Aristotle University of Thessaloniki

Renewable and Storage Forum

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FAQ ON BATTERY ENERGY STORAGE SYSTEMS PARTICIPATION IN THE GREEK WHOLESALE ELECTRICITY MARKET

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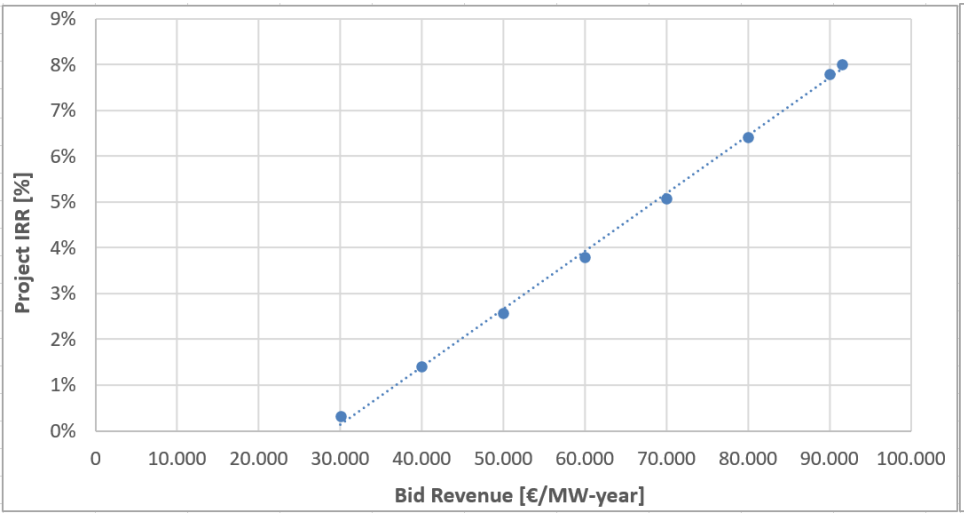
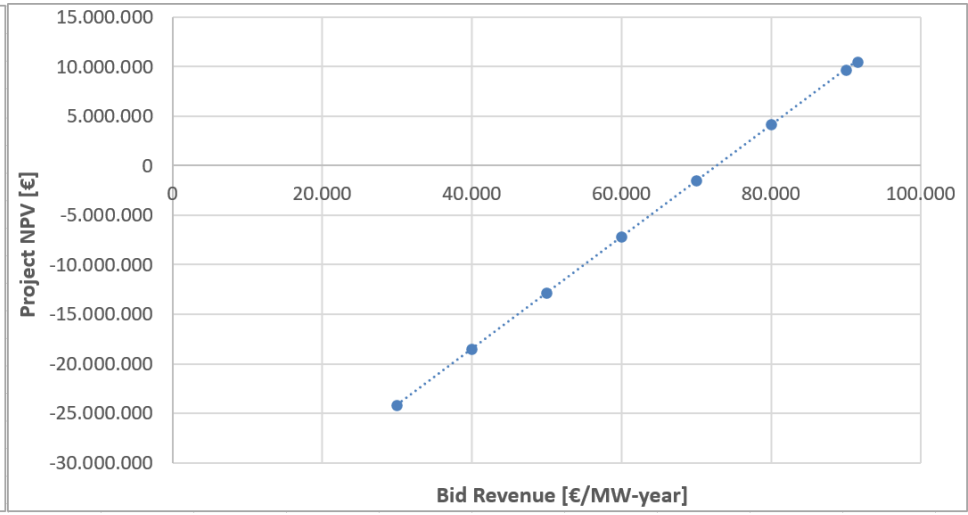
Questions and Answers

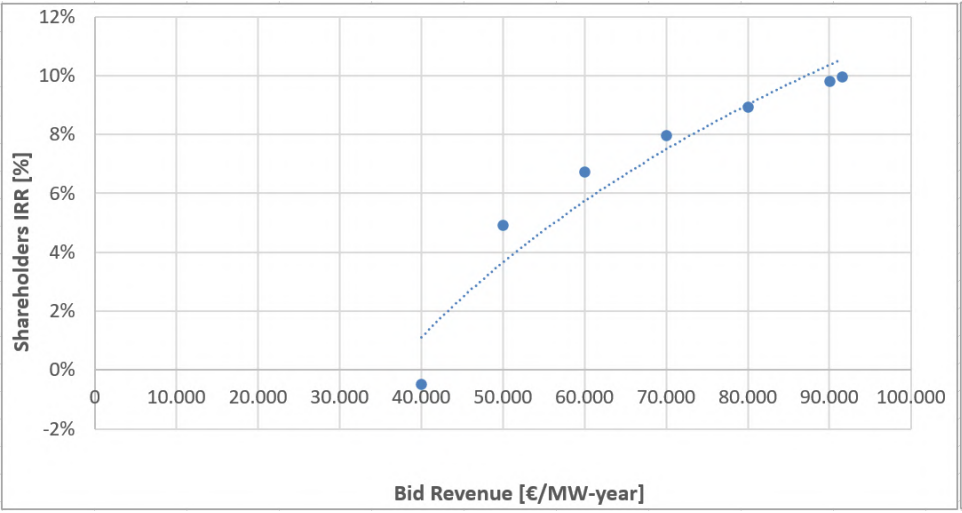
- ✓ Question 1: What are the expected revenues from the participation of a BESS in the wholesale electricity market ?

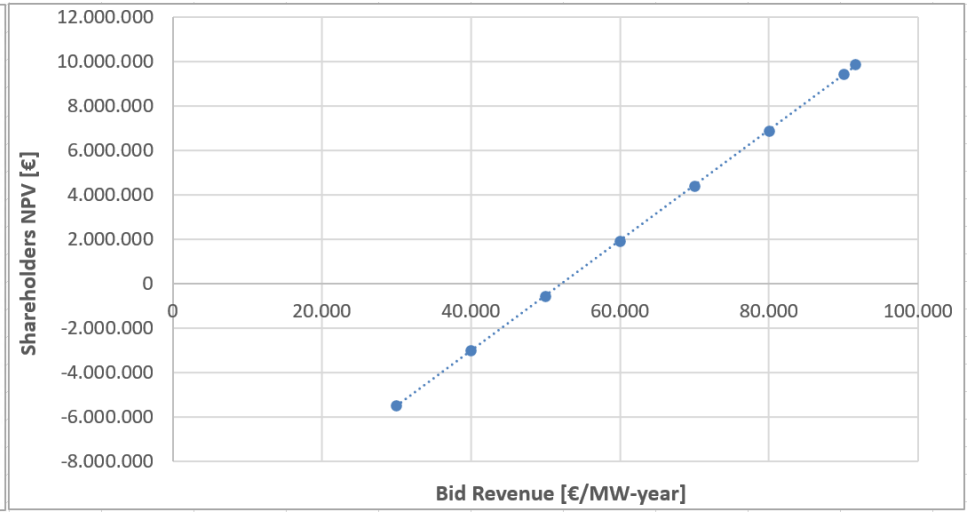
- ✓ Answer: analytical simulations are necessary
  - ✓ 1st step: daily simulation of the wholesale electricity market (DAM, ISP, RTBEM) to derive the market results
    - ✓ DAM clearing prices
    - ✓ Reserve prices per reserve type and direction
    - ✓ upward and downward Balancing Energy prices
  - ✓ 2nd step: considering the BESS station as a price-taker, we execute an Optimal BESS Operation Model, with an objective function to maximize the revenues of the BESS from its participation in the wholesale electricity market (DAM, Balancing Market), providing all possible products
    - ✓ optimal operation of the BESS in all markets
    - ✓ provided reserves
    - ✓ provided Balancing Energy
    - ✓ revenues from all sources, as well as operational costs

BESS financial results (with CAPEX in June 2023)





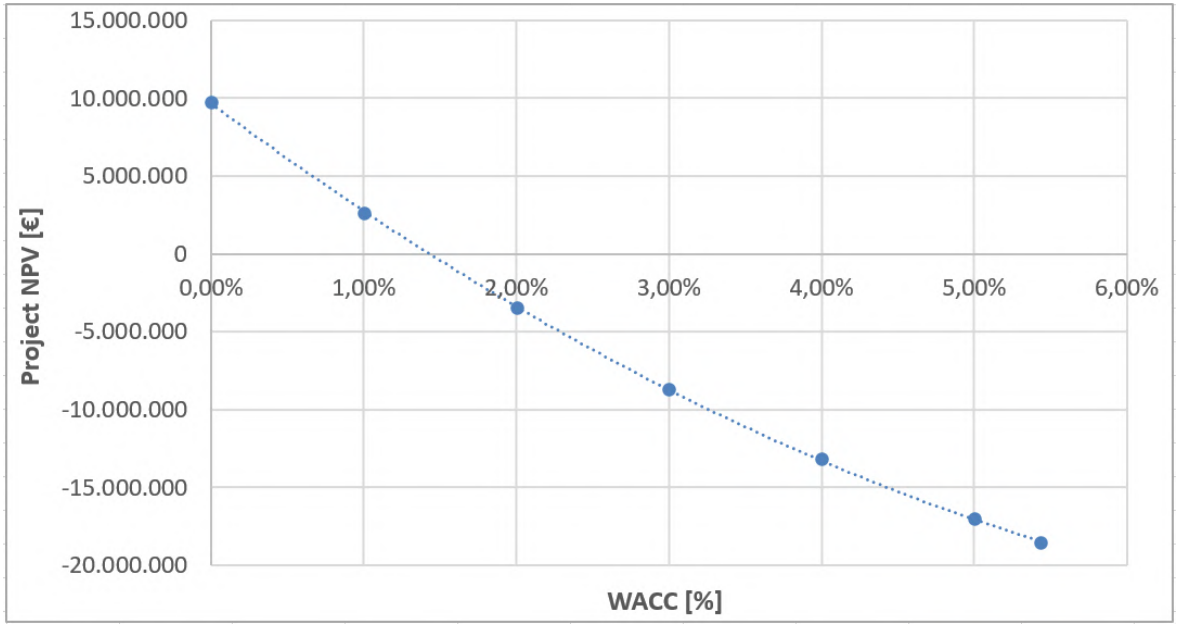




✓ WACC=5,432%, CAPEX=285.000 €/MWh, loan=80%, equity=20%, loan duration = 10 years, interconnection cost = 80 k€/MW

What-if analysis

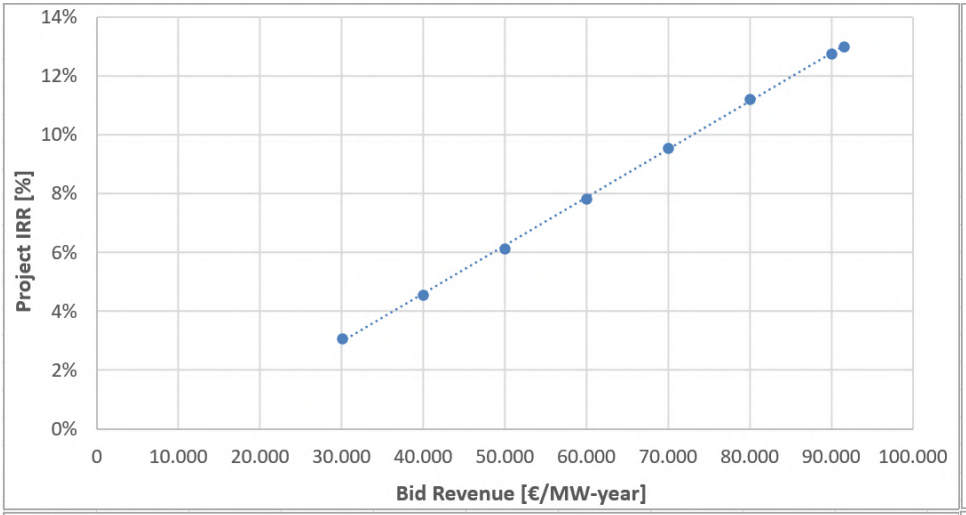
- ✓ WACC = variable, CAPEX=285.000 €/MWh, Bid Revenue = 40.000 €/MW-year

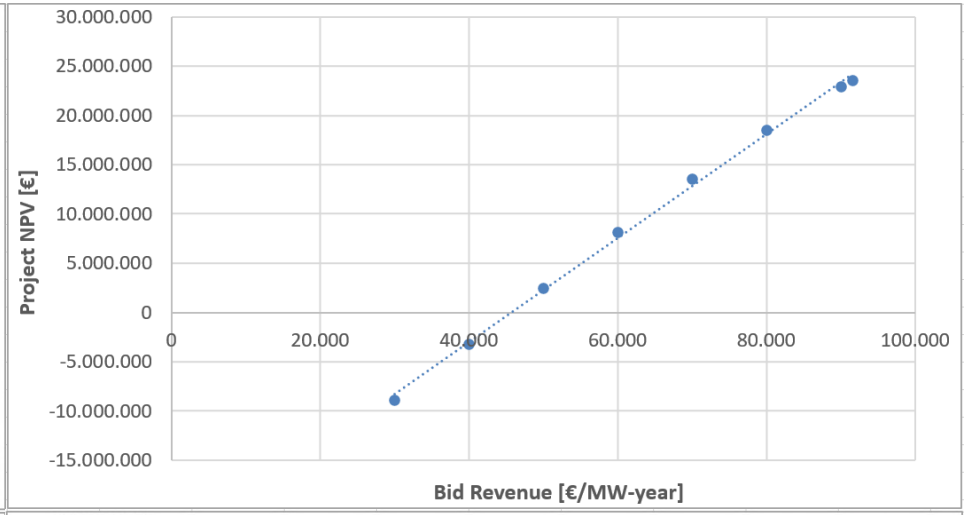


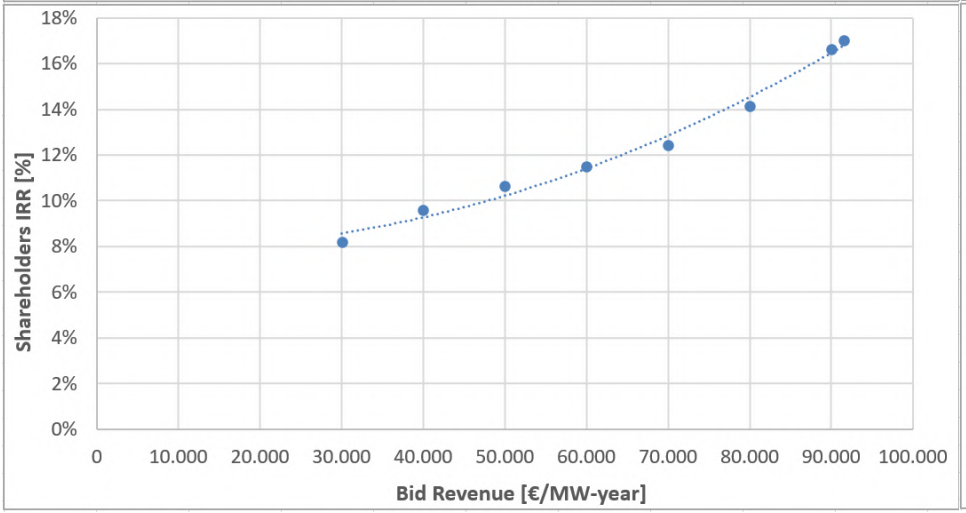
BESS CAPEX decreased

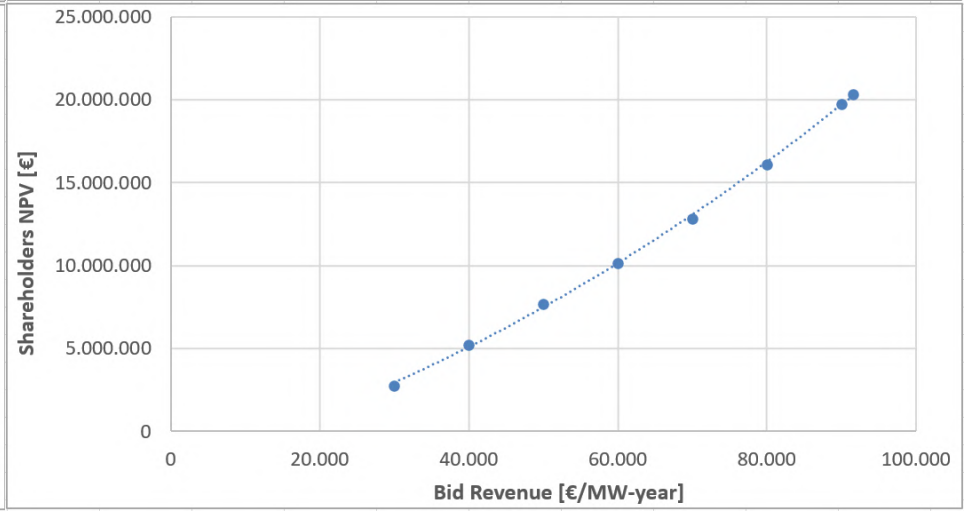
- ✓ Lithium carbonate prices decreased significantly during the last 4 months

BESS financial results (with current BESS CAPEX)



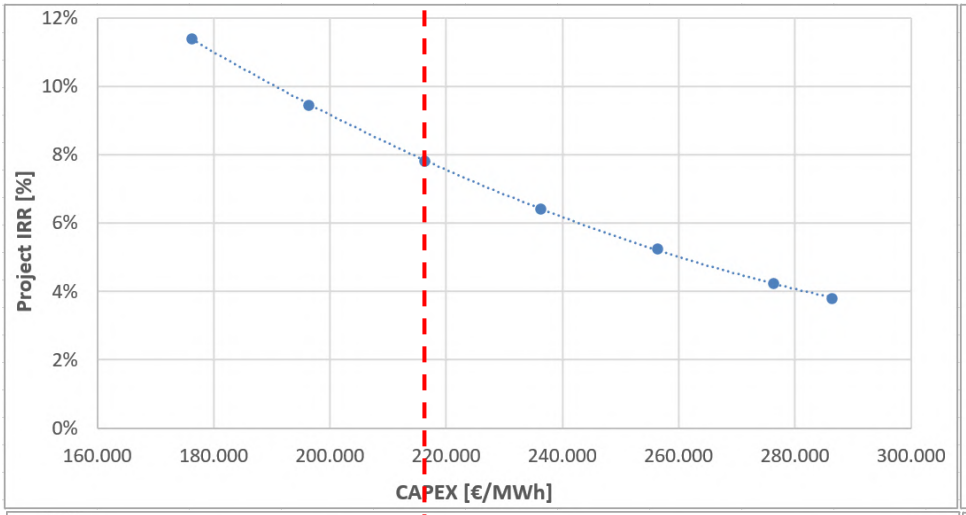


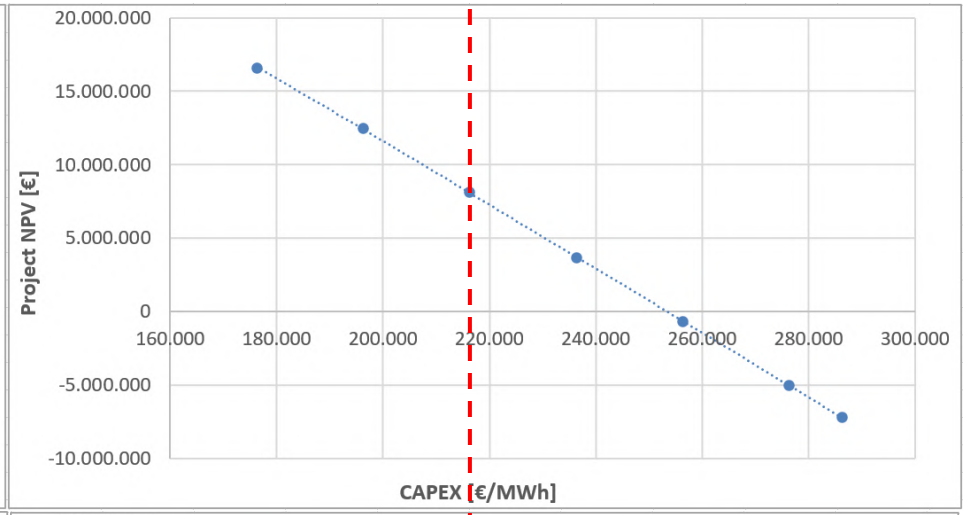


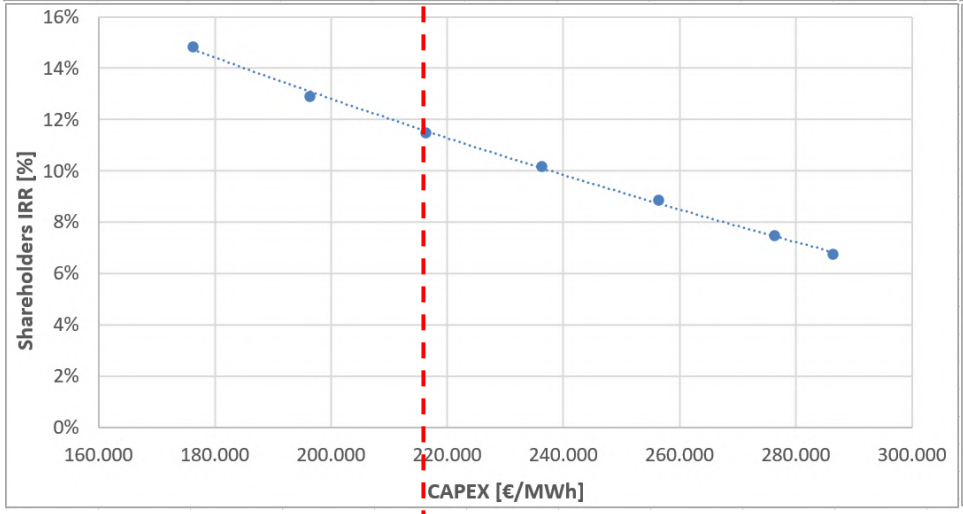


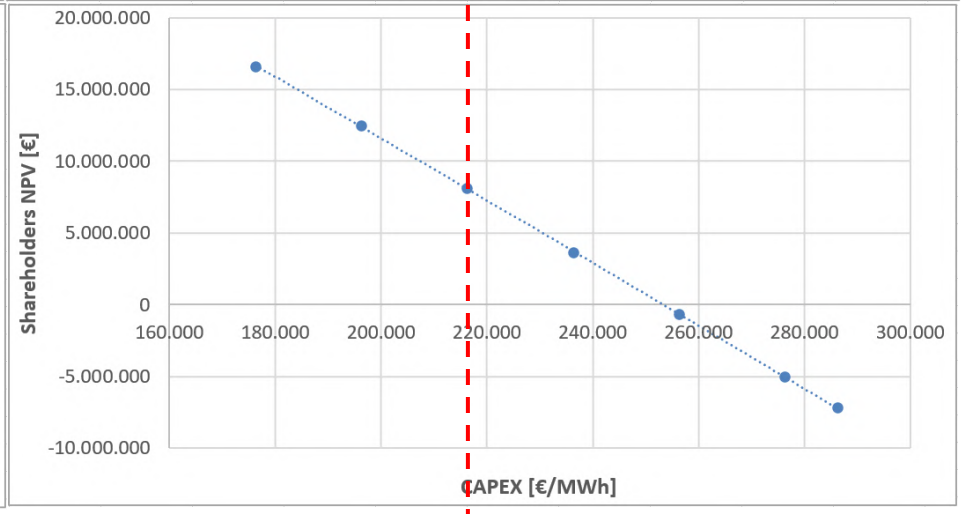
✓ WACC=5,432%, CAPEX=215.000 €/MWh, loan=80%, equity=20%, loan duration = 10 years, interconnection cost = 80 k€/MW

Conventional capacity









✓ WACC=5,432%, Bid Revenue = 60.000 €/MW-year

Questions and answers

- ✓ Question 2: Is it fruitful to participate in the 2nd RRF auction ?

- ✓ Answer: The price will probably be very low (as in the 1st auction). No need to participate, in case connection terms to stand-alone BESS are provided by ADMIE in the following 6 months.

Questions and answers

- ✓ Question 3: If I do not participate in the RRF auction, how can I finance my project? Are there alternatives?

- ✓ Answer: Yes, there are alternatives! BESS Aggregators can provide a fixed revenue (in €/MW-year) to the BESS owners, in order to operate their BESS. The level of the fixed revenue is expected to be significantly higher than the bids submitted in the RRF auction.

Experience from other markets (UK)

- ✓ Auctions for “Enhanced Frequency Response” (EFR) performed in 2016, getting additional remuneration of 9,44 £/MW of EFR

- ✓ In the last years, BESS can participate in Capacity Market auctions, and get additional remuneration for the offered capacity availability
- ✓ Last auction: £63.000/MW-year (additional remuneration)

- ✓ BESS operating merchant in the wholesale electricity market
- ✓ The UK Government does not provide direct subsidies for the deployment of storage systems (either large facilities or behind-the-meter devices
- ✓ Current storage capacity (in 2023) = 2,9 GW
- ✓ Target storage capacity for 2030 = 24 GW

Experience from other markets (Italy)

- ✓ Auctions for “Fast Reserve” (FR) performed in 2016
  - ✓ getting additional remuneration of 29.500 €/MW-year
  - ✓ Requirement: to provide 1.000 hours of service per year
- ✓ In the last years, BESS can participate in Capacity Market auctions, and get additional remuneration for the offered capacity availability
  - ✓ contracts duration: up to 15 years
- ✓ BESS operating as merchant assets in the wholesale electricity market

Experience from other markets (Finland)

- ✓ A small number of BESS have been funded by the “Recovery and Resilience Plan”

- ✓ All other BESS operating as merchant assets in the wholesale electricity market

Questions and Answers

- ✓ Question 4: What is the level of the available “electrical space” for BESS to connect to the system (in MW) ?

- ✓ Answer: It is very high, there could be restrictions only in areas with very weak transmission system lines (150 kV with small load and many RES stations, or inversely).

Questions and Answers

- ✓ Question 5: Shall the TSO provide connection terms to merchant BESS (without participating in the RRF auctions) ?

- ✓ Answer: Based on international experience, there is no organized market (in the civilized world) where there is interest to operate as a merchant asset (with no subsidies), and the government to prevent you from doing so !!!

Questions and Answers

- ✓ Question 6: Is the capacity of 3.100 MW of BESS enough for the system in year 2030?

- ✓ Answer: Considering the portfolio of Greece at the end of year 2026 (al least 25 – 26 GW RES installed and operating), a higher capacity of BESS must be installed quickly and effectively in the following years, otherwise RES producers will suffer severe curtailments and revenue losses from year 2026 and on.

Conclusions

- ✓ Leave the electricity market to operate without subsidies !!!
- ✓ The BESS stations, operating as merchant assets, can have significant profits from their participation in the wholesale electricity market. No subsidies are necessary.
- ✓ Connection terms must be provided by ADMIE to BESS assets (the sooner, the better for existing RES assets).

Thank you for your attention !!!

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