# Monetizing *Standalone* Energy Storage

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Energy Storage

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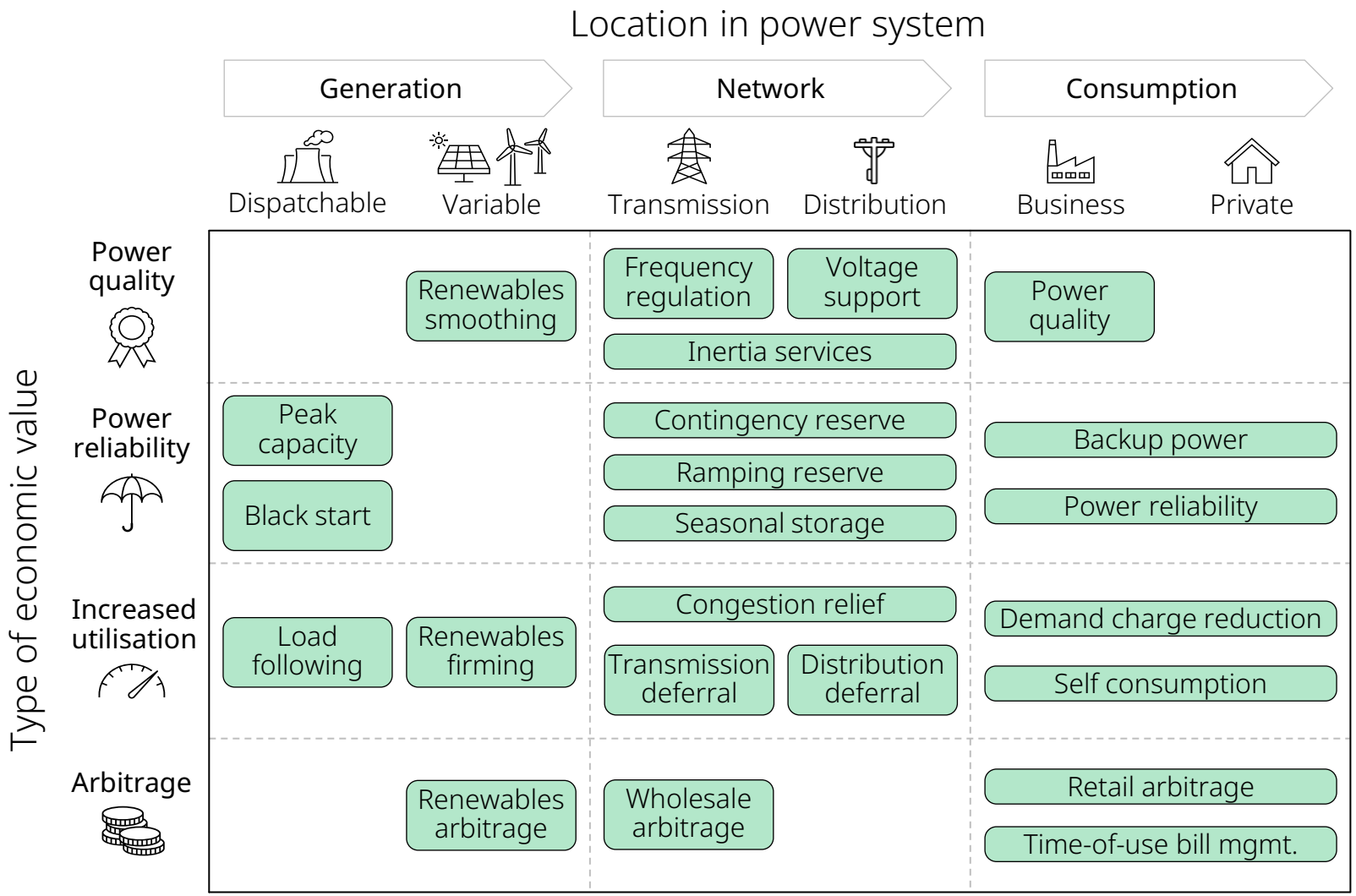
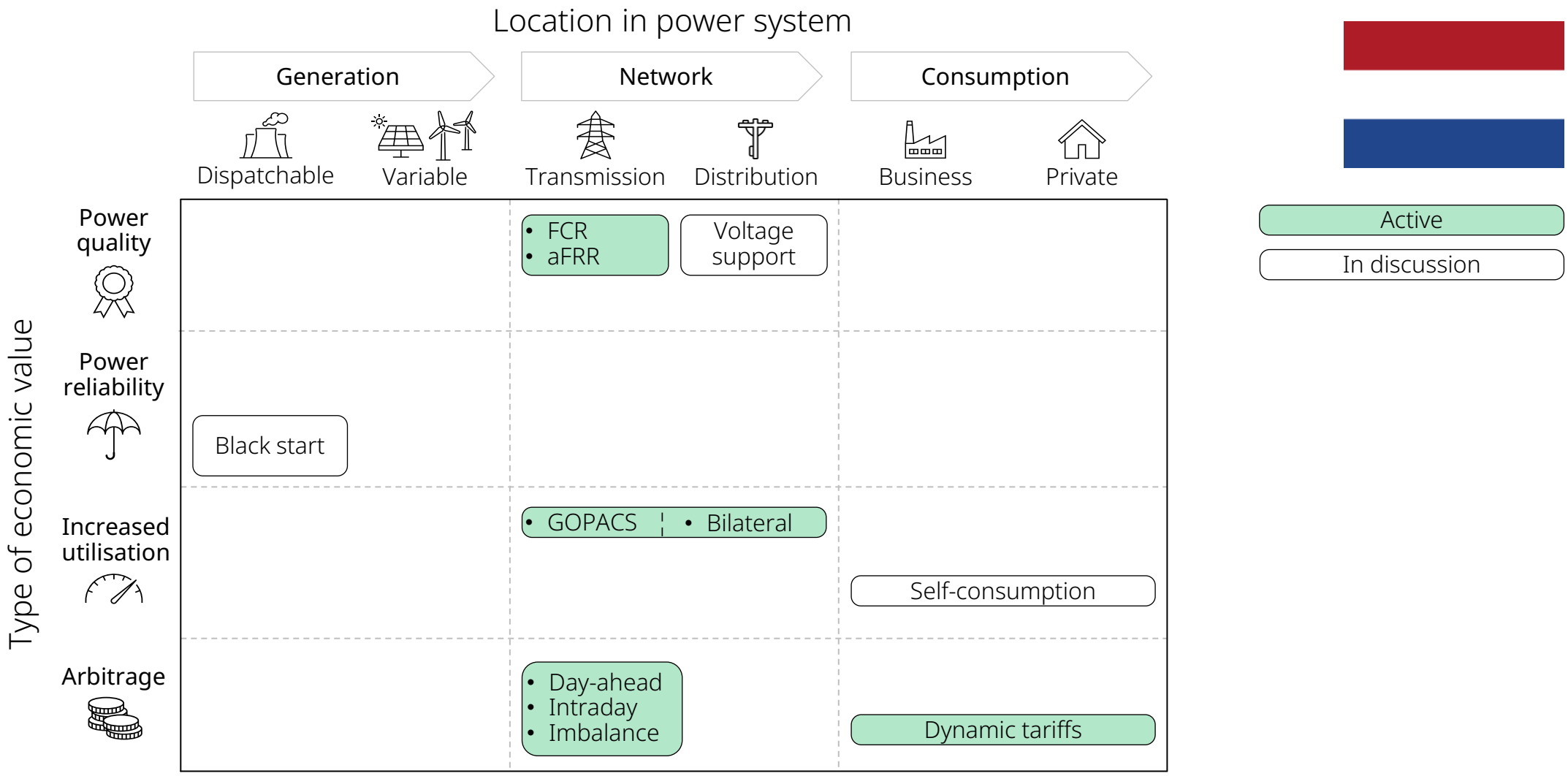
# Storage provides economic value in various applications



# In NL, this value can be monetized in 8 specific markets



# Lifetime cost quantify the revenue requirement for NPV > 0

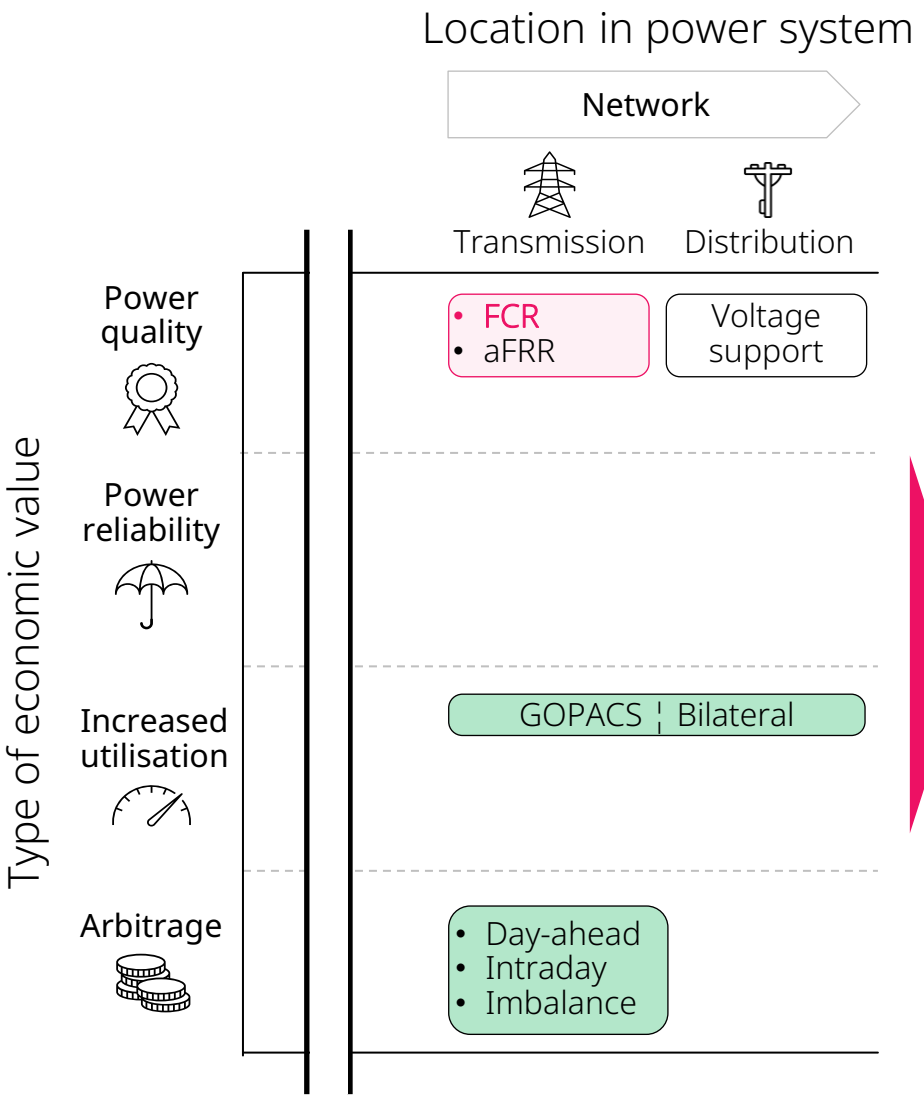
## Annuitized capacity cost

$$\text{ACC}\left[\frac{€}{\text{kW}/yr}\right] = \frac{\text{Investment} + \text{O\&M} + \text{Charging} + \text{End of life}}{\text{Power capacity} \cdot \text{Lifetime}}$$

## Levelized cost of storage

$$\text{LCOS}\left[\frac{€}{\text{MWh}}\right] = \frac{\text{Investment} + \text{O\&M} + \text{Charging} + \text{End of life}}{\text{Energy capacity} \cdot \text{Cycles per year} \cdot \text{Lifetime}}$$

# FCR can be provided at a cost of ~70 €/kW/year




**Battery specs**

- 10 MW / 5 MWh
- € 4 Mio. capex
- 85% efficiency
- 10 years lifetime
- 8% discount rate

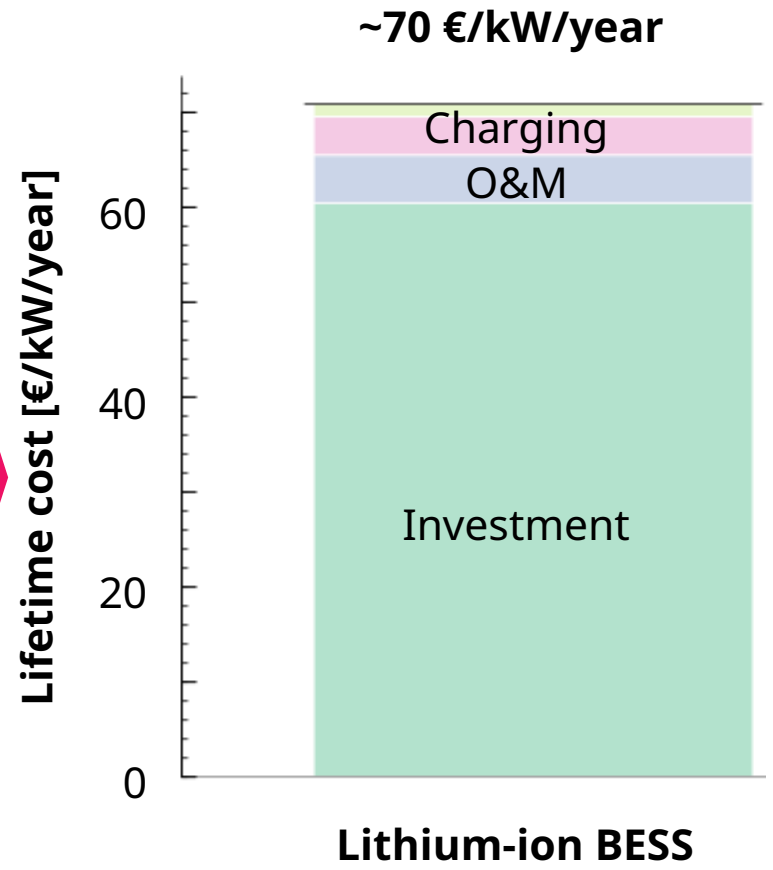
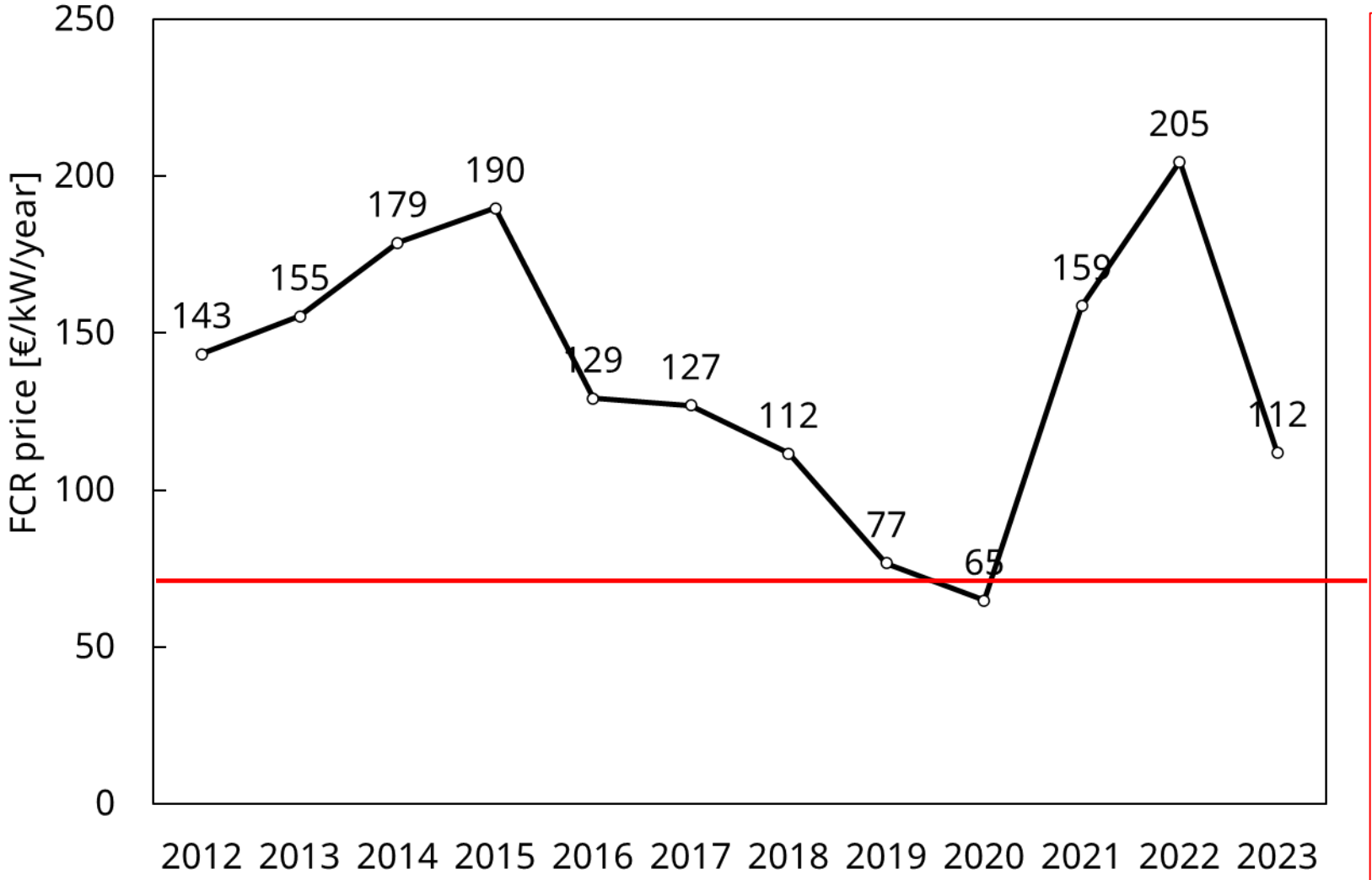



*Chart from www.EnergyStorage.ninja*

# The crossborder settlement price used to be higher than that



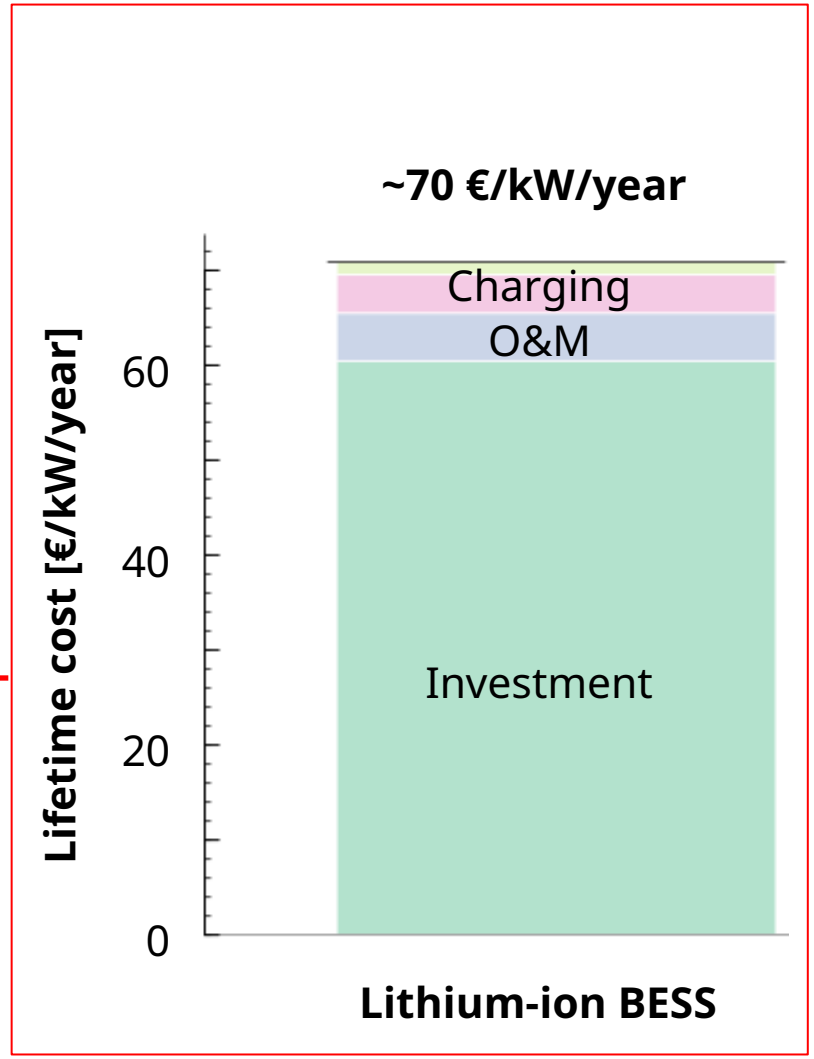
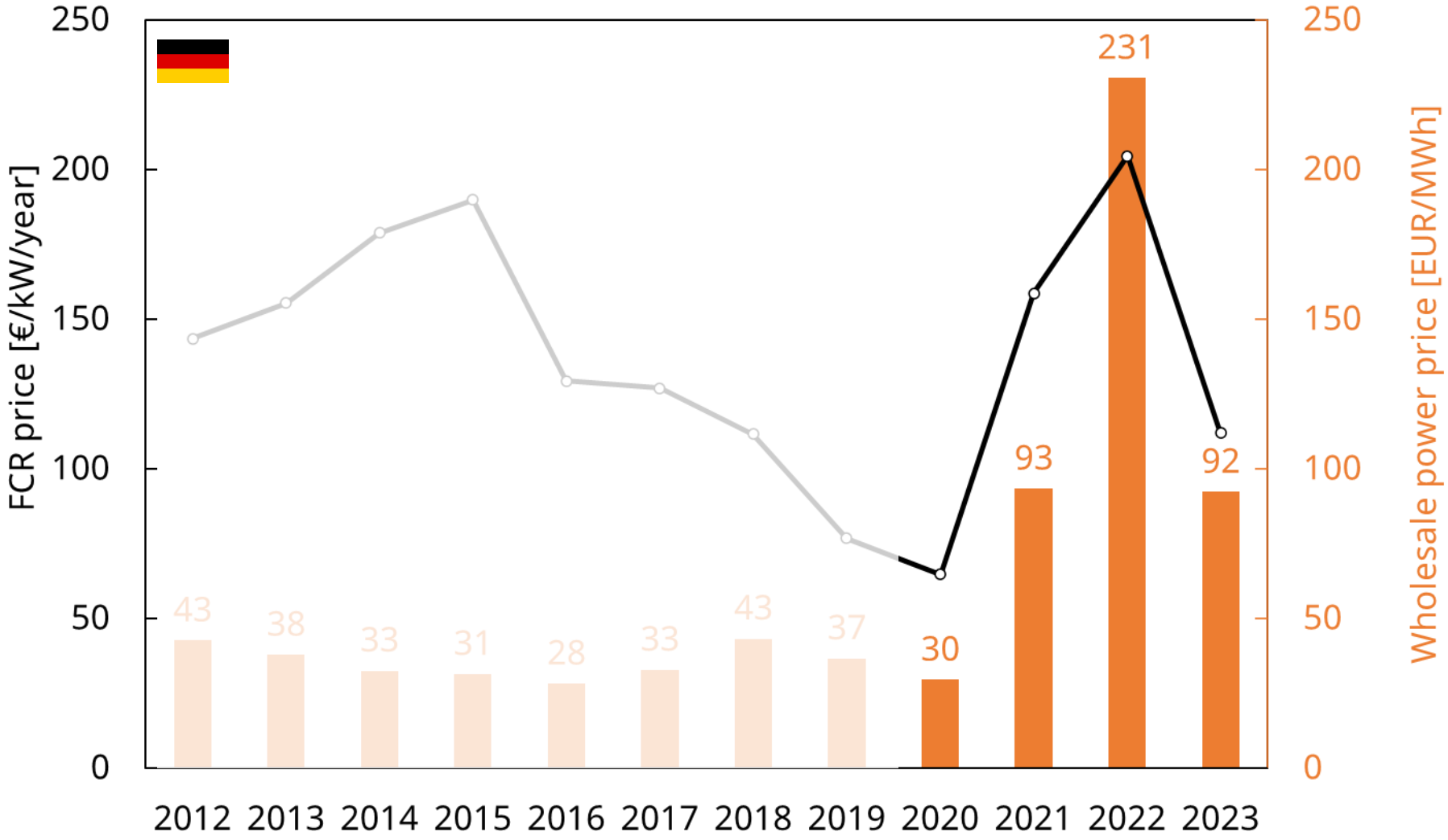




*Chart from www.EnergyStorage.ninja*

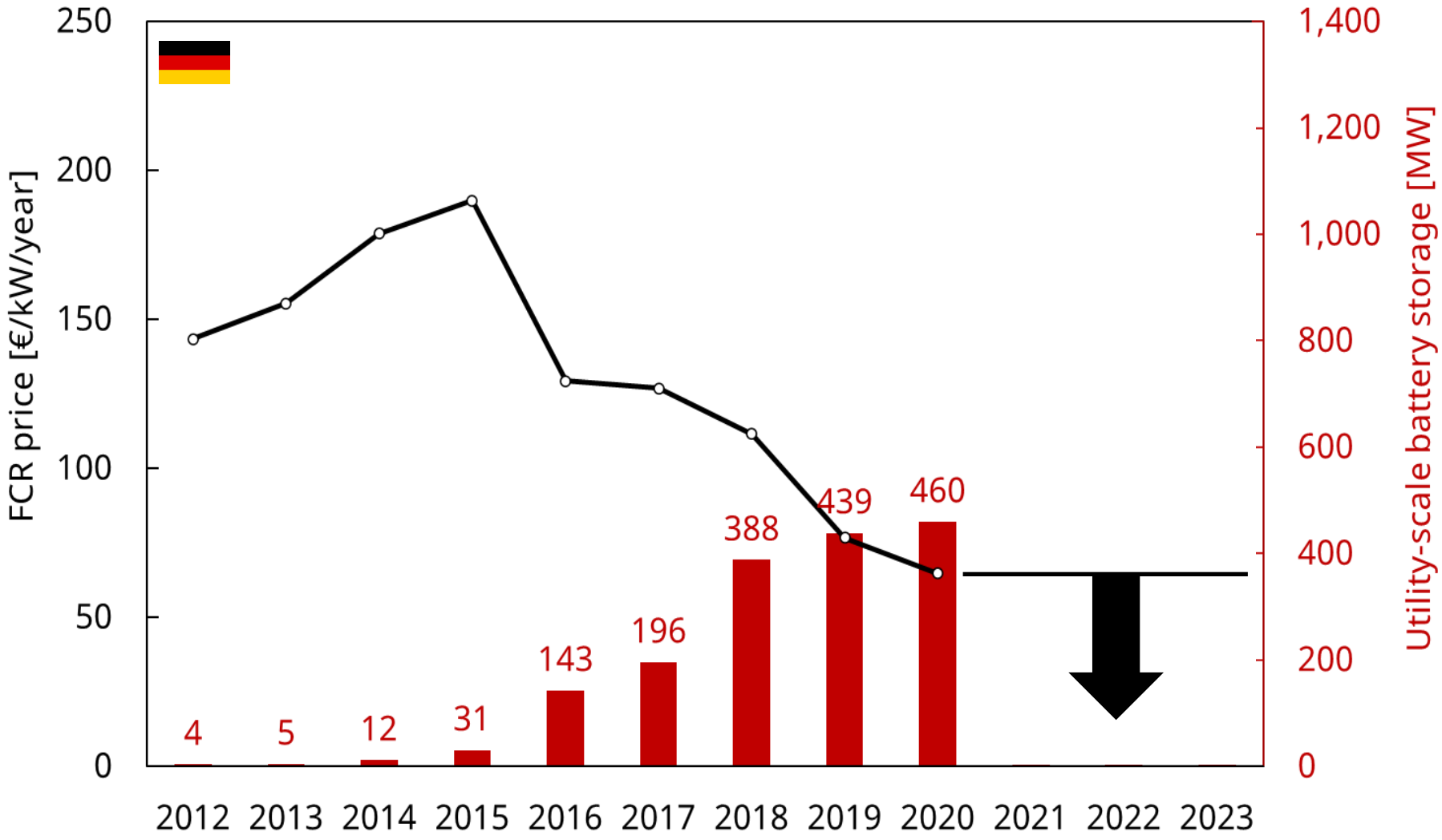
# Partly because of high power prices in 2021-23




… average day-ahead wholesale power prices were significantly higher in 2021-2023 than in the 10 years before…

… with a significant impact on FCR prices.

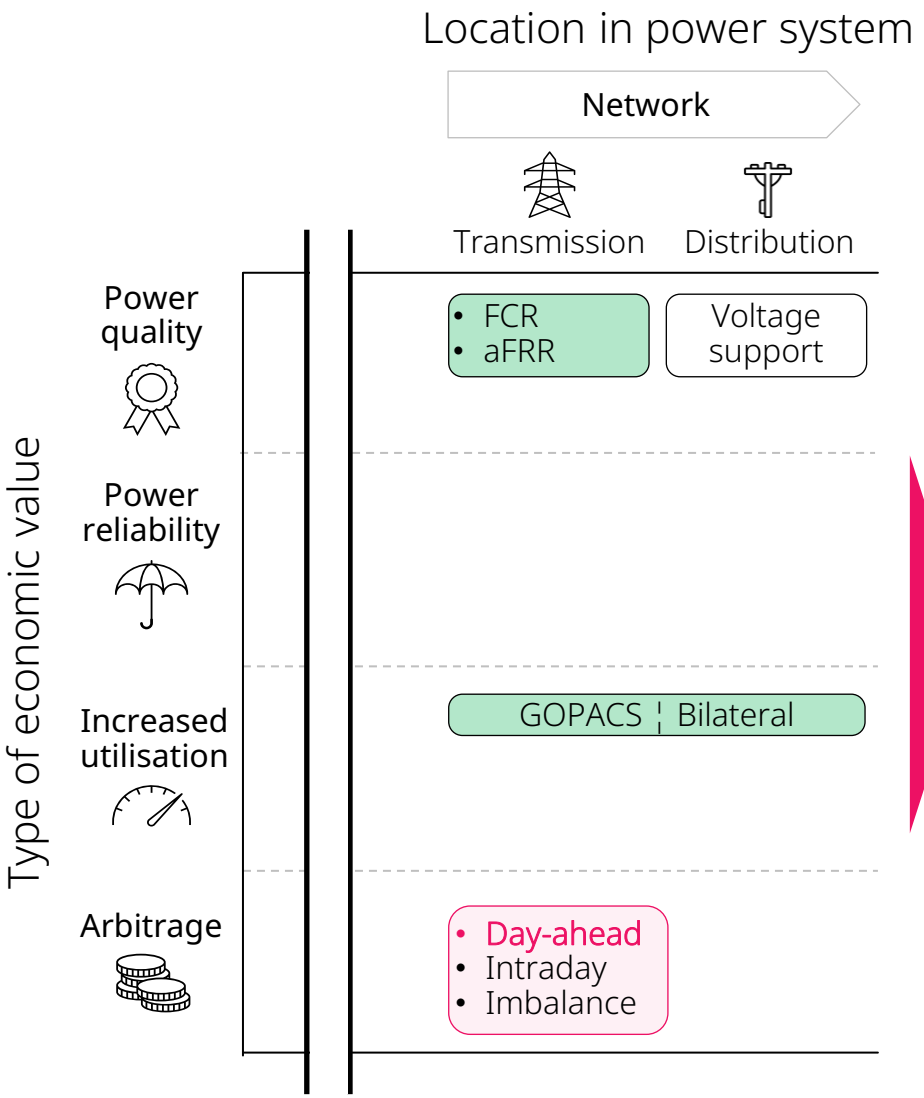
# But, up to 2020 prices fell due to more battery capacity




... significant additional deployment suggests that prices will fall further once power prices have stabilized...

....making FCR much less attractive for **full-time** operation.

# Arbitrage can be provided at a cost of ~160 €/MWh




**Battery specs**

- 10 MW / 40 MWh
- € 14 Mio. capex
- 85% efficiency
- 10 years lifetime
- 5-year replacement
- 8% discount rate

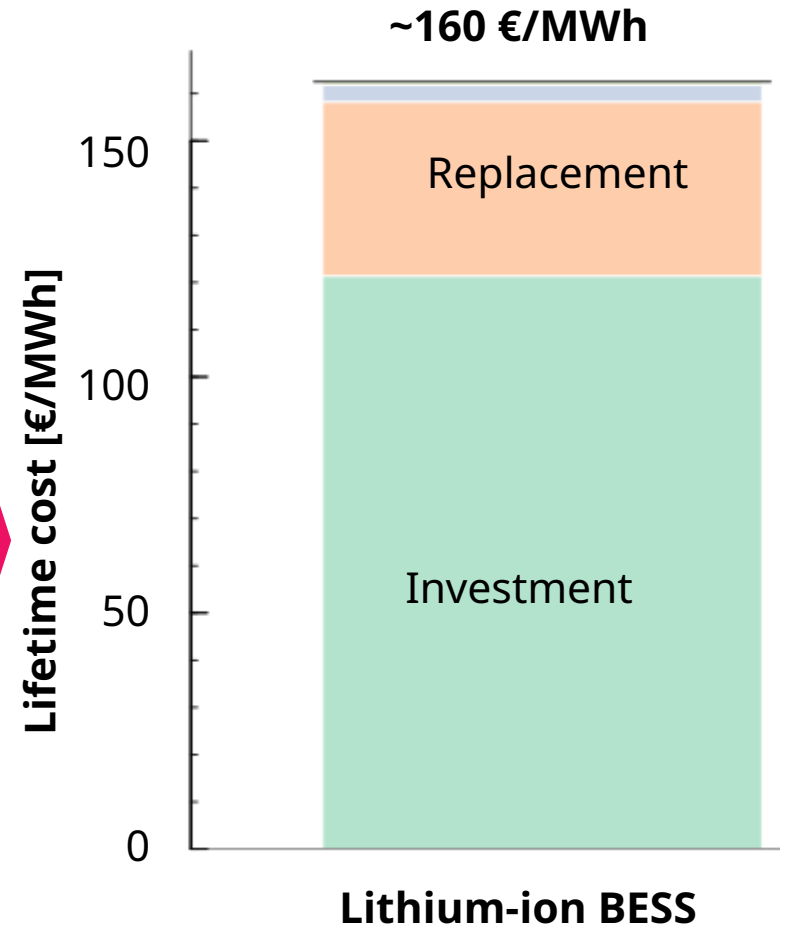



*Chart from www.EnergyStorage.ninja*

# However, average 2023 arbitrage revenues were 57 €/MWh

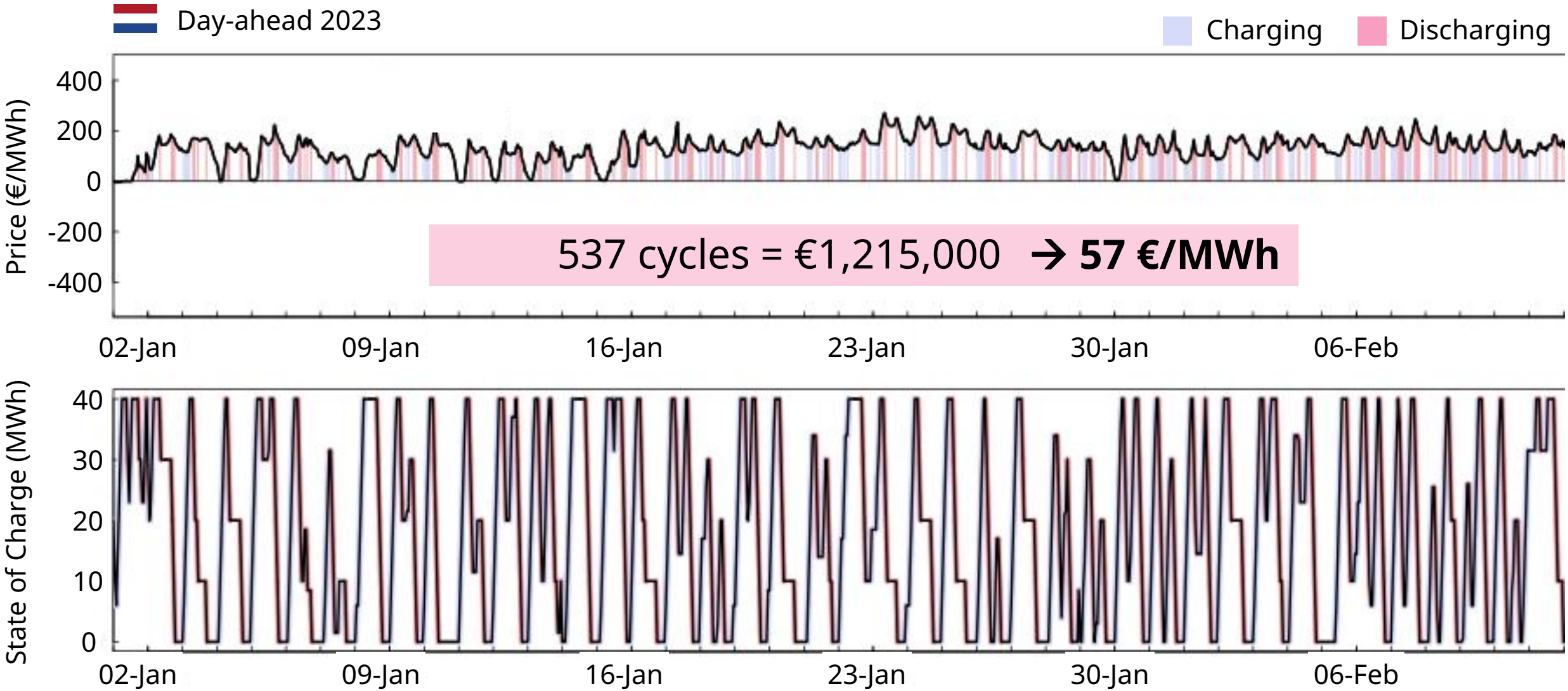



*Chart from www.EnergyStorage.ninja*

# But, fewer cycles allow to extract most of the value still

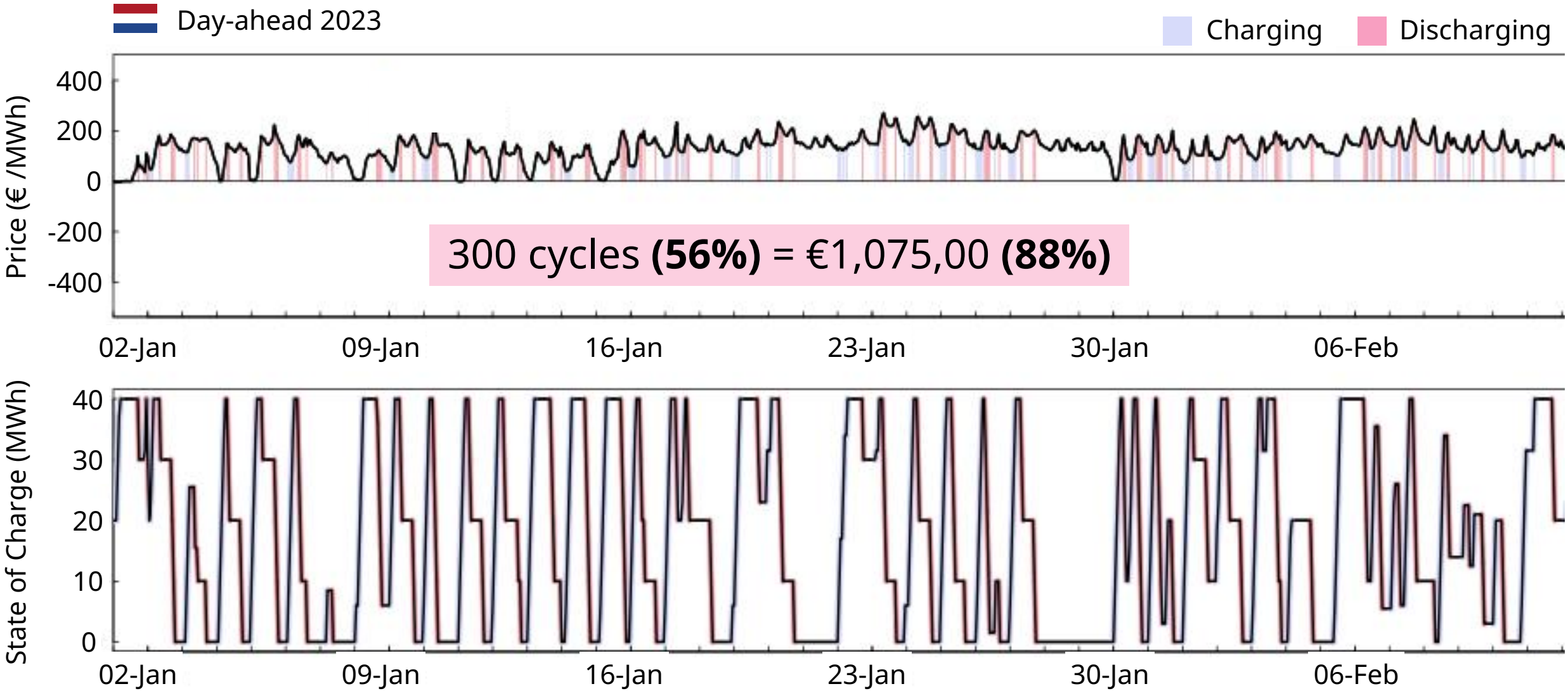



*Chart from www.EnergyStorage.ninja*

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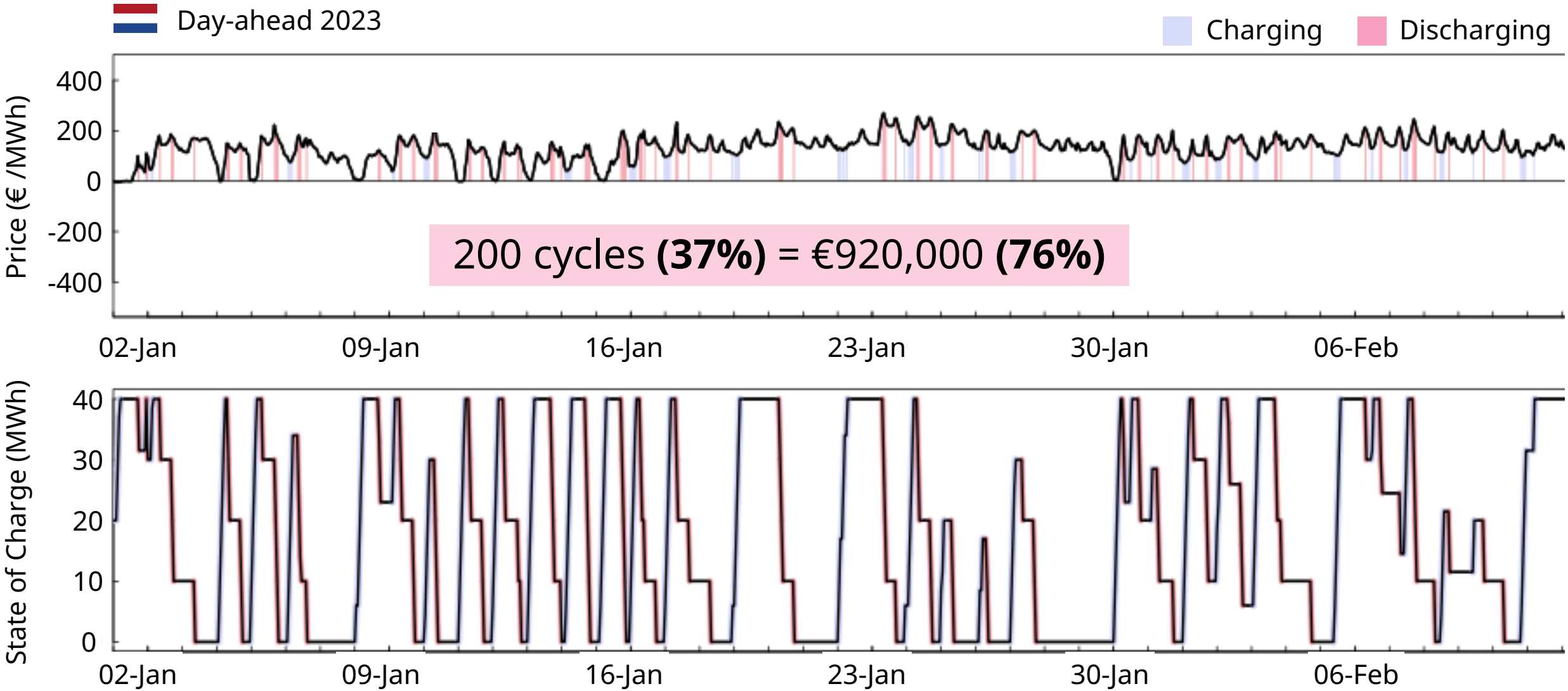


200 cycles **(37%)** = €920,000 **(76%)**

*Chart from www.EnergyStorage.ninja*

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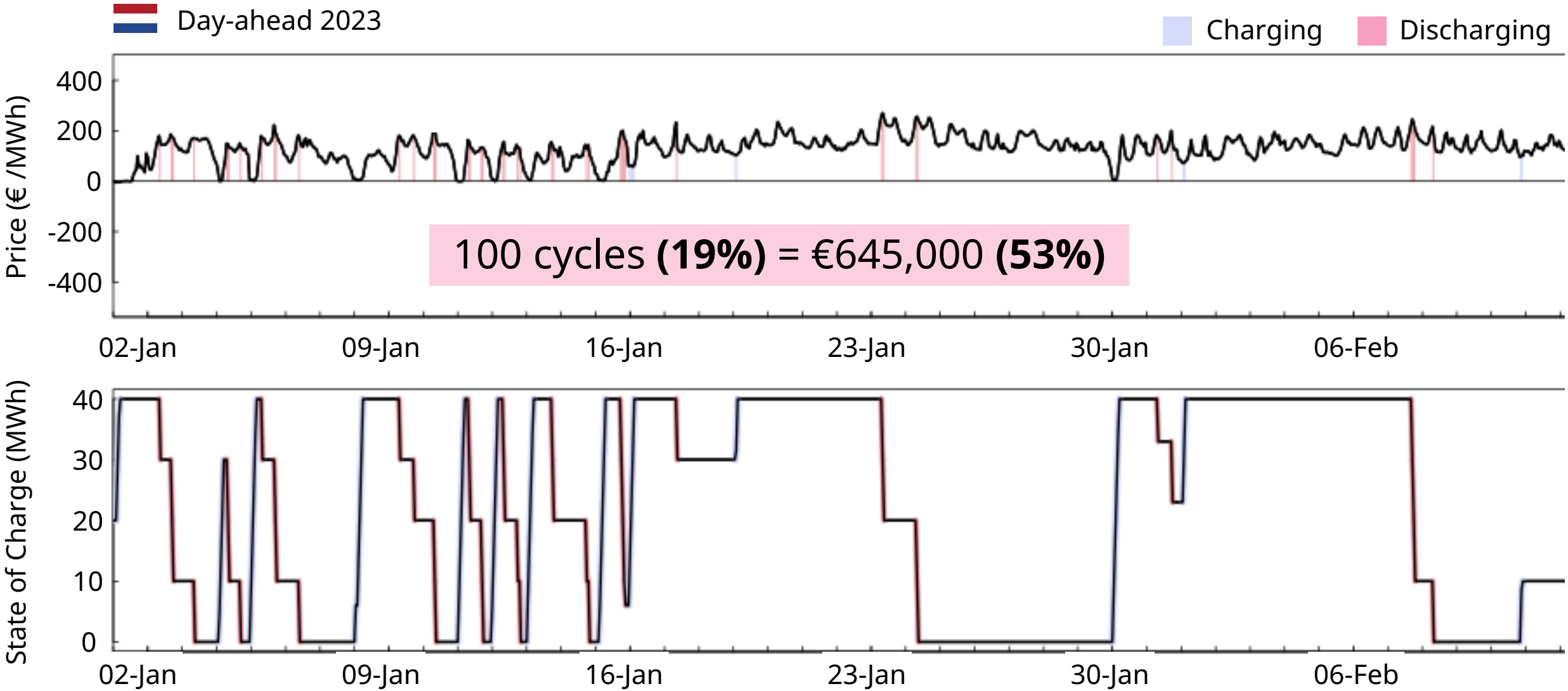
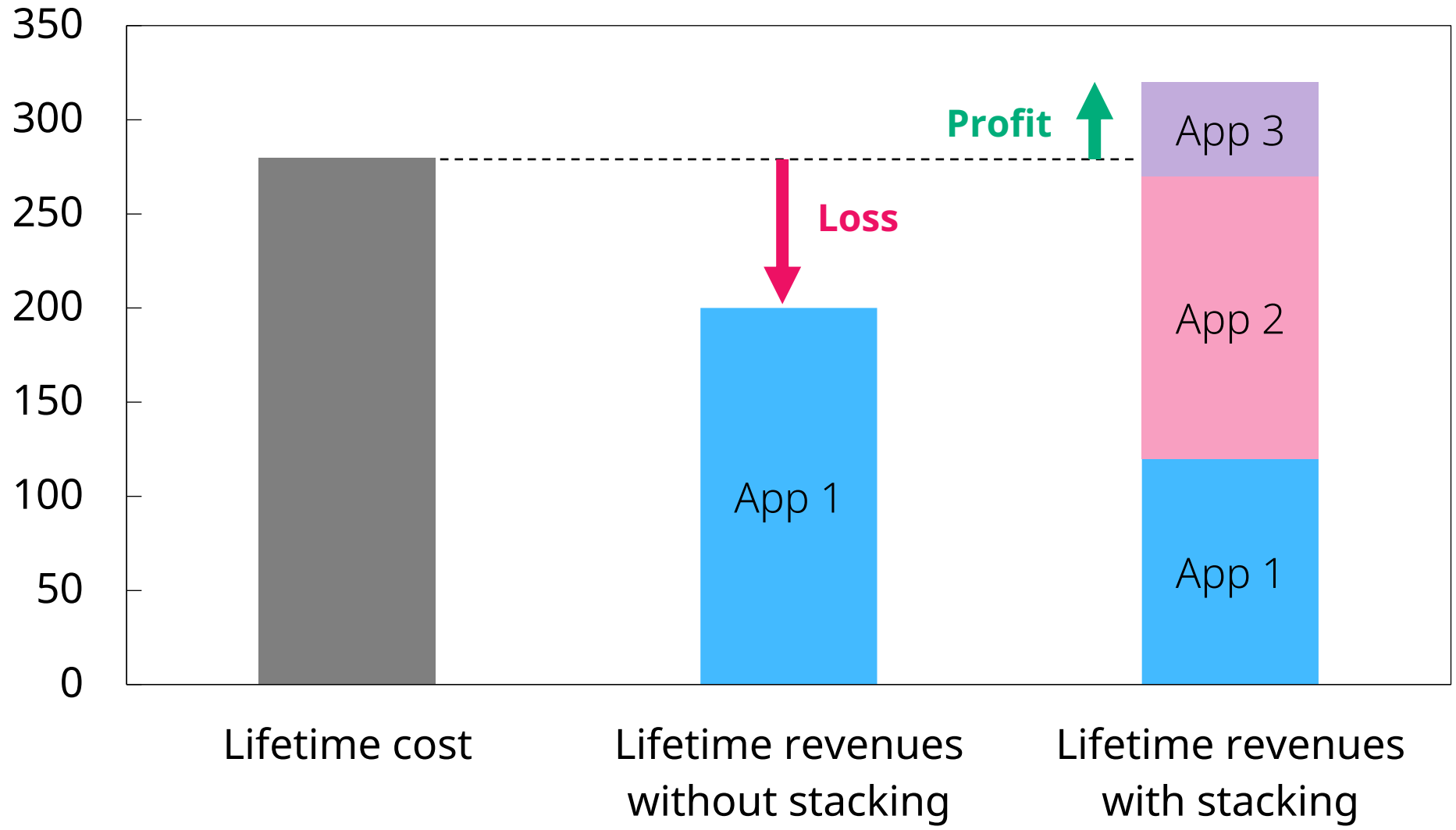
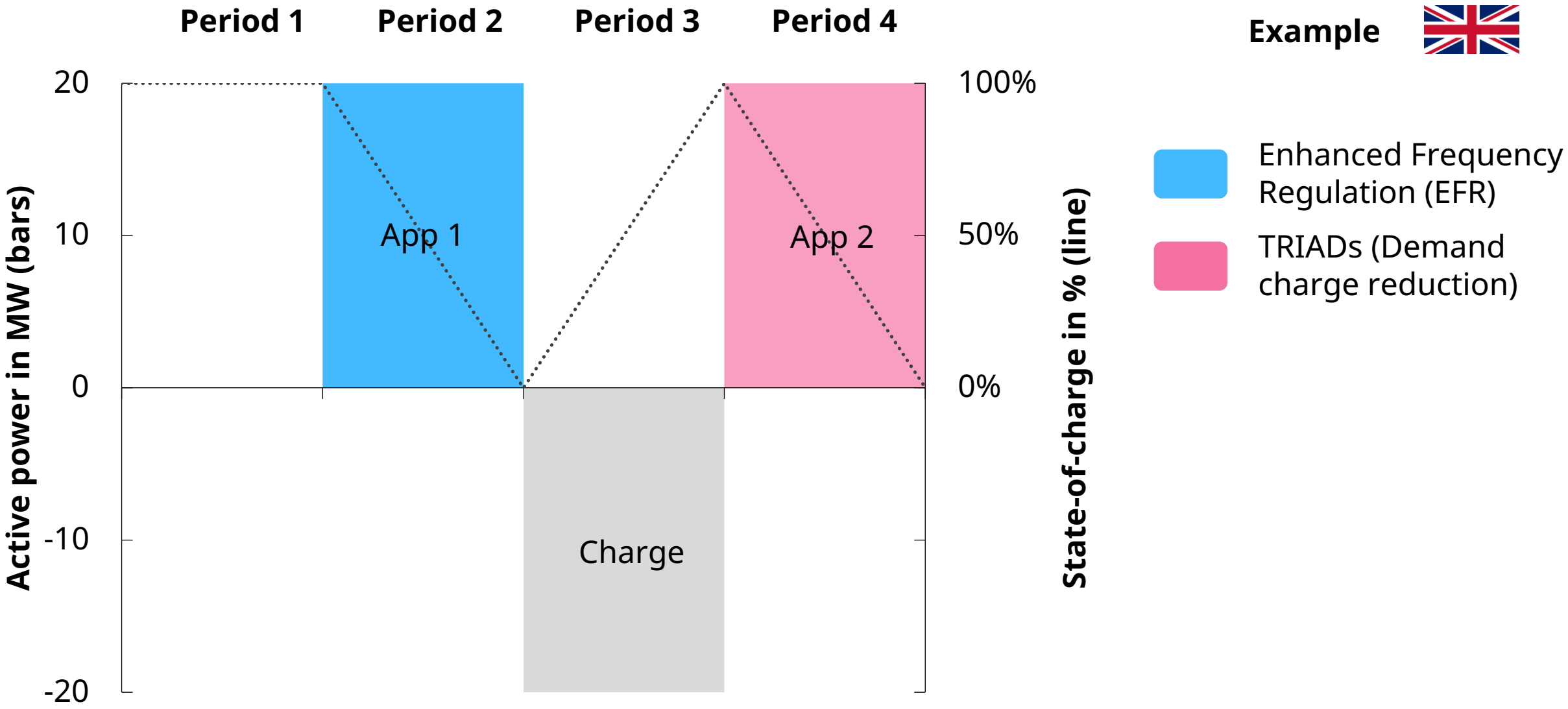



*Chart from www.EnergyStorage.ninja*

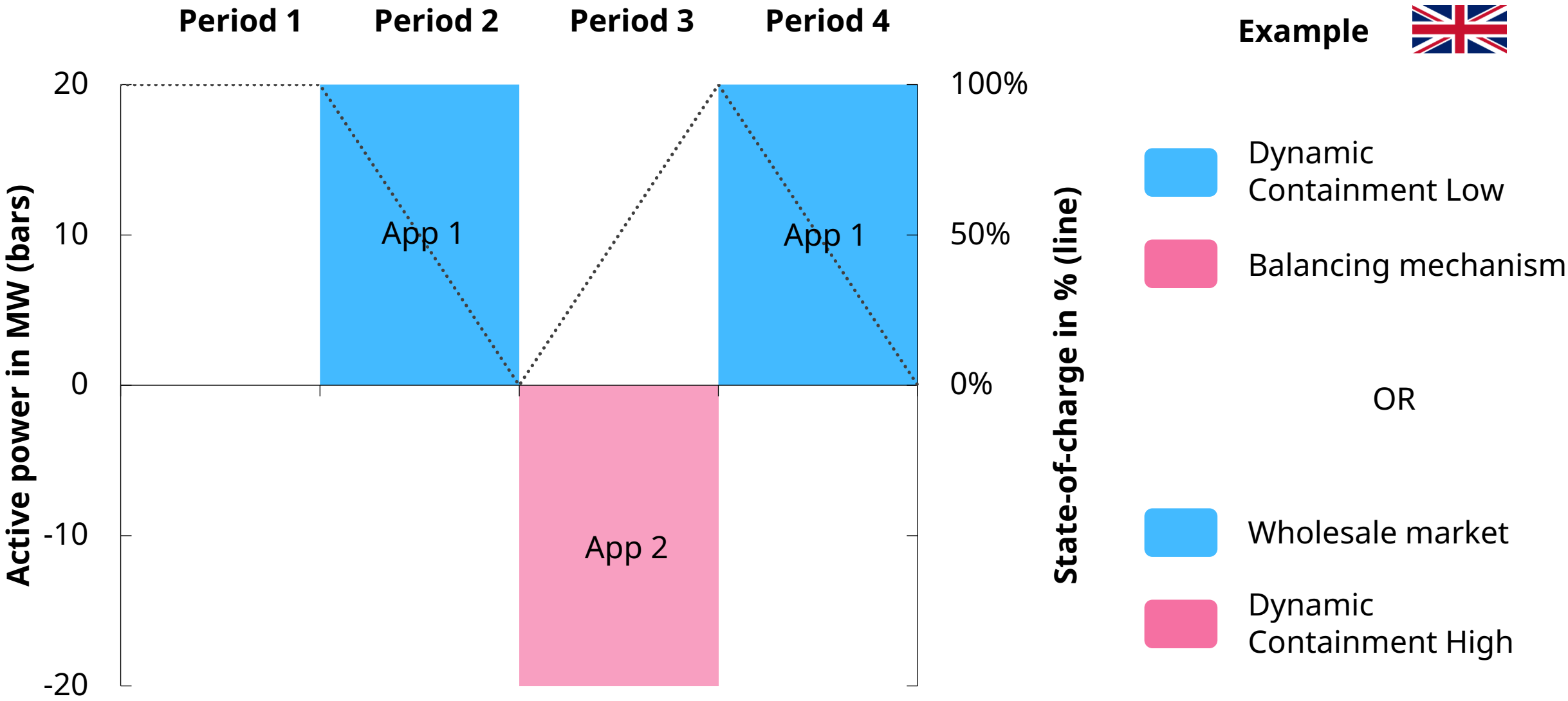
# Therefore, multiple revenue streams must be combined



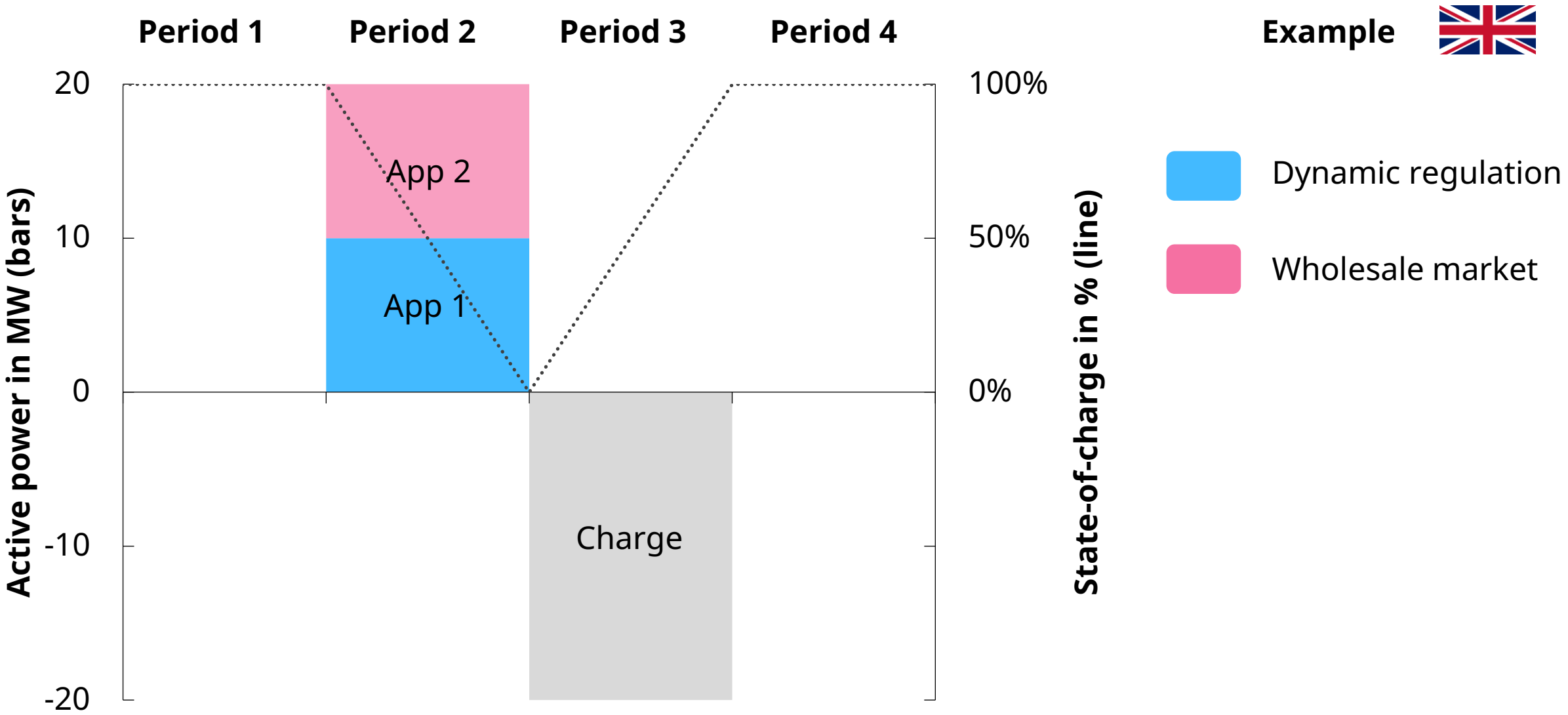
# Option 1: Sequential stacking



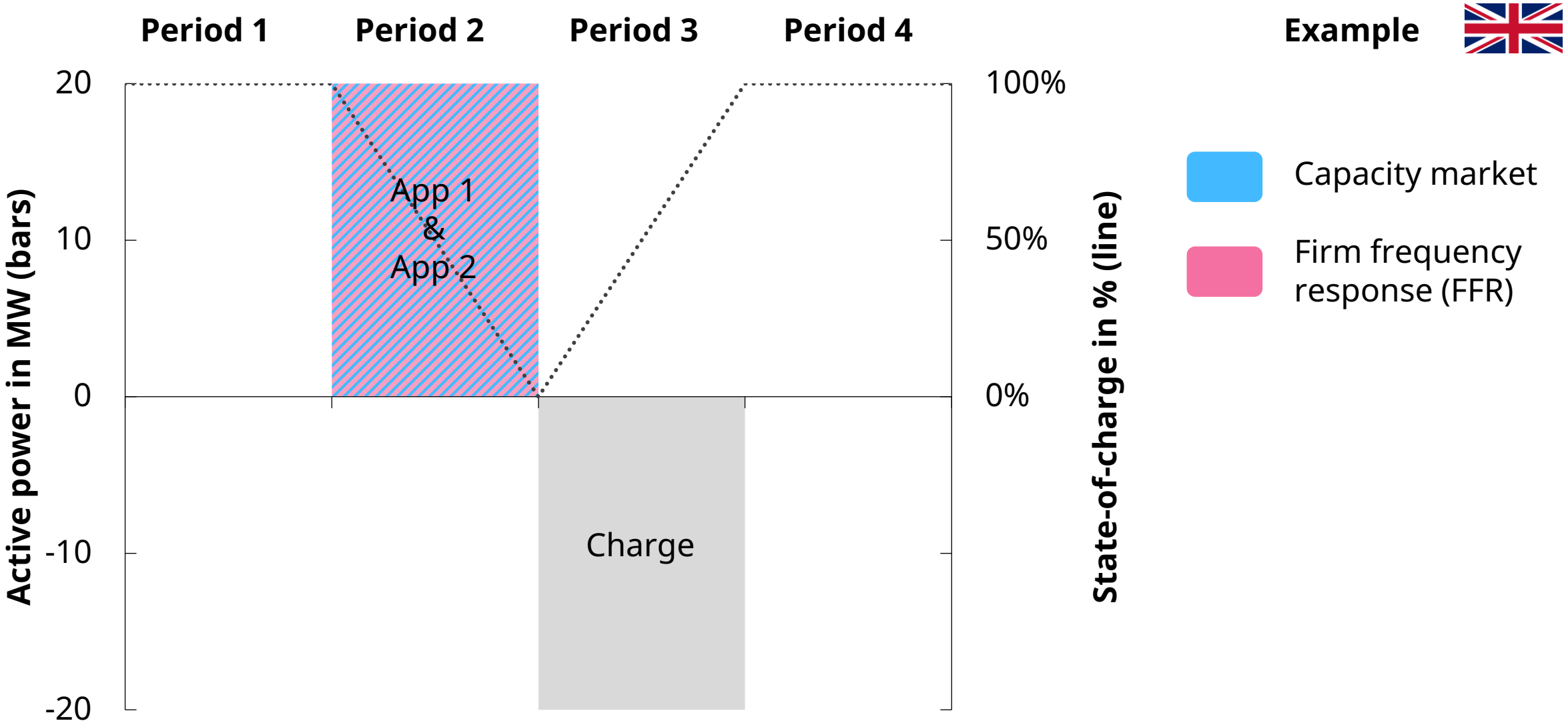
# Option 2: Sequential stacking in opposite directions



# Option 3: Parallel stacking



# Option 4: Overlapped stacking



# The insights and tools shown here are freely available for your analyses

*"Essential for me as an investor to navigate this complex, fast-paced energy storage industry."*

Gerard Reid, Alexa Capital

*"The go-to resource… exemplary in terms of academic rigour set in a real world context."*

Jim Skea, Chair of the IPCC

*User-friendly tools for custom analyses:* [www.EnergyStorage.ninja](http://www.EnergyStorage.ninja)