

# ENCOURAGING PRIVATE INVESTMENTS INTO FLEXIBILITY

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- Ukraine needs substantial amounts of new decentralized, flexible electricity generation and energy storage capacities
- Achieving such an ambitious program requires active participation from private investors
- The current market and regulatory environment does not adequately support the bankability of these projects



## Structure

- 1) THE NEED FOR FLEXIBILITY
- 2) REVENUES FOR PROVIDING FLEXIBILITY
- 3) RISKS AND CHALLENGES FOR INVESTORS
- 4) MITIGATION INSTRUMENTS
- 5) CONCLUSION



## 1-THE NEED FOR FLEXIBILITY

- **Lack of efficient, flexible capacities was evident already before the invasion**
  - Peak electricity demand was mainly covered by coal, natural gas-fired and hydropower plants
  - In 2021, the Ukrainian TSO stated the following flexible capacity needs:
    - construction of at least 1 GW of new flexible capacities with quick ramp-up
    - 0.5 GW of frequency regulation systems (like battery energy storage)
    - reconstruction of TPP units or new construction of 1.2-1.5 GW of semi-peak capacities
- **War-related loss of flexibility just in 2024 (based on expert estimates):**
  - 1.5+ GW of flexible hydro capacities were damaged
  - 6+ GW of old, but flexible thermal capacities (large coal and gas-fired TPPs) were damaged
  - 0.5+ GW of CHP capacities were damaged
  - Around 2 GW of damaged TPP capacity may potentially be restored within 1-2 years
- **Increasing share of baseload/non-dispatchable generation**
  - Ukraine relies heavily on baseload nuclear generation as a main source of electricity production
  - Share of renewable energy sources is supposed to grow from 10% before the invasion to 25% by 2030
  - Flexibility is needed to enable the integration of more renewables

# OPTIONS FOR FLEXIBILITY

- Different technologies can provide flexibility in the power system: flexible generation (hydro, gas or biomass-fired), energy storage, and demand-side response
- A Ukrenergo and a Ministry of Energy/Danish study highlighted the benefits of flexible generation and BESS
- The market currently does not deliver new flexible generation and battery energy storage systems (BESS)

**Focus of our study:**  
How to encourage private investments into flexible generation and BESS

**WHAT NEEDS TO BE BUILT: GENERATION**

The Ukrainian power system requires private investments in new high-tech balancing facilities. This will allow to maintain the power system operational when renewables share in the electricity generation mix expands. Investments in such facilities depend upon the resolution of the issues of the balancing and ancillary services markets

Generation type	Nuclear power plant	new highly flexible plants	New biofuel thermal power plants	Energy Storage	Wind energy	Solar energy	Dniistrovska pumped-storage plant
Installed capacity today	13.8	0.0	0.3	0.0	0.5	6.2	2.0
To be constructed capacity (total 15 GW)	+2.4	+1.4	+1.1	+0.8	+4.5	+3.8	+1.0
Resulting capacity	16.2	1.4	1.4	0.8	5.0	10.0	3.0
What needs to be done	Construction completion of Units 5 and 6 at Khmelnytskyi nuclear power	Building new high-manoeuvring capacities with a control range of at least 50% of the installed capacity and the startup time not exceeding 15 minutes	Building new generating capacities on biogas, biomass, etc. attracting financing from international financial institutions.	Building energy storage systems that can deliver captured energy for 2-4 hours to balance the power system with a large number of solar and wind power plants	Building new solar and wind power plants to replace existing thermal power plants that will be decommissioned as part of the National Emission Reduction Plan		Building 5-7 hydropower units at Dniistrovska pumped-storage plant;
<b>34.5</b> investments (\$ billion)	<b>20.0</b>	<b>1.5</b>	<b>3.9</b>	<b>0.7</b>	<b>4.0</b>	<b>2.7</b>	<b>1.7</b>
Expected non-discounted payback period (years)	15	5	9	5	5	4	5-8



## 2-REVENUES FOR PROVIDING FLEXIBILITY

Flexible gas generation and BESS can be remunerated on the different market segments:

- day-ahead market (DAM)
- intraday market (IDM)
- balancing market
- ancillary services market.

In Ukraine currently, due to limited spreads at the DAM and the IDM, the ancillary services market and the balancing market are more attractive options.

Ukrenergo currently conducts auctions for the following ancillary services:

- FCR – frequency containment reserve
- FRR – frequency restoration reserve
- RR – replacement reserve

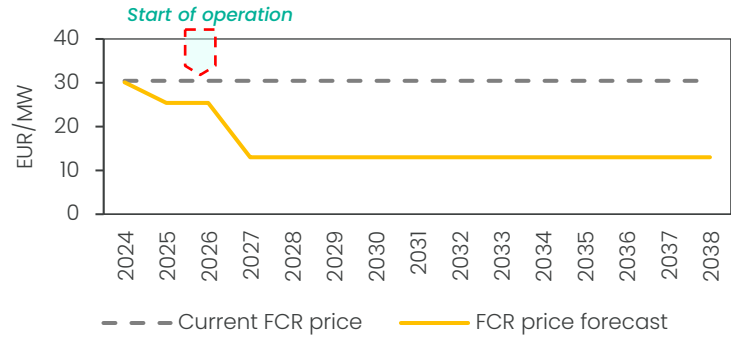
# SIMPLIFIED BESS ECONOMICS: ANCILLARY SERVICES – FCR (1/2)

- 2024 FCR requirement by TSO: 99 MW
- TSO recommends no less than 2-hour battery for FCR service provision

**INPUTS:**

- 2-hour battery
- **Capex:** 650 EUR/kW
- **Operational life:** 19 years
- **FCR service provision:** 23 hours/day
- **Annual Opex:** 2.5% of Capex
- **Base case FCR price forecast:** the price is expected to converge to the level of ~13 EUR/MW when the BESS capacity in Ukraine significantly exceeds the volume of FCR currently required by TSO

FCR price is expected to decline, once sufficient capacities are in operation





## SIMPLIFIED BESS ECONOMICS: ANCILLARY SERVICES – FCR (2/2)

### RESULTS (2-hour battery):

- Project internal rate of return (IRR) = 11%; payback period = 8 years
- An average FCR price of 14 EUR/MW maintains the project IRR at 10%, approaching an investor's break-even point

### COMMENTS:

- This segment is interesting for the trailblazers, which are able to take advantage of the current deficit and quickly build BESS to catch the years of relatively high prices
- The current FCR price is restricted by a price cap (set by the regulator) and could be higher without it considering the deficit. We expect that the price may converge towards EU levels in the mid-term
- An illustrative project benefits only marginally from the current FCR price, as its commercial operations are set to begin in 2026, while the price will be going down in EUR terms if price cap (set in UAH) remains in place
- If TSO needs in FCR exceed 99 MW, this will extend the period of current FCR price and improve profitability of respective BESS projects



## SIMPLIFIED BESS ECONOMICS: ANCILLARY SERVICES – FRR

- **2024 requirement by TSO:**
  - FRR-up: 1000 MW
  - FRR-down: 421 MW
  - TSO recommends no less than 3-hour battery for FRR

### INPUTS:

- 3-hour battery
- **Capex:** 900 EUR/kW
- **Operational life:** 5 years
- **FRR service provision:** 18 hours/day
- **Balancing market:** 6 hours of activation per day
- **Annual Opex:** 2.5% of Capex

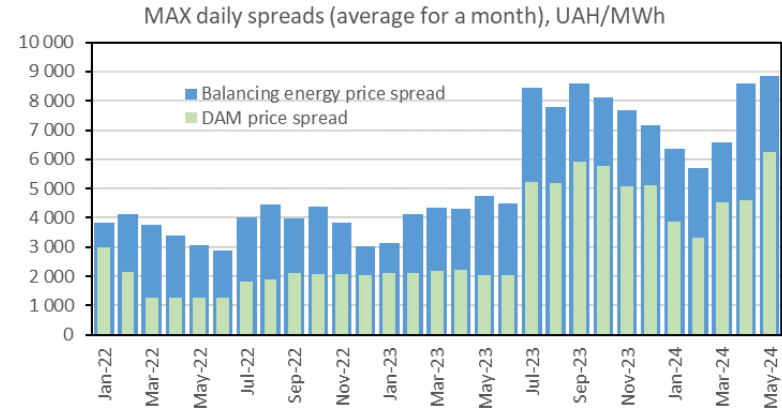
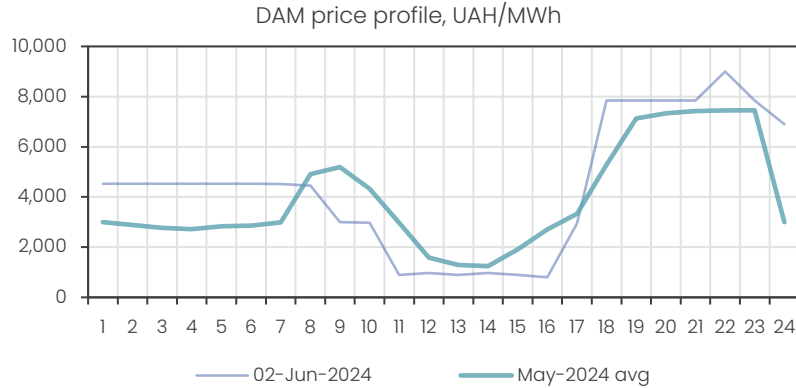
### RESULTS:

- Despite the current price of FRR (up and down) at 1340 UAH/MW (~30 EUR/MW), the project's profitability remains insufficient, with the project IRR of 6% at this price level

### COMMENTS:

- There is substantial uncertainty regarding the actual number of activations that will be executed based on commands from the TSO
- Higher number of activations shorten battery lifespan, resulting in a negative economic impact that outweighs the benefits of extra revenue obtained from additional activations
- Given that current electricity shortage will not disappear quickly, a high number of activations for this service is highly likely
- The current FRR price is constrained by a price cap. We believe that lifting this price cap will be essential to attract investors to this segment

## BESS ECONOMICS: PRICE ARBITRAGE



- Recent revisions of price caps by the regulator contributed to an increase in the spreads between maximum and minimum prices throughout the day
- The tight situation with generation in Ukraine is also expected to push spreads higher, but existing price caps (and absence of negative prices) artificially restraining the spreads
- Solar generation is currently the main driver for the relatively large spreads. Therefore, the conditions for arbitrage in cold months are unlikely to be favorable

## SIMPLIFIED BESS ECONOMICS: PRICE ARBITRAGE AT DAM AND BALANCING MARKET

### INPUTS:

- 4-hour battery
- **Capex:** 1200 EUR/kW
- **Operational life:** 11 years
- **DAM/Balancing market activity:**  
1 charge/discharge cycle
- **Annual Opex:** 2.5% of Capex

### RESULTS:

- The average spreads for May 2024 between discharge price (highest price for the day) and charge price (lowest price for the day) amounted to ~200 EUR/MWh on the balancing market and ~150 EUR/MWh on the day-ahead market
- New price caps became effective on 1 June, resulting in an expanded DAM spread, sometimes reaching up to 200 EUR/MWh.
- The current spreads are insufficient to ensure project profitability in this segment. The project becomes attractive for arbitrage purposes with spreads exceeding 220 EUR/MWh

### RISKS:

- **Significant debts at the balancing market causing a 1-year delay of payments do currently not allow relying on this market segment**



## SIMPLIFIED GAS PEAKER (ICE) ECONOMICS

### INPUTS:

- **Capex:** 800 EUR/kW
- **Operational life:** 25 years
- **Market segments:**
  - FRR Up: 12 hours/day
  - Balancing market: 3.5 hours/day
  - DAM: 8 hours/day
- **Natural gas price:** ~300 EUR/000' m<sup>3</sup>

### RESULTS:

- Current pricing environment of June–July 2024, with a DAM base price of ~120 EUR/MWh and a Balancing Energy UP price of ~150 EUR/MWh, suggests a substantial IRR of 30%

### COMMENTS:

- Current electricity shortage presents advantageous conditions for the implementation of such project, offering a rapid payback period under present pricing conditions
- However, sustainability of such high prices in the medium and long-term remains a critical factor. Consequently, swift construction and high capacity utilization will be essential for achieving the project's payback
- Considering uncertainties with price evolution, ability to rely on the ancillary services market and/or cogeneration with heat sales will be important to ensure the project's bankability



### 3- RISKS AND CHALLENGES FOR INVESTORS

- Non-payment at some market segments
- Price caps and volatility of regulatory framework
- Absence of long-term predictable revenue streams
- Currency devaluation / risk of not being able to repatriate profits
- All relevant projects (not only gas generation) need to get exemption from lengthy permitting procedures
- Limitations of main international financial institutions (IFIs) to finance flexible gas generation projects
- Insurance of war risks is a custom-made product not easily available to mainstream investors
- Limited domestic engineering capacity cannot deliver hundreds of projects in parallel

## RISKS: NON-PAYMENT AT SOME MARKET SEGMENTS

- Delayed settlements remain common in some market segments:
  - ✓ *At **balancing market** the period of non-payment exceeds 12 months, TSO's debts to market participants stand at UAH 16+ bln, while market players owe TSO UAH 30+ bln (main reason is the so-called "protected consumers" that do not pay for electricity)*
  - ✓ *Debts of the state-owned renewable electricity off-taker (**Guaranteed Buyer**) to renewable power plants working at feed-in tariff under **Renewable Public Service Obligation** are around UAH 20 bln despite recent positive settlement dynamics*
  - ✓ *There is also a multi-billion chain debt associated with the **Household Public Service Obligation***
- This may create concerns on the investor side if/how timely and full settlements at balancing market can be guaranteed and whether ancillary services market has immunity from such problem going forward (even if currently there are no debts in this segment)
- TSO's transmission and dispatch tariffs approved by the Regulator are often insufficient to reimburse full expenses



## RISKS: PRICE CAPS AND VOLATILITY OF REGULATORY FRAMEWORK

- Electricity price caps approved by the NEURC prevent full market-based price formation and limit spreads observed at DAM, IDM and balancing market
- **Recent improvement:** Starting from July 2023, following multiple rounds of price cap reviews, the upper price limit in peak hours on the DAM was increased from 4000 UAH/MWh to a range of 5600-9000 UAH/MWh, depending on the hour, while prices still do not reflect actual scarcity of electricity
- Price caps for ancillary services is also an important limiting factor for investors
- Regulatory framework in the electricity market remains volatile. With frequent changes and lack of long-term planning, it is hard for investors to assess how regulation is going to evolve
- 1-year standard TSO tariff approval cycle does not provide reliable basis for securing longer term financial commitments of the TSO (for example, to honour commitments under long-term contracts for ancillary services)
- **Recent improvement:** following Ukrenergo's initiative, the NEURC approved in June 2024 amendments to the auction framework envisaging possibility for TSO to award via the auctions long-term (up to 5 years) contracts for ancillary services. This should improve bankability of new BESS and flexible generation projects



## RISKS: ABSENCE OF LONG-TERM PREDICTABLE REVENUE STREAMS

- Investors are looking for a predictable market environment to build financial models of new projects and have confidence in revenues
- Ukraine's electricity market is an immature market with a history of frequent regulatory and administrative interventions as well as a highly concentrated generation segment that makes it hard to rely on historical market data
- The war (attacks, occupation) causes constantly changing structure of electricity supply and demand. The resulting structural balance can be hardly predicted as it depends strongly on the trajectory of the war causing electricity price forecasts to be unreliable
- There is a limited number of bankable consumers that can sign long-term Power Purchase Agreements. As a result, investors have a hard time to show predictable revenue streams to financiers
- There are many unforeseen circumstances that can become reality (damages to electricity and gas networks, destruction of infrastructure, cyber attacks, etc.). Investors which agree to accept these risks are hardly able to absorb also regulatory and market risks in full volume
- **Recent improvement:** Ukrenergo can now sign long-term contracts at ancillary services market



## RISKS: CURRENCY DEVALUATION/ RISK OF NOT BEING ABLE TO REPATRIATE PROFITS

- Revenues from all electricity market segments in Ukraine are in UAH, while capital costs are mainly in EUR or USD and UAH is hard to hedge against hard currencies
- National Bank of Ukraine (NBU) in the past repeatedly changed its rules for repayment of loans and repatriation of profits
- **Recent improvement:** prices in the long-term contracts for ancillary services awarded via special auctions will be linked to EUR; In May the NBU liberalised the repatriation of profits
- Still, the risks remains that restrictions for cross-border currency transactions can be re-introduced at some point of time in the future

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## CHALLENGES

- Despite recent positive changes approved the Government that made **permitting** of gas-fired generation projects easier, similar framework needs to be extended to other types of energy projects important for the power system, in particular, energy storage, biomass-fired generation, etc.
- Some IFIs and DFIs have policies that discourage financing of the projects, which are based on **fossil fuels**. This limits access of investors to financing for flexible gas generation projects, which are critical for Ukraine under current circumstances
- While **insurance of war-related risks** is already available from DFC and MIGA, respective products are quite complex. The framework for their provision needs to be simplified, so they can be accessible for all investors as Ukraine needs parallel implementation of hundreds of new energy projects
- Russian-Ukrainian war leads to a shortage of **experienced engineers and technicians** with core engineering skills. Local engineering as well as municipal utility companies need to enhance capacity to work in parallel on multiple projects on construction of flexible generation and BESS
- During martial law, international manufactures of equipment usually do not allow their engineering/assembly teams travelling to Ukraine. There are also **restrictions for Ukrainian engineers** to travel abroad during the war to get necessary training and certifications



## 4-MITIGATION INSTRUMENTS

- Address the problem with debts and settlements at the balancing market
- Remove price caps at all market segments (as minimum, publish clear timeline for a staged phase-out)
- Create donor “payment guarantee” fund that can step in the case of off-taker’s default and guarantee minimum revenues to investors under PPAs or ancillary services contracts
- Enhance capacity of Ukrainian engineers (in particular, via trainings, certification, etc.) to implement in parallel numerous energy projects
- **Done:** Approve regulatory framework for long-term contracts at ancillary services market
- **Done:** Link prices for ancillary services to EUR (under long-term contracts)



## 5- CONCLUSION

- Private investments will be crucial for efficient restoration, development and operation of Ukraine's power system going forward
- In principle, investments in battery energy storage systems and flexible generation can be profitable in Ukrainian electricity market, while bankability of such projects remains an issue
- Substantial economic and political risks, as well as regulatory barriers and uncertainty, discourage private investments
- Donors, Ukrainian authorities and investors should jointly develop mechanisms to address key bottlenecks, including off-take risks

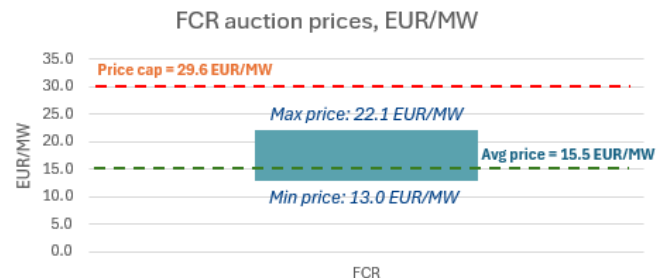
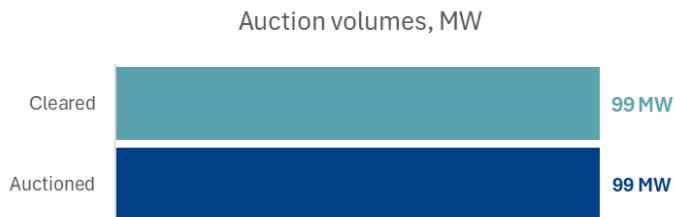


# ANNEX



## 5-YEAR AUCTION RESULTS – FCR

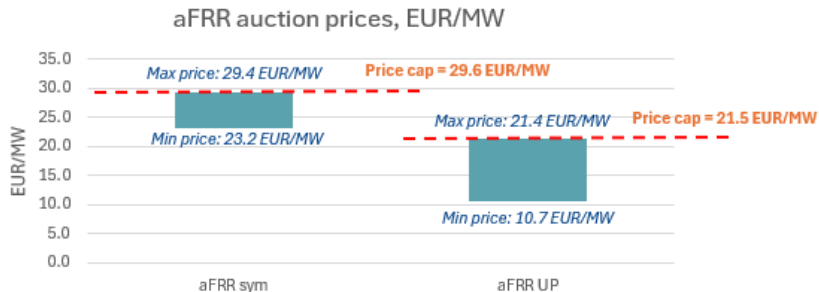
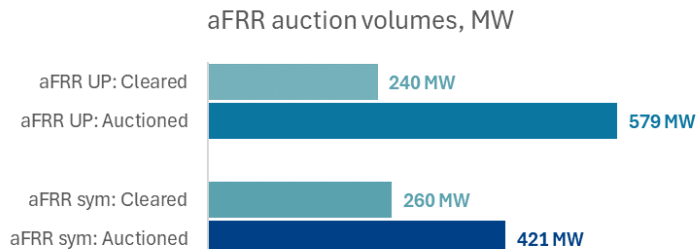
- TSO held the auction on August 15 for long-term purchase of frequency containment reserve (FCR)
- Pricing mechanism: **pay-as-bid**, prices are fixed in EUR
- 39 participants, 12 companies submitted winning bids
- Service provision will start on October 1, 2025
- TSO will sign 5-year contract for the service provision
- Auction winners have 1 month to submit collateral





## 5-YEAR AUCTION RESULTS – aFRR

- TSO held the auction on August 22 for long-term purchase of automatic frequency restoration reserve (aFRR)
- aFRR-symmetric and aFRR-UP were placed for the auction
- Pricing mechanism: **pay-as-bid**, prices are fixed in EUR
- 35 participants, all bids were winning as the services were undersubscribed
- Service provision will start on October 1, 2025. TSO will sign 5-year contract for the service provision
- Auction winners have 1 month to submit collateral





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