



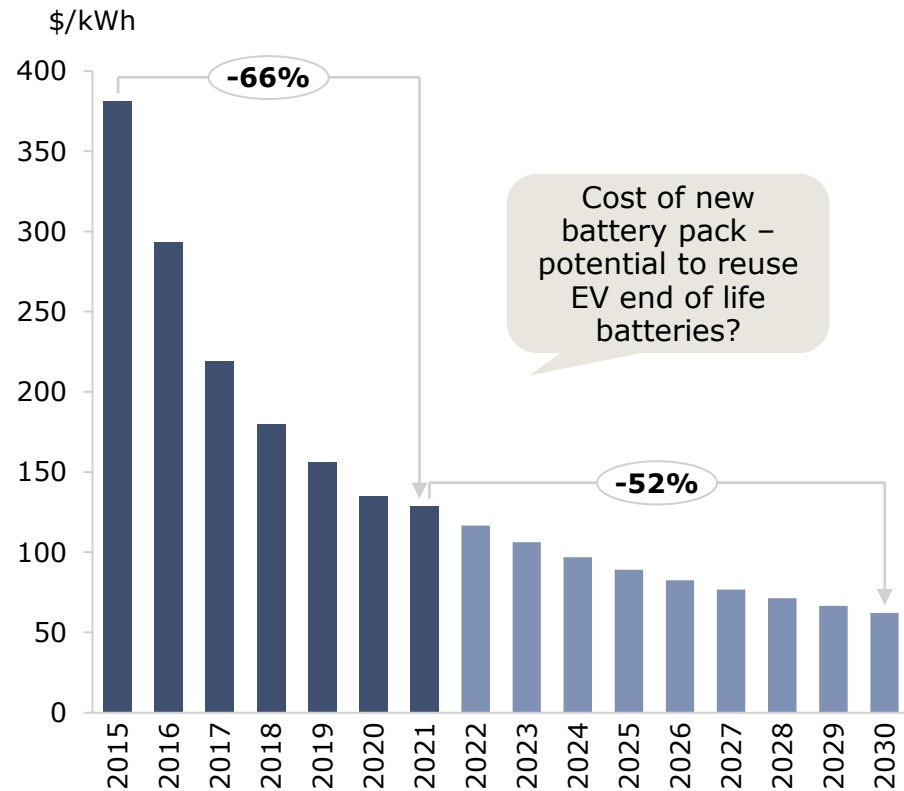
# Sähkön varastoinnin tarve ja kannattavuus tulevaisuuden sähkömarkkinoilla

Nikita Semkin

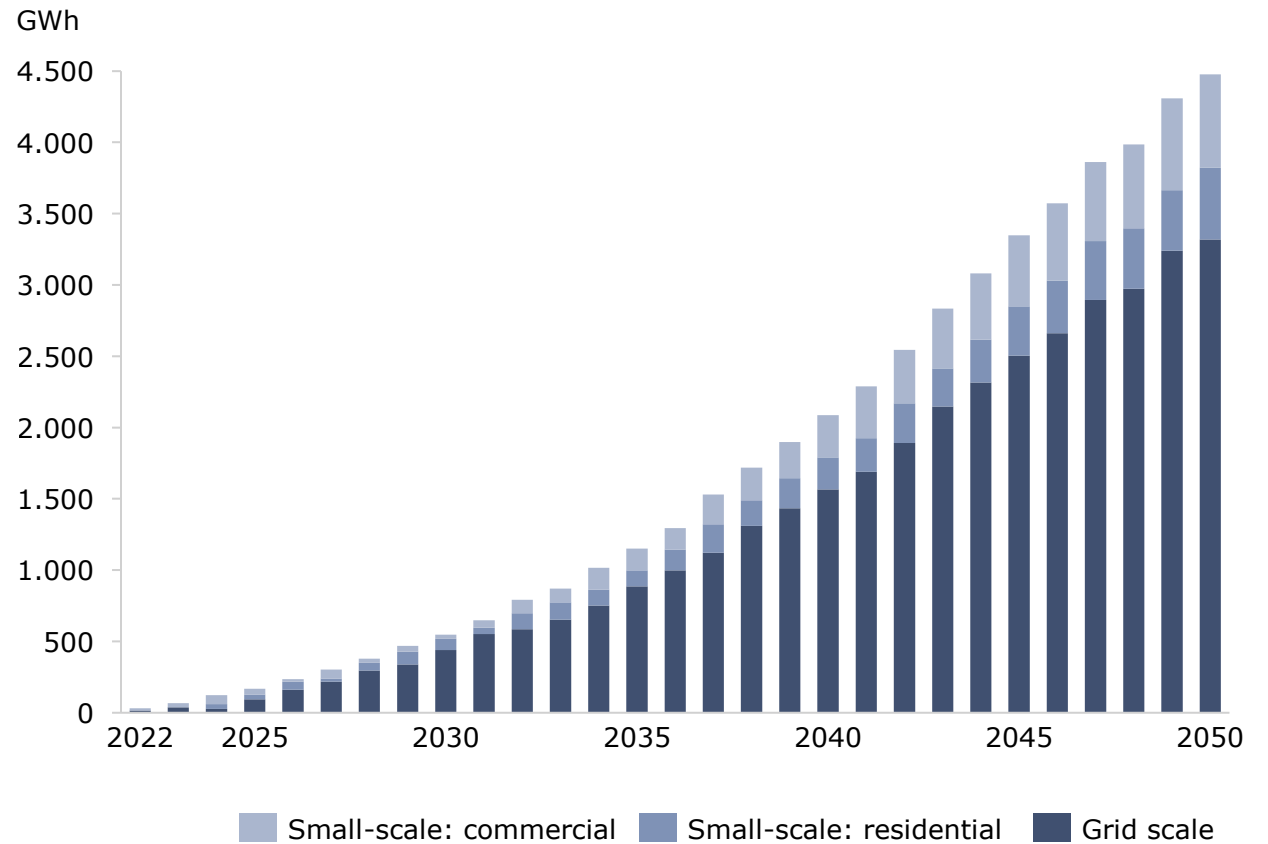
ELOKUU 2023

The global battery market will see significant growth over the upcoming three decades, installed capacity is projected to 40-fold from today's levels

**TECHNOLOGY COST REDUCTION EXPECTED TO CONTINUE**



**GLOBAL CUMULATIVE BATTERY STORAGE ENERGY CAPACITY**



Source: BloombergNEF, IEA 2022

# Battery energy storage system (BESS) can stack revenues and optimize value through different services – AS markets primary driver in Finland

## BESS REVENUE STREAMS

### MARKET WIDE SERVICES

#### Ancillary service markets

- BESS can capture value in all ancillary service markets
- Great freedom of geographical placement

#### Arbitrage

- BESS able to participate in Day Ahead markets
- BESS able to co-optimize in hybrid parks with e.g. wind/solar

### LOCAL SERVICES

#### Grid investment deferral

- Bilateral contracts with DSO/TSOs
- No market currently
- Placement based on local needs

#### Voltage service

#### Black start and other services

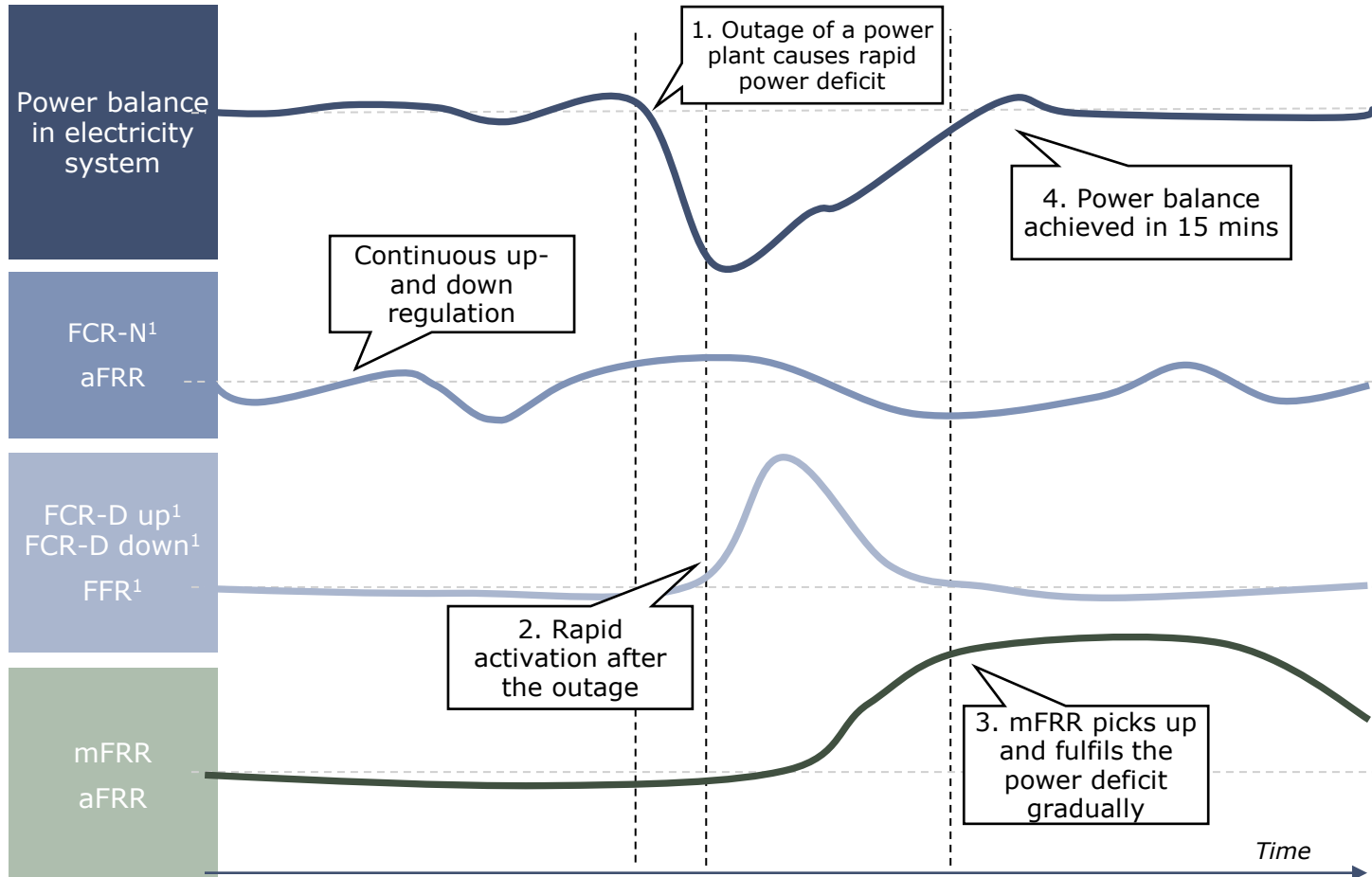
- No market currently
- Placement based on local needs

← BESS + EV charging stations →

- Ancillary service markets provide a revenue stream for BESS operators, and most actors build their business case this opportunity.
- Spot market arbitrage provide an opportunity to secure additional revenues in limited time frames

- Revenue streams related to local services are less developed compared to both ancillary service market and arbitrage
- New markets may develop in the future where it will become increasingly important with BESS placement to tap into value pools

# There are many reserves in the Nordics designed to maintain security of supply in the power system

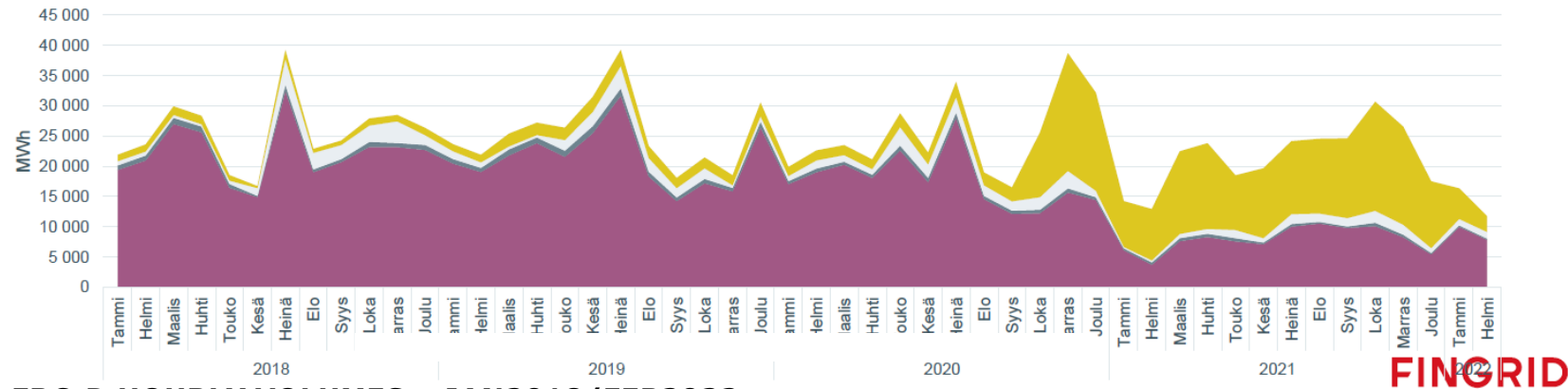


- Critical markets and services for maintaining grid stability
- Lots of small markets with different:
  - Market rules & bidding sizes
  - Price setting
  - Time horizons
  - Technical requirements
  - ...

Note: 1) Markets more feasible for battery participation, due to bid size and activation requirements

# Batteries have gained share both in FCR-N and FCR-D hourly markets – The competing technologies have been hydro power and demand response

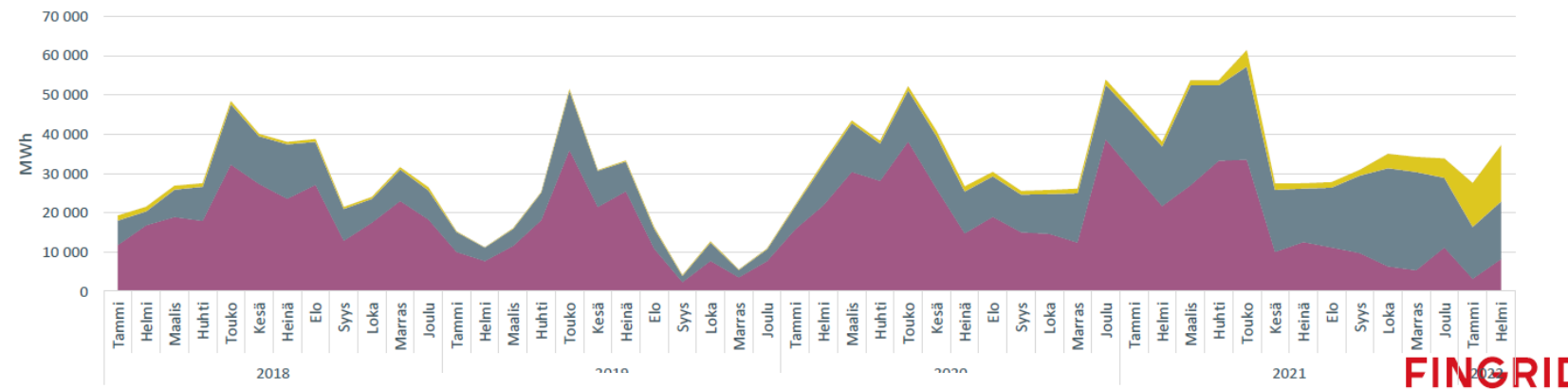
**FCR-N HOURLY VOLUMES – JAN2018/FEB2022**



- Market share of the energy storages in the FCR-N hourly markets has increased substantially since 2020

**FINGRID**

**FRC-D HOURLY VOLUMES – JAN2018/FEB2022**



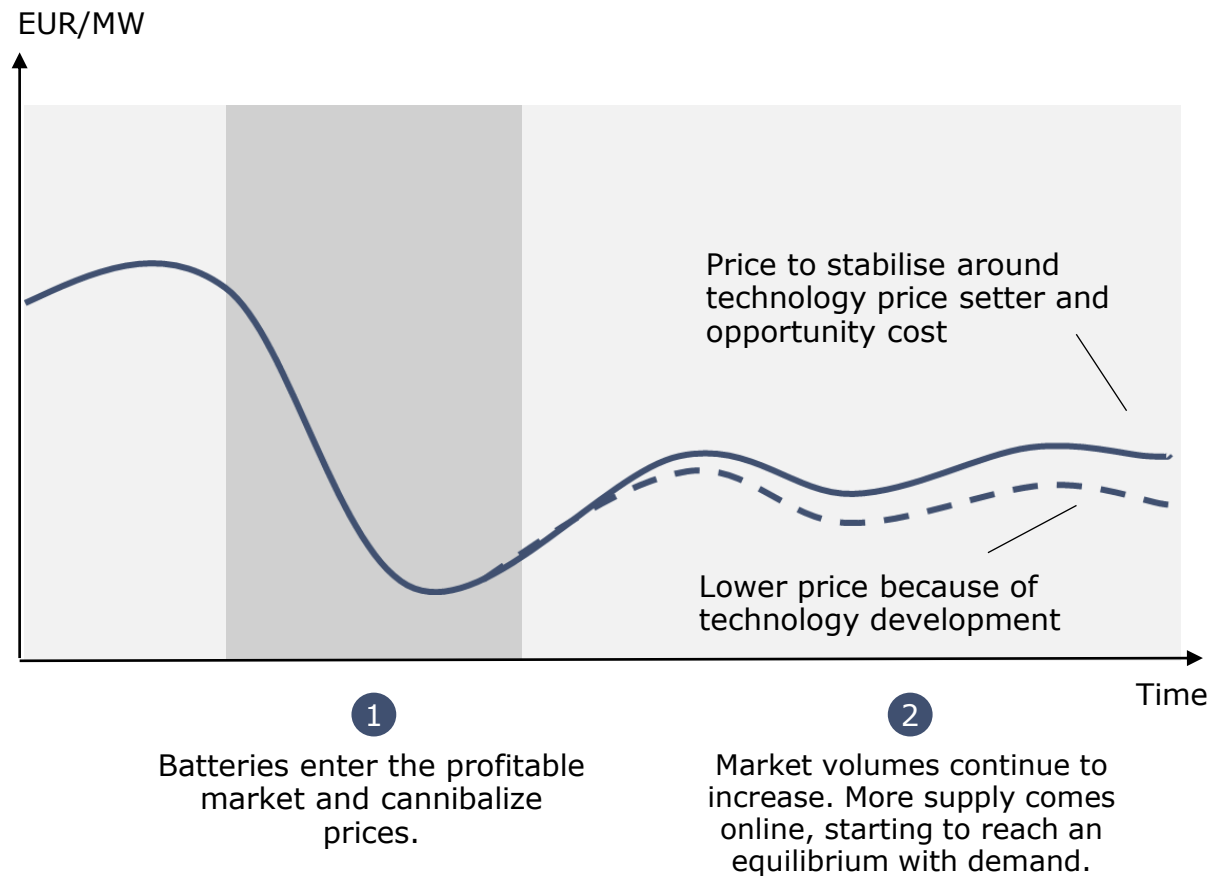
- Market share of the energy storages in the FCR-D hourly markets has been marginal until Q3 of 2021
- Since then the market share of energy storages has increased to compete with Demand response and Hydro power

**FINGRID**

Source: Fingrid

Hydro Thermal  
Demand Energy storage

Due to low barriers to entry and relatively easy deployment, batteries will likely enter market until not profitable anymore




### BATTERY MARKET ENTRY

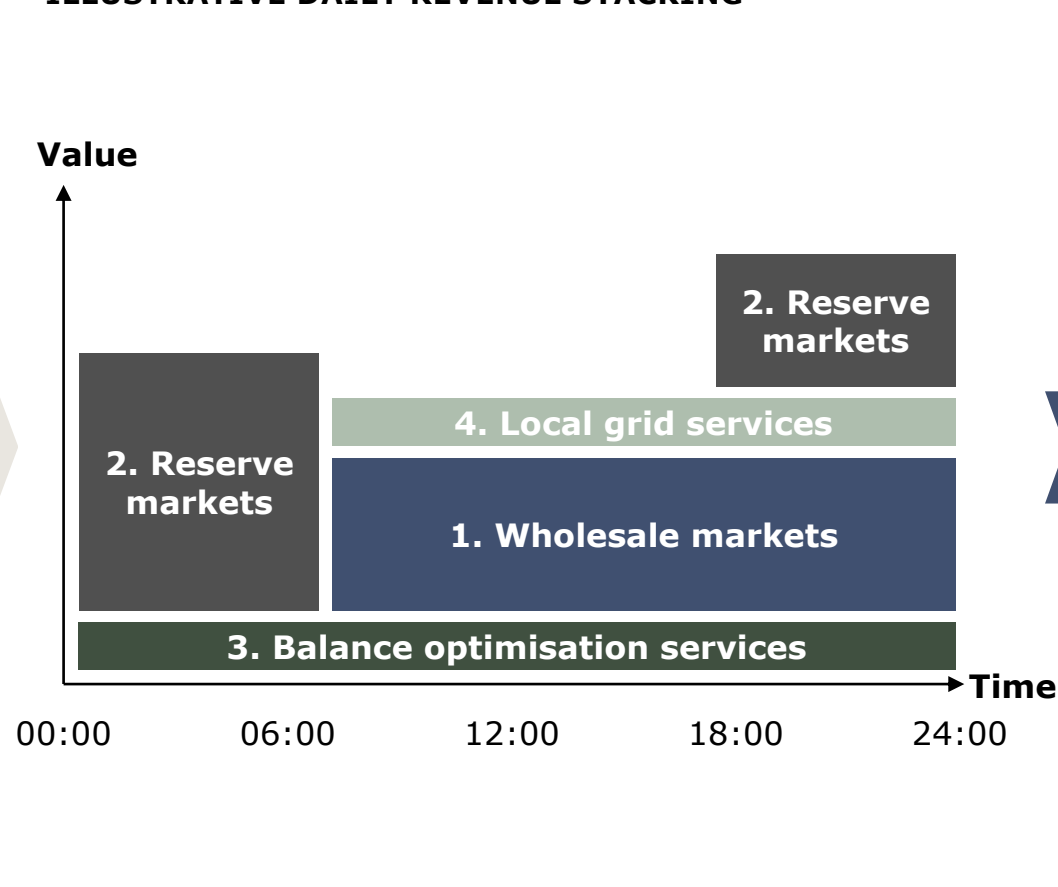
- Compared to other reserve providers, batteries are a very easily deployable technology due to:
  - Low requirements for space, location,
  - Short construction time,
  - Unit size (and investment size) can be relatively low
- Regulatory and other barriers to entry have efficiently been removed
- Batteries will enter the attractive reserve markets and cannibalize revenues
- Hydropower will still be an important technology in the reserve markets, creating variance between and within years

# Batteries can access multiple revenue sources – in more competitive markets, it's a necessity with revenue stacking across multiple sources

## REVENUE SOURCES (EXAMPLES)

- 1. Wholesale markets 
- 2. Reserve markets 
- 3. Balance optimisation 
- 4. Other local grid services 

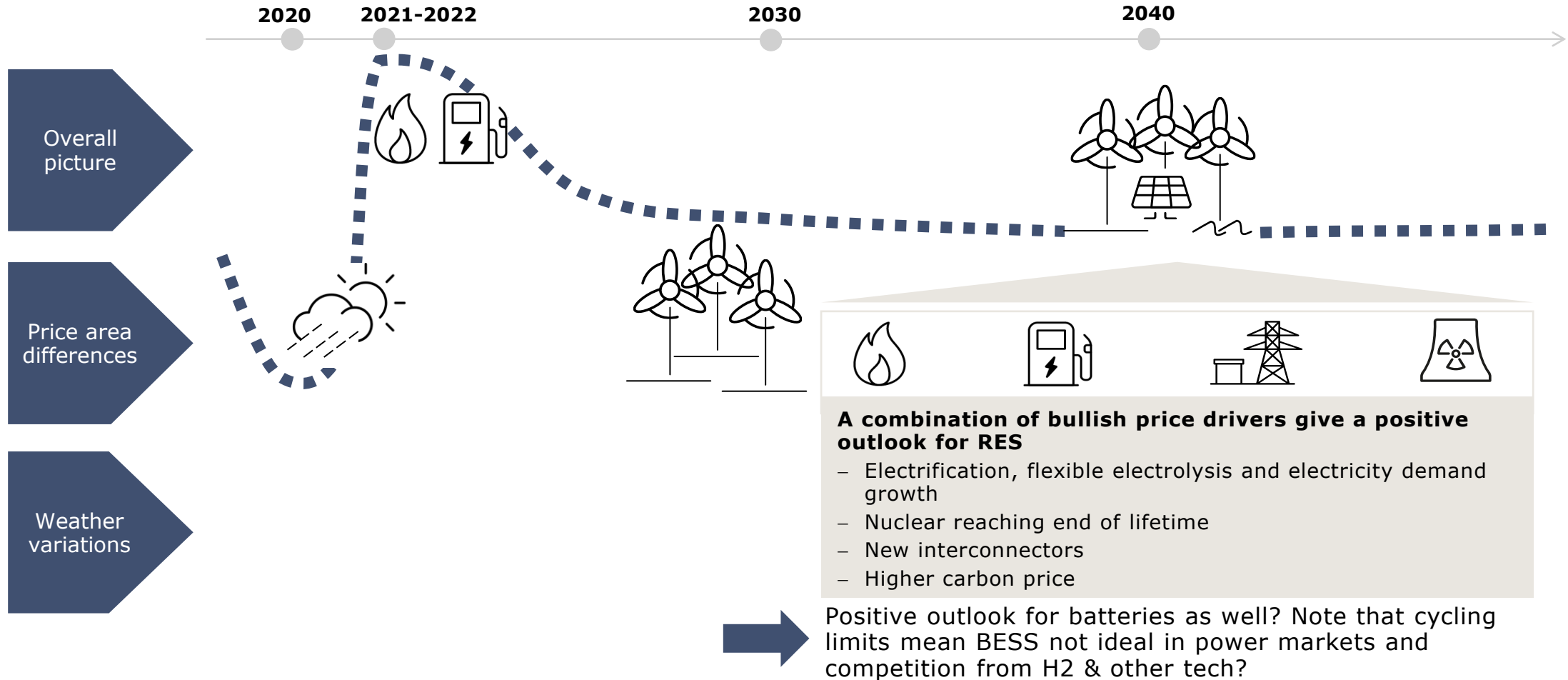
## ILLUSTRATIVE DAILY REVENUE STACKING



## KEY TAKEAWAY

**Battery business model is complex and requires an agile approach to maximise revenues across multiple sources**

# Nordic power prices expected to drop from all-time highs and RES penetration increase – increasingly important revenue source for BESS





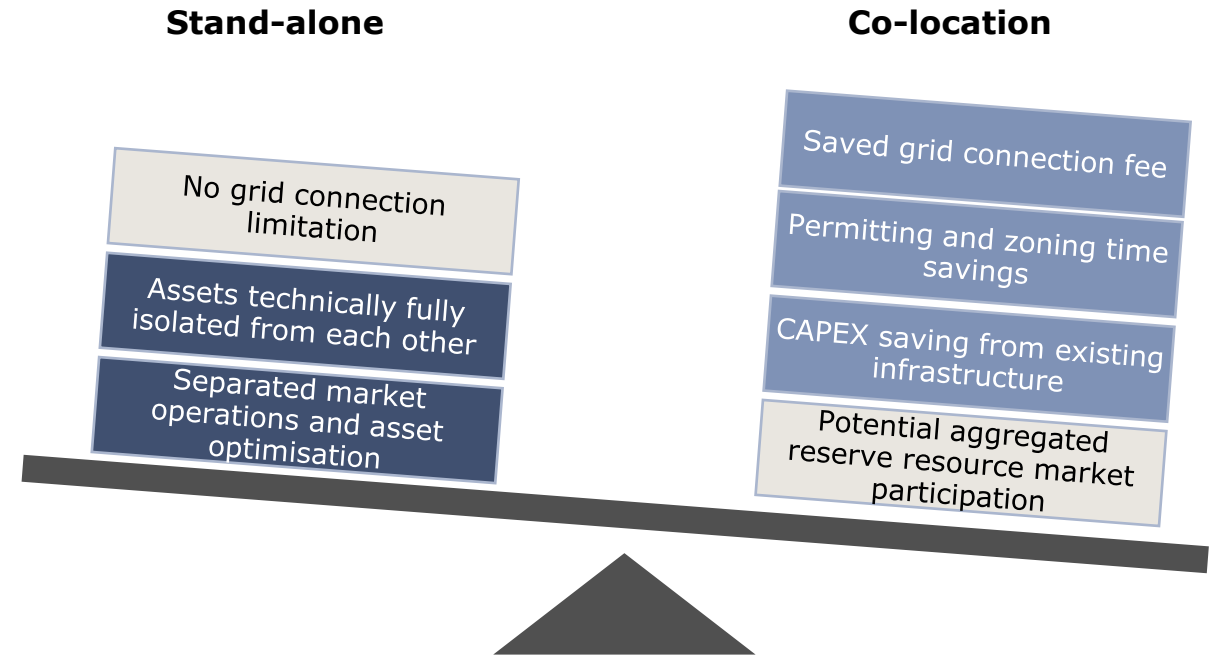
# How about BESS + RES hybrid parks?

## EXAMPLES ALREADY UNDER CONSTRUCTION



Built in Alajärvi, South Ostrobothnia, Western Finland, Ilmatar's hybrid farm and its first completed wind turbines commenced production in early June. Currently, eight turbines are already producing renewable energy with a total rated capacity of 48 MW. By the end of 2023, the production of renewable energy will reach full capacity of 220 MW with 36 wind turbines. In the next few years, the hybrid farm is due for an extension with a 150

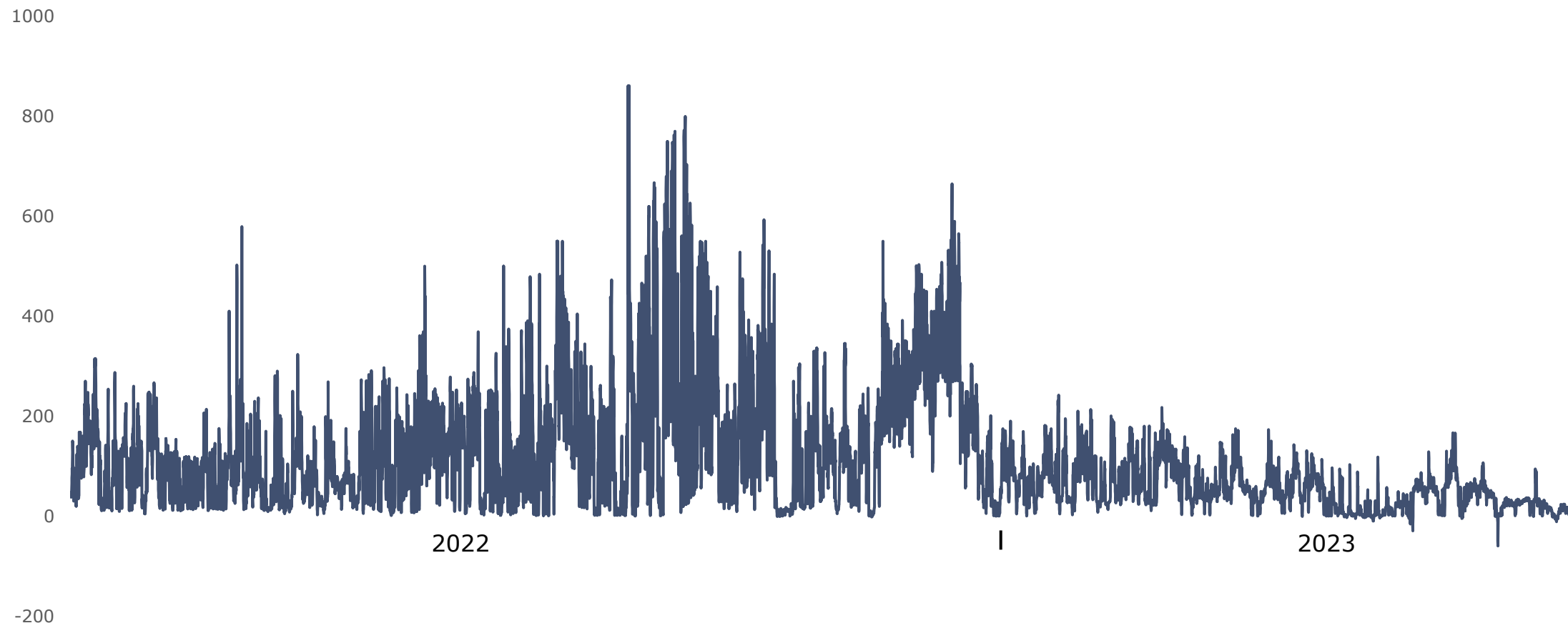
## BENEFITS ARE THERE BUT NOT SIGNIFICANT



– Note that benefit against the spot market actually minimal – no real opportunity cost between stand-alone v co-located

BESS benefits greatly from volatility and volatility is fundamentally not possible to fully predict

**SPOT PRICE IN FINLAND (EUR/MWH)**



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