

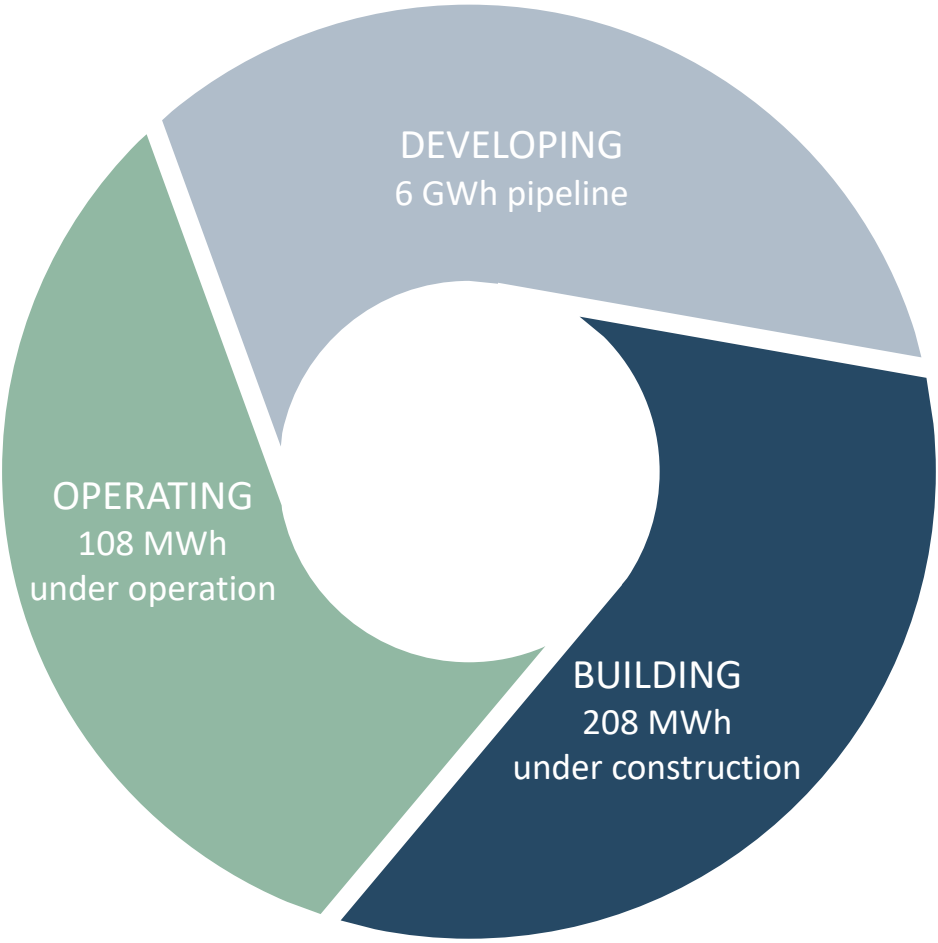


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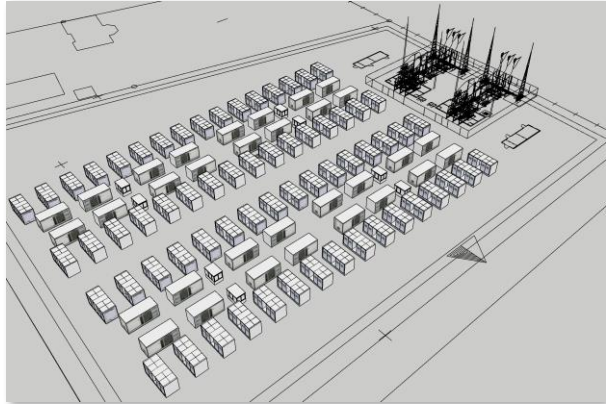
Acceptance for large-scale battery storage

Stabilizing the local grid

Focus on large-scale battery storage systems since 2021



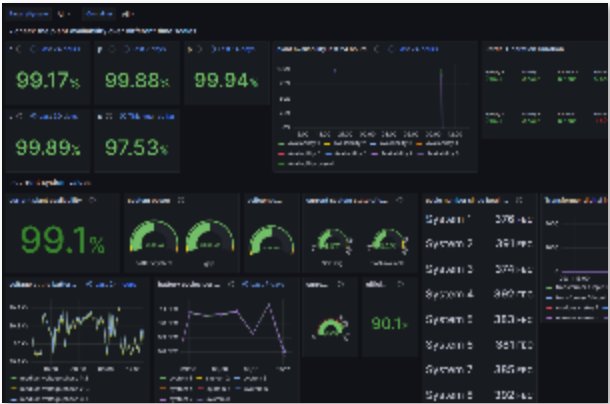
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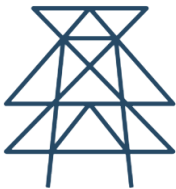
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Acceptance for large-scale storage

# How should we build and operate batteries to facilitate project development?

## Stakeholders and their motivation



**TSO**

- Frequency regulation
- Grid stabilization
- Ancillary services



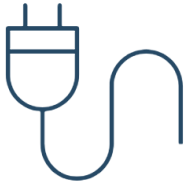
**INVESTORS**

- High-risk high-chance investment
- Hedging renewable portfolio



**LOCAL COMMUNITIES**

- Low environmental impact
- Local tax payments



**LOCAL GRID OPERATORS**

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Decreasing acceptance

# Local grid operators are increasingly reluctant

Too many grid access requests

Bad experiences with (some) existing storage systems



- Der geplante Betrieb des Speicher [REDACTED] mit einer Speicherleistung von [REDACTED] ist je nach aktueller Belastungssituation [REDACTED] Netz zulässig oder nur bedingt zulässig oder teils auch unzulässig. Diese Einschränkungen betreffen sowohl den Betrieb beim Leistungsbezug als auch bei Leistungseinspeisung, da die hohen Einspeiseleistungen aus EE-Anlagen im Netzbereich vorrangig aufzunehmen sind.

Eine zeitreihenbasierte Leistungsflussrechnung wurde nicht durchgeführt, u. a. da das Betriebsverhalten des Speichers unbekannt ist.

- Die Bereitstellung von Leistungen zur Primär- und Sekundärregelung ist ebenfalls nur mit Einschränkungen, die durch die Aufnahme von EE-Einspeiseleistungen im Netzbereich bedingt werden, möglich.

*Excerpt from a grid connection commitment*

*Grid access partially restricted*

*Renewable feed-in priority*

*Operational behavior unknown*

*Balancing energy restricted by local RES generation*

# Storage & Redispatch

Storage redispatch is more complicated than “standard” renewables:

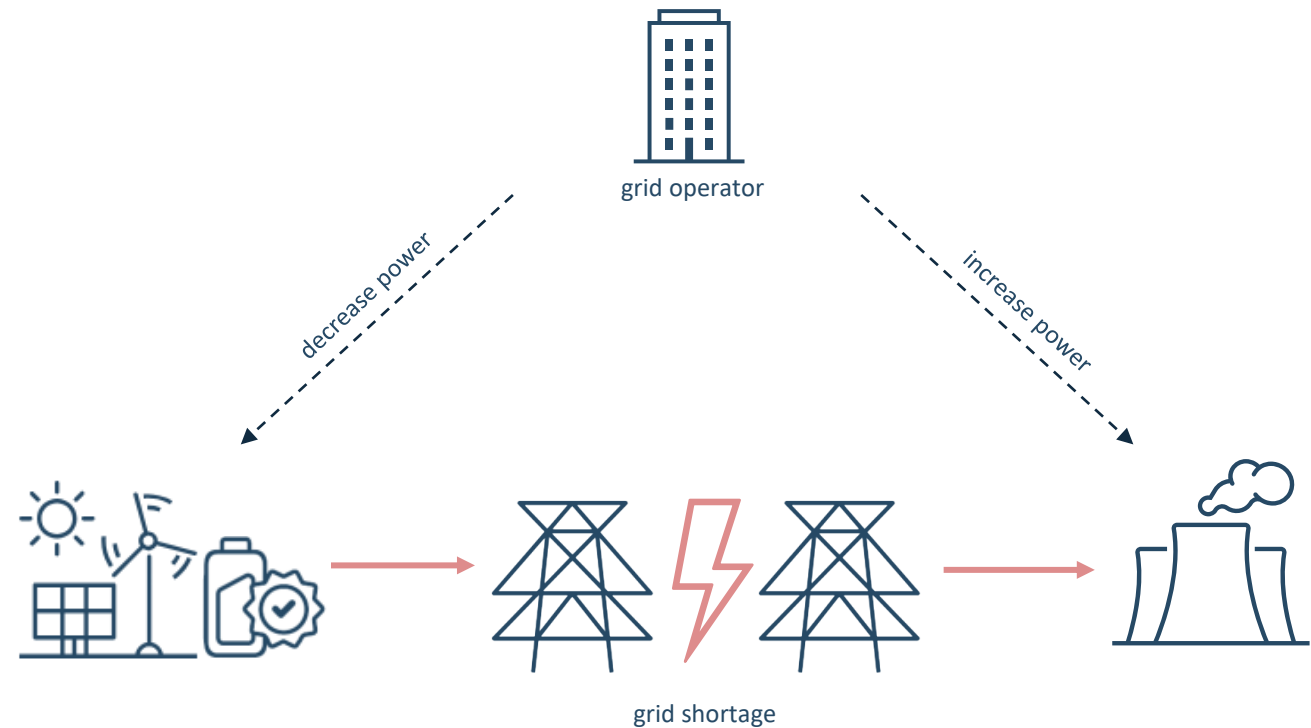
**renewable feed-in priority**

**FCR blocks assets for redispatch**

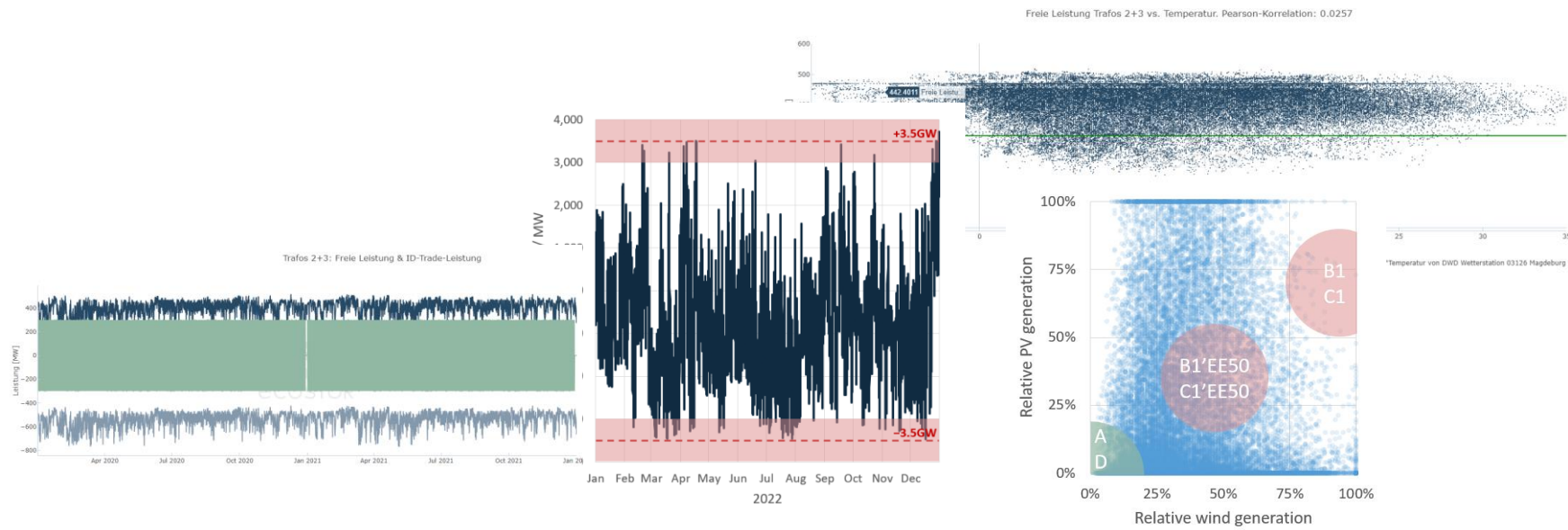
**lost revenues only for DA trades**

**no existing regulation**

**only individual agreements**



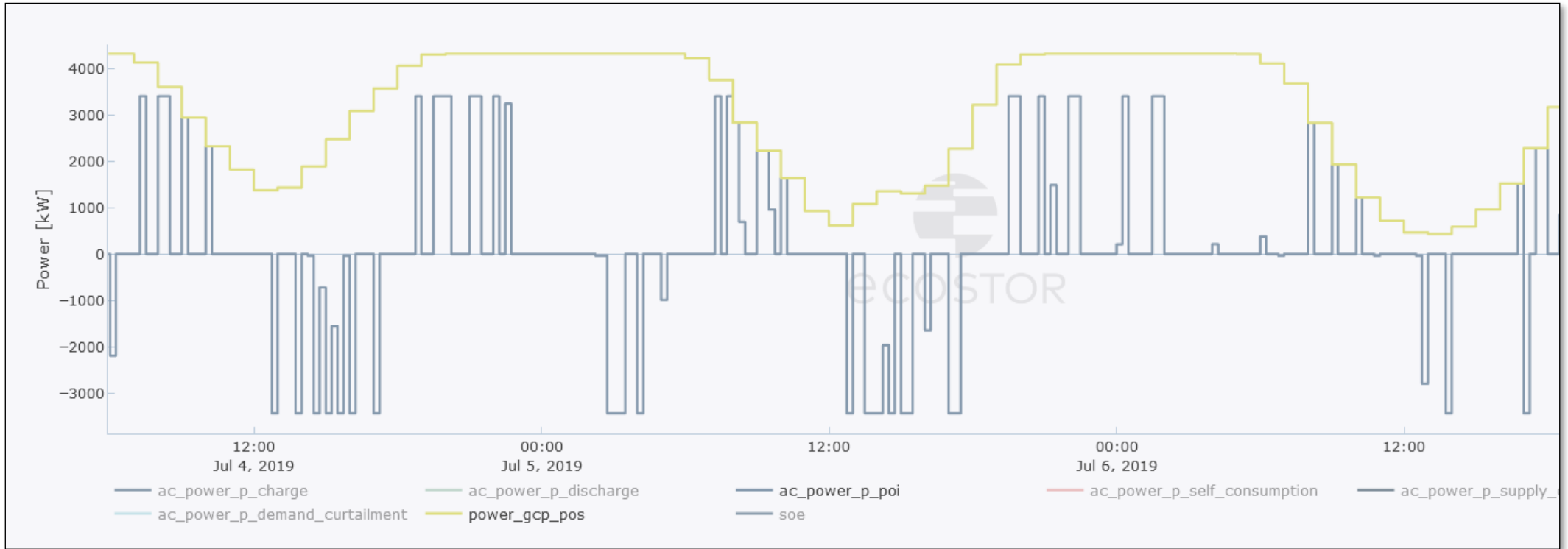
## Analyze local grid situation



-> Need for redispatch mostly << 10 %

# Integration of renewables

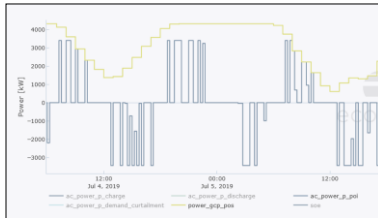
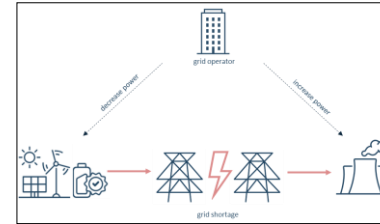
Solar PV generation and ID trading are mostly negatively correlated



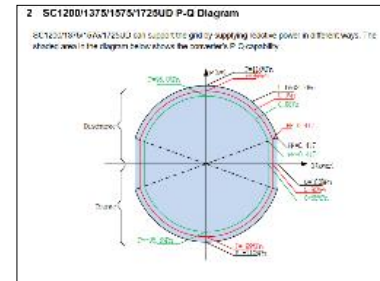
Colocation PV & storage - storage power profile (ID) vs. available power at grid access point

# How can we build and operate batteries to support the local grid?

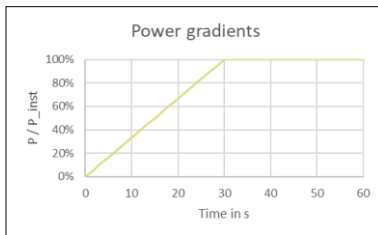
Very flexible redispatch



Integration of renewables



Stepless adjustable reactive power control

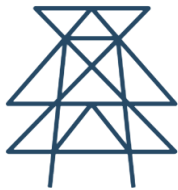


Tolerable power gradients



# How should we build and operate batteries to facilitate project development?

## Stakeholders and their motivation



**TSO**

- Frequency regulation
- Grid stabilization
- Ancillary services



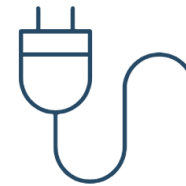
**INVESTORS**

- High-risk high-chance investment
- Hedging renewable portfolio



**LOCAL COMMUNITIES**

- Low environmental impact
- Local tax payments



**LOCAL GRID OPERATORS**

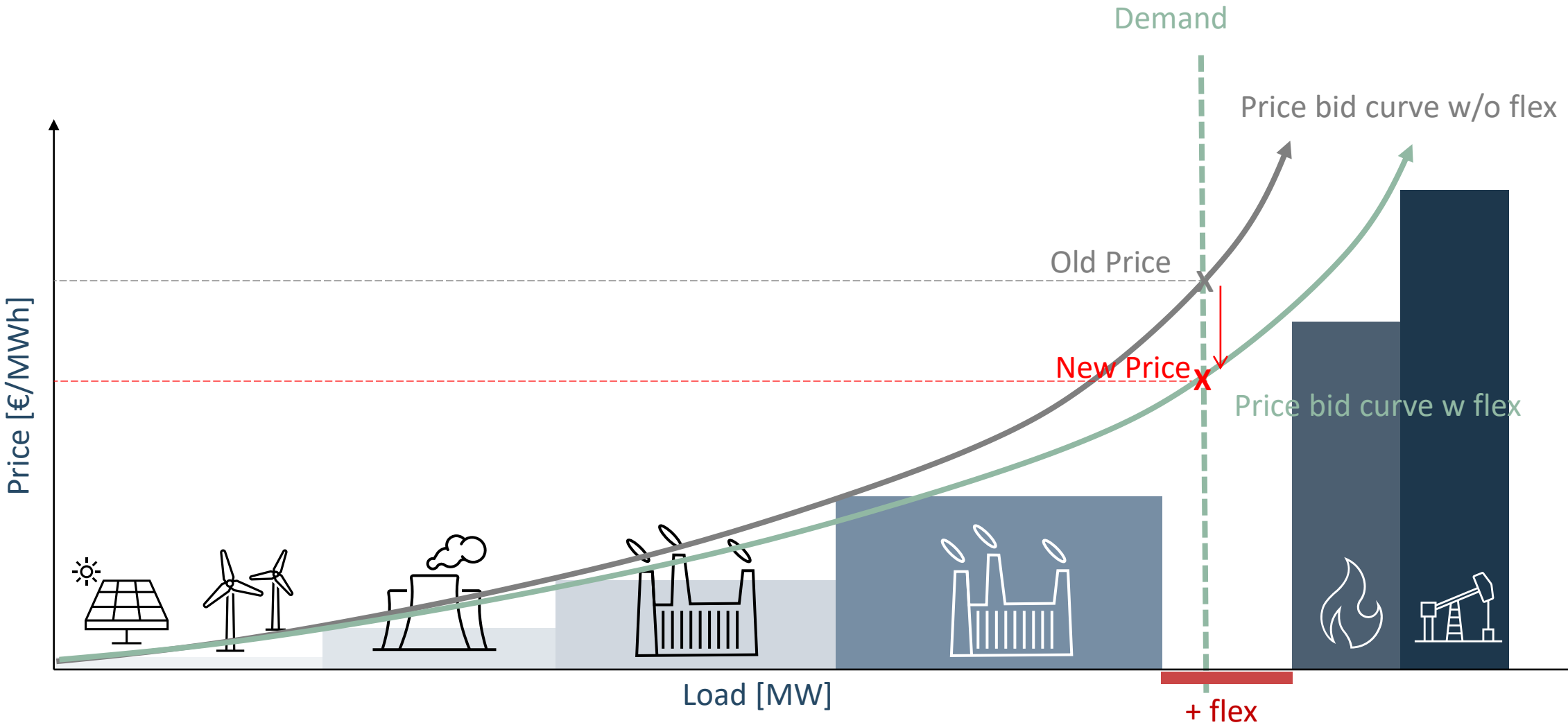
- Integration of renewables
- Local grid stabilization



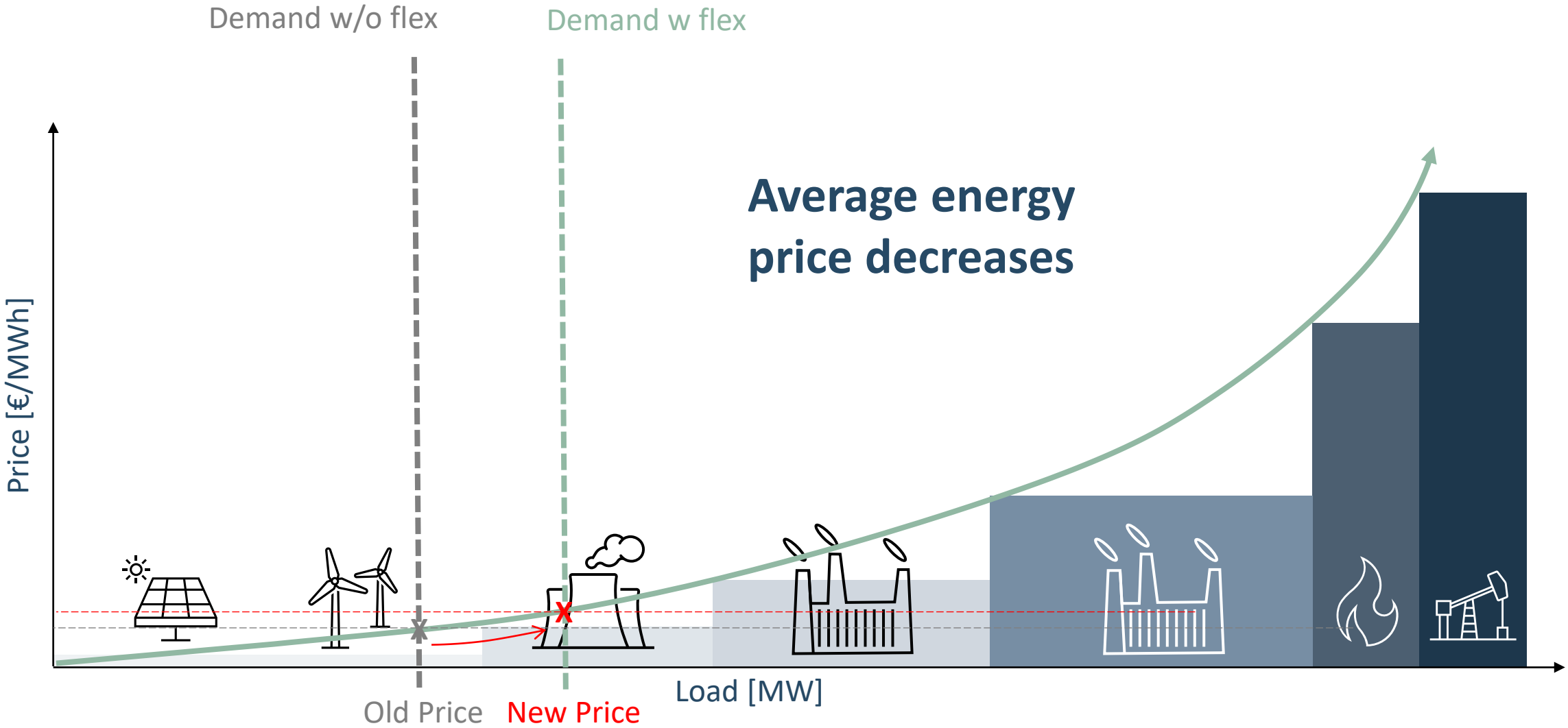
**REGULATION**

- ?
- No grid fee exemption after '26 §118 EnWG (6) 1

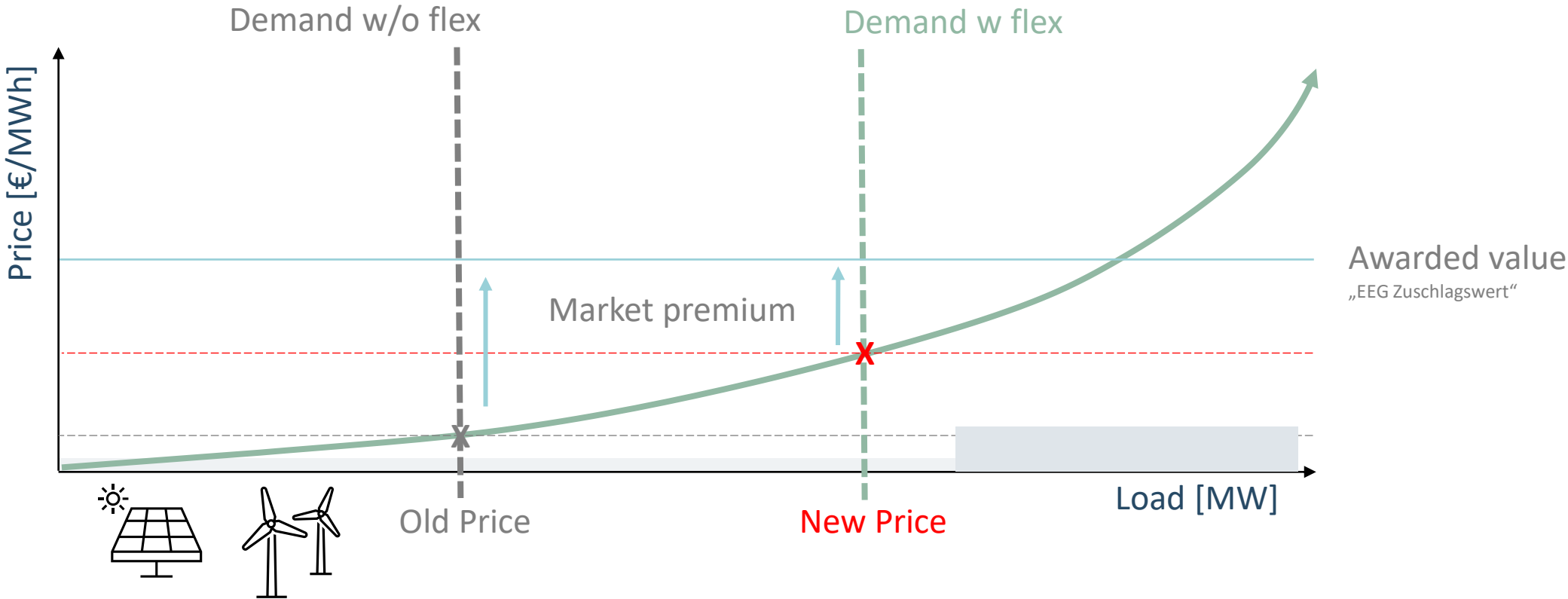
# Merit Order - low renewable generation



# Merit Order - high renewable generation



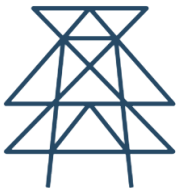
# Merit Order - capture price



**Capture price increases -> tax-financed market premium decreases**

# How should we build and operate batteries to facilitate project development?

## Stakeholders and their motivation



**TSO**

- Frequency regulation
- Grid stabilization
- Ancillary services



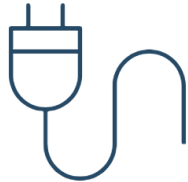
**INVESTORS**

- High-risk high-chance investment
- Hedging renewable portfolio



**LOCAL COMMUNITIES**

- Low environmental impact
- Local tax payments



**LOCAL GRID OPERATORS**

- Integration of renewables
- Local grid stabilization



**REGULATION**

- Reduction of average energy prices
- Reduction of tax-financed market premium



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## Acceptance for large-scale battery storage

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Stabilizing the local grid

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Thank you!