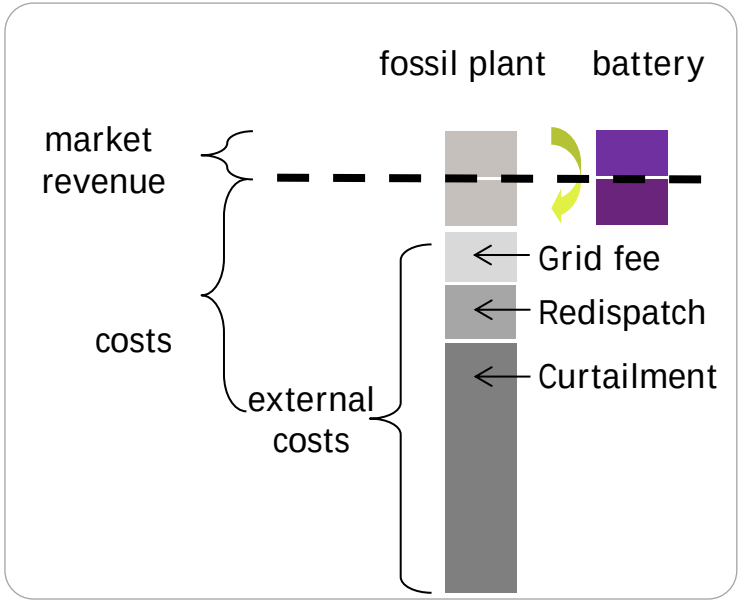
*Battery power plant's response time< 5 ms

Microeconomic and macroeconomic balance - Batteries are the most efficient option to provide grid stability

Comparing costs for 2MW (+/- 1MW) control band of frequency regulation



External costs outside the regulated framework*



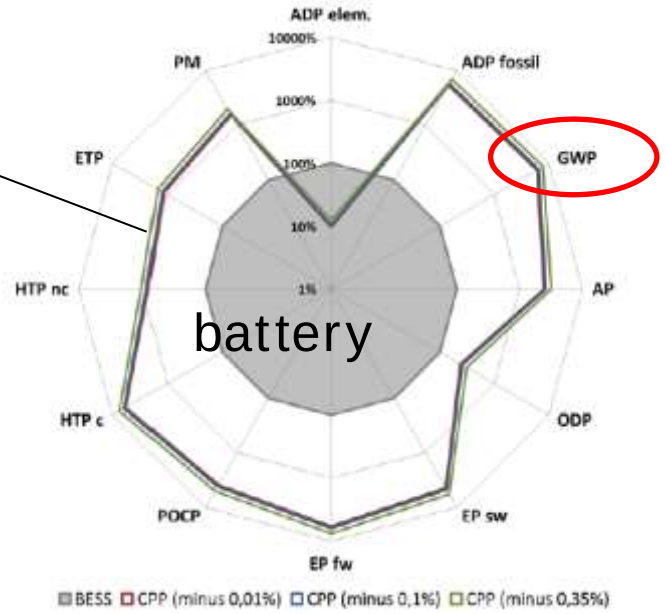
Batteries are cheaper for the system, because they operate without external costs

*(dena, Systemdienstleistungen 2030, 2014)

Ecological balance - Battery vs. coal plant

Comparison for the provision of frequency containment reserve

coal plant



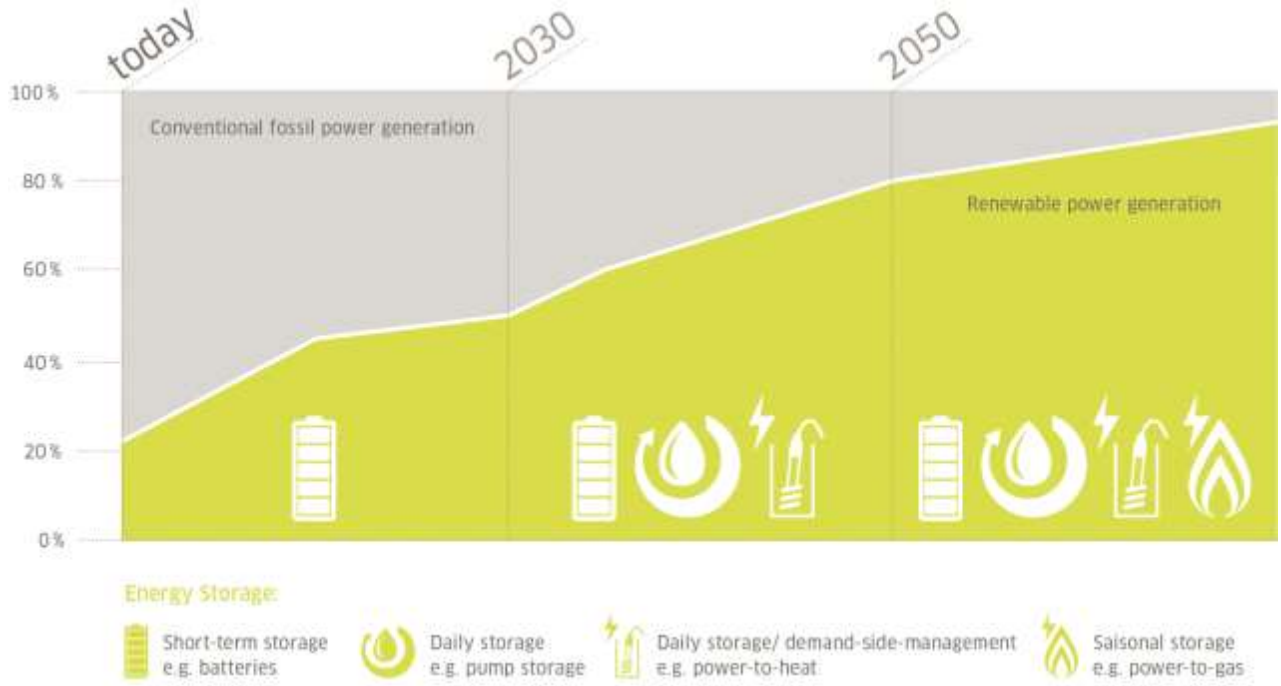
$ADP_{elem.}$	Abiotic Resource Depletion Potential (mineral)
ADP_{fossil}	Abiotic Resource Depletion Potential (fossil)
GWP	Global Warming Potential
AP	Acidification Potential
ODP	Ozone Depletion Potential
EP sw	Eutrophication Potential (saltwater)
EP fw	Eutrophication Potential (fresh water)
POCP	Photochemical Ozone Creation Potential
HTP c	Human Toxicity Potential (carcinogen)
HTP nc	Human Toxicity Potential (non carcinogen)
ETP	Ecotoxity Potential
PM	Particulate Matter

global warming potential of coal plants exceeds that of battery plants by a factor of up to 90

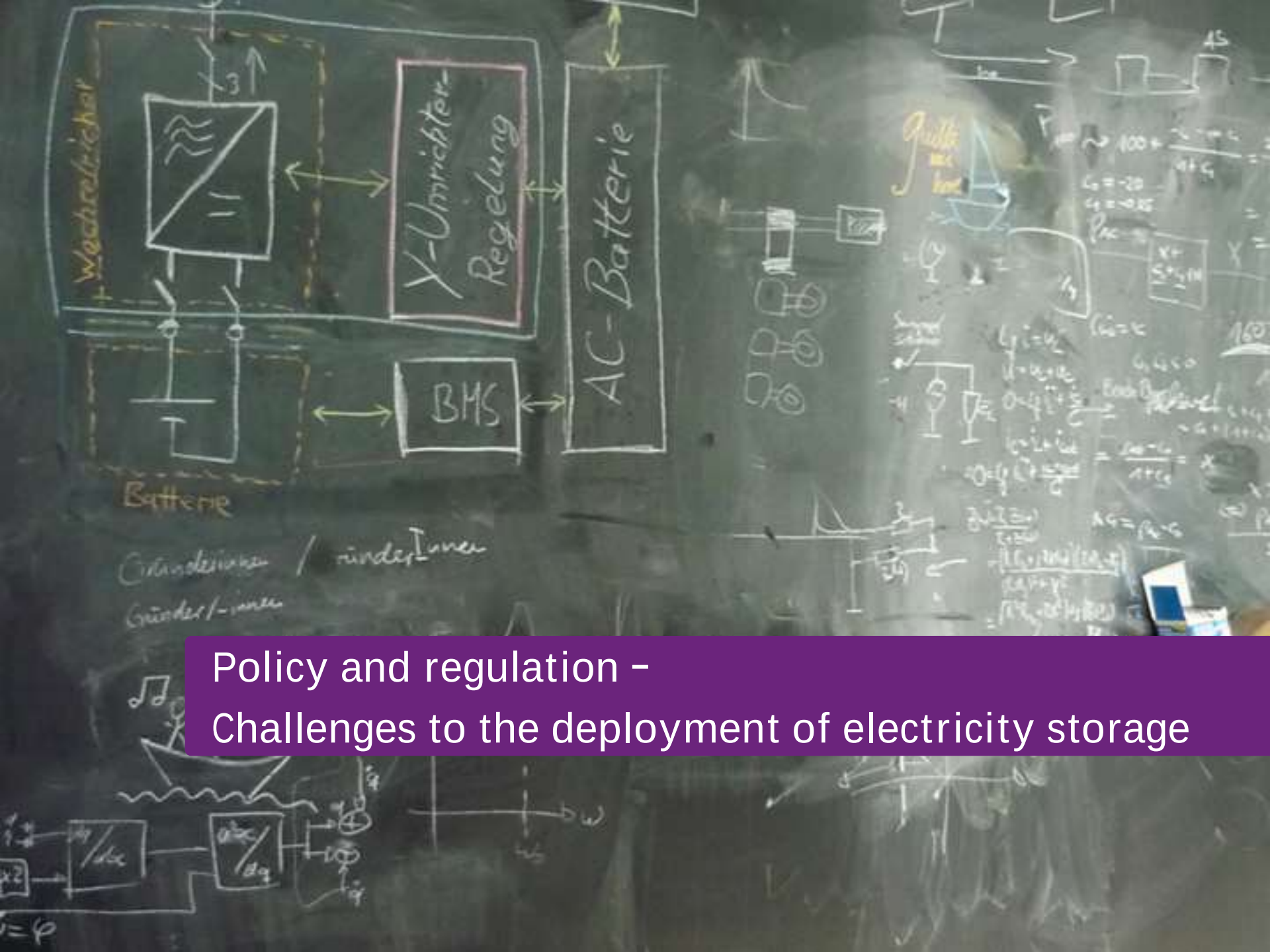
Batteries help to reduce emissions and pollution from the energy sector

*FZ Jülich (2015): Life Cycle assessment of primary control provision by battery storage systems and fossil power plants

Conclusion - Storage roadmap for the Energiewende



System requirements define application, time and usage of storage technologies in the energy sector



Policy and regulation –
Challenges to the deployment of electricity storage

Battery Energy Storage – a new enabler in the old regulatory framework

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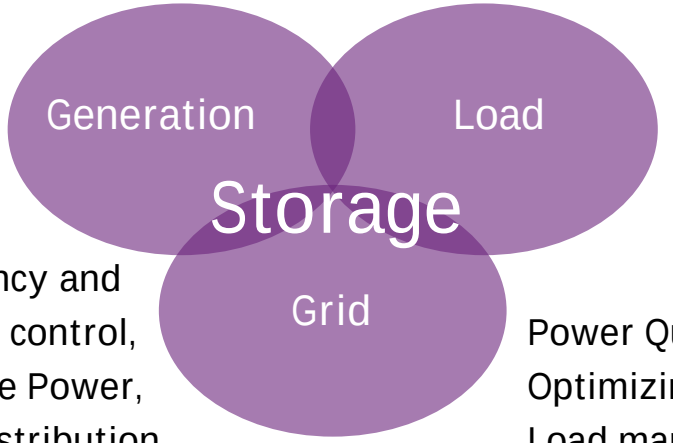
Across the unbundled energy sector

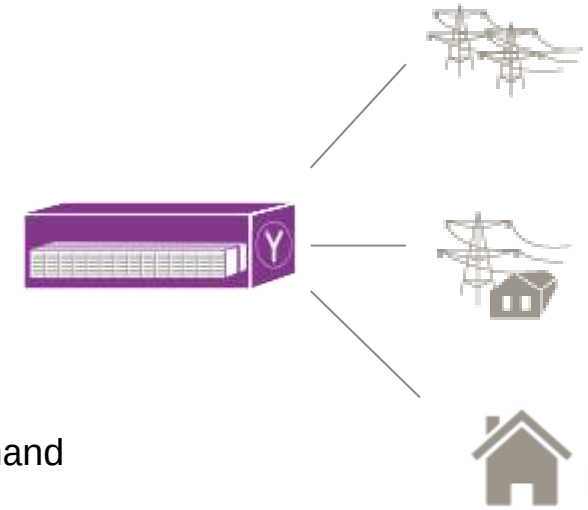
Peak shaving, Ramping,
Integration of renewables



Frequency and
Voltage control,
Reactive Power,
Load distribution

Power Quality
Optimizing of demand
Load management

Across different grid-levels



high voltage – TSO level

medium voltage – DSO level

low voltage – DSO/consumer level

Storage technology can be employed in different applications and on different **grid levels, which constitutes a challenge in today's regulatory framework**

Regulatory aspects: main barrier to market integration of storage

Regulatory aspects constitute a main barrier for market penetration of storage

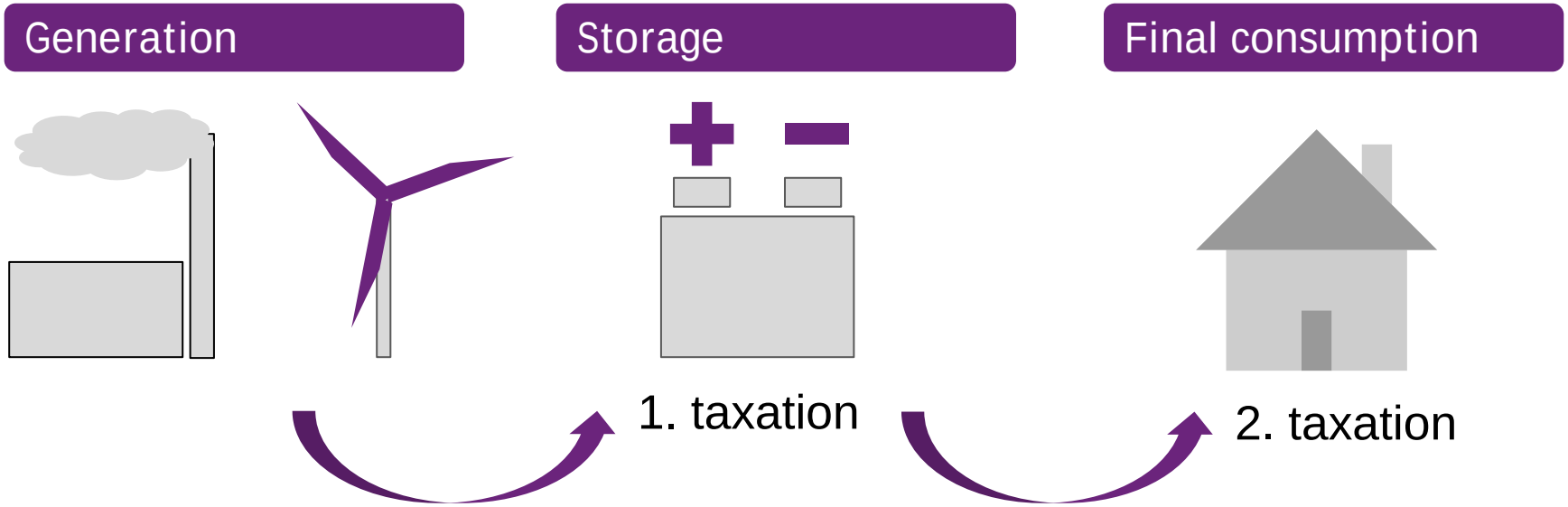
Energy Storage in the electricity system is not defined in regulatory framework on EU or national levels

- Creating uncertainty on market access
- Creating uncertainty on ownership roles
- Different national definitions within EU complicate the situation

Due to missing definition, storage is often discriminated against

- Uncertainty on capacity requirement for storage capacity in FCR
- Double payment of taxes and levies of stored electricity (exemptions for PH)
- Different market access and remuneration of services compared to other market players (e.g. Italy, UK)

Example:
Double taxation of the same kWh

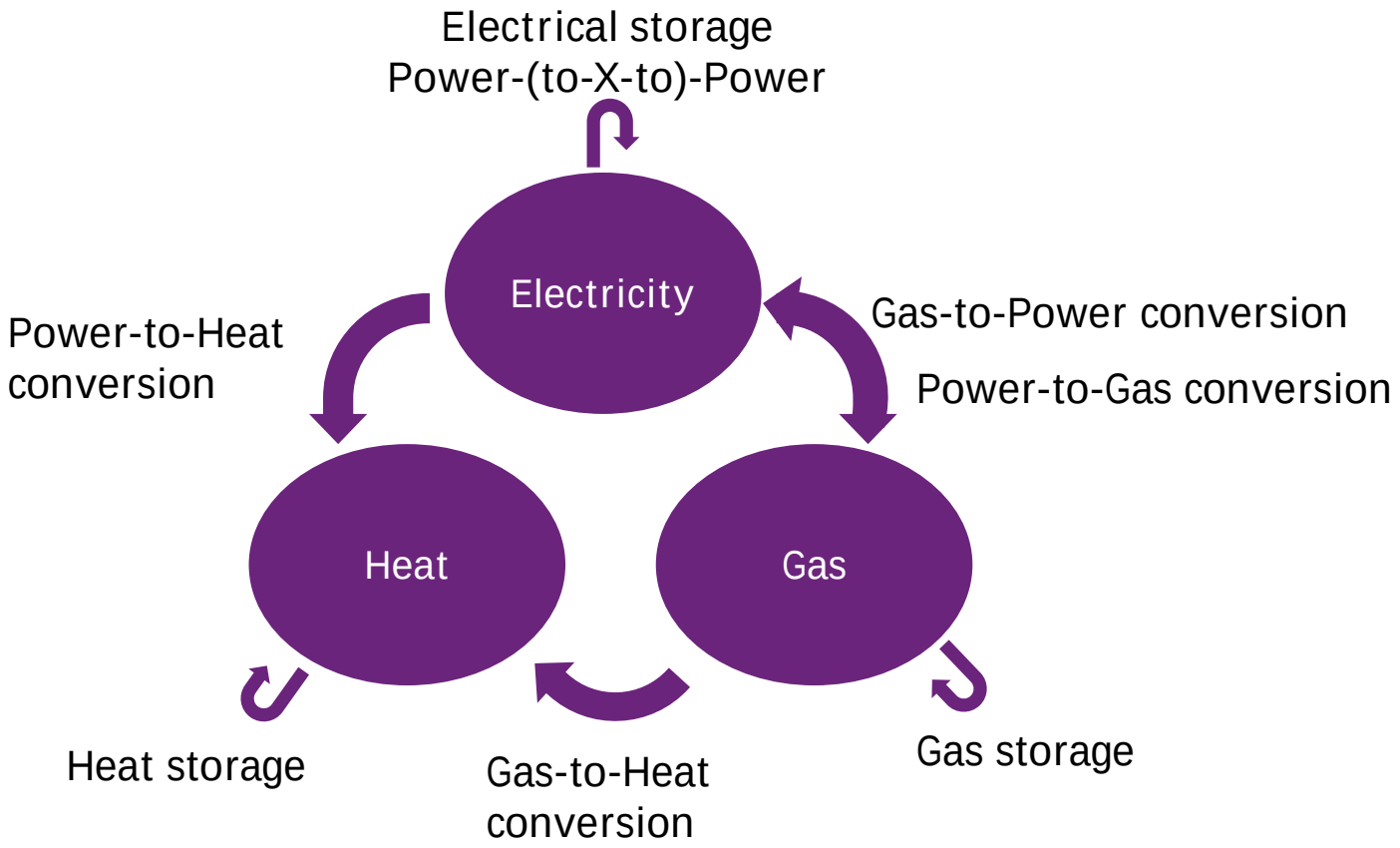


Lack of definition of energy storage in the electricity system: storing of electricity from the grid is wrongly associated as final consumption

Double taxation as result: When electricity is forwarded to the final consumer, taxes and levies are charged a second time

Concerns only Power-to-Power: double taxation only for power-to-power storage, not for power-to-gas or power-to-heat, as energy does not go back to electricity sector

Distinction between energy and electricity storage necessary

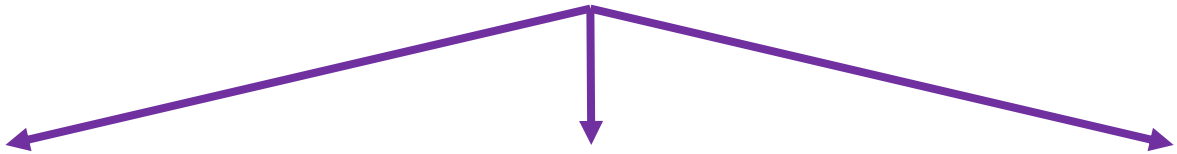


Define electricity storage vs. energy storage to prevent cross-sectoral financial distortions due to levies and taxes

Definition of electrical Storage – Energy storage in the electricity System

Energy storage (cross-sectorial solutions):

act of deferring an amount of Energy that was generated or feed in (primary energy sector/public network) to the moment of use, either as final energy (final energy sector/public network) or converted into secondary energy carrier (secondary energy sector).



Electrical storage:
Electricity sector internal act of deferring an amount of Energy that was generated to the moment of use, either as final energy or converted into energy carrier (without using public infrastructure of other sectors for the primary storing process).

Gas storage:
Gas sector internal act of …

Heat storage:
Heating sector internal act of …

European ancillary markets – market barriers

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- Role of TSOs/DSOs in procurement of storage is unclear
- TSOs/DSOs invest in storage assets, if those only provide grid services?
- Can future business models be found, in which TSOs and market actors jointly build and operate storage assets?
  - e.g. DSO uses grid investment deferral and voltage support, market player uses frequency regulation
- As storage competes in ancillary services against existing power plants or grid assets, there is a lack of investment, even though batteries have lower OPEXs → caused by lack of storage definition/regulatory aspects

Thank you for your attention!

Gunnar Wrede

Gunnar.Wrede@younicos.com

+49 30 81879-9010

Younicos AG

Am Studio 16

12489 Berlin

Germany

www.younicos.com

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