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# A YEAR OF OPERATION OF THE COMPETITIVE WHOLESALE ELECTRICITY MARKET IN UKRAINE

## SUMMARY REVIEW PAPER

Energy Security Project (ESP) – August 2020

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## ACRONYMS

| | |
|---|---|
| ACER | Agency for the Cooperation of Energy Regulators |
| AMCU | Anti-Monopoly Committee of Ukraine |
| ASM | Ancillary Services Market |
| BCM | Bilateral Contract Market |
| BPM | Balancing Power Market |
| BEI | Burshtyn Energy Island |
| CMU | Cabinet of Ministers of Ukraine |
| DAM | Day-Ahead Market |
| DSO | Distribution System Operator |
| EA | NAEC EnergoAtom (State Enterprise) |
| ECT | Energy Community Treaty |
| EML | Electricity Market Law of Ukraine |
| ENTSO-E | European Network of Transmission System Operators for Electricity |
| EU | European Union |
| FIT | Feed-in Tariff |
| GB | Guaranteed Buyer (State Enterprise) |
| GoU | Government of Ukraine |
| IDM | Intraday Market |
| IPS | Integrated Power System (see also UES) |
| JSC | Joint-Stock Company |
| MO | Market Operator |
| MP | Market Player |
| NEURC | National Energy and Utilities Regulatory Commission |
| NJSC | National Joint-Stock Company |
| NPP | Nuclear Power Plant |
| NSSMC | National Securities and Stock Market Commission |
| PJSC | Public Joint-Stock Company |
| PPA | Power Purchase Agreement |
| PSO | Public Service Obligation |
| PV | Photovoltaic |
| REMIT | EU Regulation on Wholesale Energy Market Integrity and Transparency |
| RE | Renewable Energy |
| SE | State Enterprise |
| SLR | Supplier of Last Resort |
| TSO | Transmission System Operator |
| TPES | Total Primary Energy Supply |
| TPP | Thermal Power Plant |
| UAH | Ukrainian Hryvnia |
| UE | NPC Ukrenergo, SE (later corporatized into PrJSC) |
| UES | United Electricity System (see also IPS) |
| UHE | UkrHydroEnergo |
| USAID | United States Agency for International Development |
| USD | US Dollar |
| USS | Universal Service Supplier |
| VAT | Value Added Tax |
| WEM | Wholesale Electricity Market of Ukraine |

# EXECUTIVE SUMMARY

On July 1, 2019, Ukraine transitioned out of the single-buyer electricity market model and launched the new Wholesale Electricity Market (WEM), based on competitively traded volumes of electricity on integral market segments of the day-ahead and intraday markets, supplemented by the bilateral contract market, and supported by the balancing power market, as well as, the ancillary services market.

This shift to a new electricity market model was a step toward complying with European rules and standards, in line with Ukraine's commitments.

The new model faced many problems; often, decision-makers introduced minor amendments to solve immediate problems without taking into account possible unintended consequences or the need for fundamental systemic change.

Challenges in the WEM's first year included:

- Financial imbalance due to several interrelated factors:
    - RES increase: Rapid growth of installed capacity and generation from renewable energy sources (RES) in addition to high RE feed-in tariffs.
    - Very low household tariffs: Tariffs for household end-users are kept low due to the public service obligation (PSO) mechanism, as well as the fact that industrial and commercial customers subsidize household tariffs.
    - Decreased consumption: COVID-19 restrictions caused declining consumption throughout the country and accelerated the industrial and commercial sector's decreasing share of energy consumption compared to household users. Because household tariffs are so much lower than industrial/commercial tariffs and end-user tariffs vary based on consumption, this contributed to declining revenue.
- The crisis of settlements between key market players such as the Guaranteed Buyer and EnergoAtom (due to the PSO mechanism) or between the Settlement Administrator, groups responsible for balancing and balancing service providers.
- Insufficient market transparency and opportunities to manipulate the market, exacerbated by the market monopoly. The market lacks transparency measures as hourly bilateral contract volumes (which affect day-ahead market price formation), timely publishing of balancing market operation results, up/down-regulation volumes, marginal up/down-regulation prices, imbalance prices, etc.
- High market concentration in generation, especially in the real-time balancing market, which is dominated by a few market players. This was the primary reason for introducing bidding caps under the "Safe Mode" scheme to facilitate market opening and avoid a possible 'crash' of the market.

Despite these challenges, decision-makers did not work to improve market rules in a timely manner so that the model would function more efficiently; when changes were made, they were often implemented incorrectly. The USAID Energy Security Project's (ESP) advice helped alleviate or reduce the impact of some of these problems.

Despite these obstacles, the new WEM proved to function relatively efficiently. Analysis suggests that, under today's conditions, the previous market model would have faced the same financial imbalance as the new model, most likely with worse results. Under the single-buyer model, pricing was manually regulated, with all tariffs set by government rather than the market from generation to end-users. This created political, investment, and corruption risks, including the abuse of monopoly. The new model unbundled some previously vertically integrated market participants (a requirement of the Third Energy Package), which reduced monopoly power by forming competing electricity suppliers and allowing consumers to choose their supplier on a competitive basis.

The roadmap for the future of the WEM encompasses:

- Gradually eliminating market distortions, such as the PSO mechanism and protected customers, including a switch to a Financial PSO mechanism (F-PSO);
- Increasing market transparency and efficient market monitoring and surveillance by regulators (particularly NEURC and the AMCU, and, as the market's financial segment expands, the NSSMC) through implementation of REMIT, and establishing a Market Data/Transparency Platform;
- Improving the financial settlement mechanism;
- Implementing common cross-border capacity auctions with neighboring EU countries and facilitate market coupling;
- Adopting required improvements for the ancillary services market (ASM);
- Addressing the financial deficit in the RE support mechanism and facilitate market participation of RE producers; and,
- Establishing a competitive trading environment (regulatory and technical) for the bilateral contracts segment (with physical delivery obligation) and ensuring financial settlement.

Section One of this report discusses the history of WEM implementation, the constraints it faced, and ESP's contributions to its development and launch.

Section Two summarizes the model's first year of operation, covering major developments during the year, as well as, ESP's analyses and proposals to mitigate some of the challenges.

Section Three analyzes the remaining gaps which present the greatest threat to the WEM's successful and efficient operation and provides recommendations for improvement and development.

## BACKGROUND

In 1998, the Law of Ukraine "On Electricity Industry" established a single-buyer model for the wholesale electricity market, under which all generated electricity was sold to the wholesale market and all electricity settlements must be made through the wholesale market, i.e., through the Market Operator - Wholesale Supplier (the state enterprise Energorynok).

The single-buyer retail market featured both regulated electricity tariffs for the distribution companies (oblenergos) and non-regulated tariffs for large end-consumers. Tariffs were set by the regulator and Energorynok had a key role in settlements. The market also used a cross-subsidization mechanism, moving income from electricity sales to support other activities within a company or between related companies. Major problems with this model included:

- Monopolization and lack of competition in both wholesale and retail markets. End-customers could not choose among competitive suppliers and "wire-related" activities from trade and supply of electricity were bundled, which combined to increase costs to consumers;
- Cross-subsidies from industry to households;
- Heavy indebtedness along the entire delivery chain, from the generators to the single buyer to oblenergos and finally to consumers;
- Absence of incentives to invest in networks and generation; and
- Lack of transparency, leading to widespread corruption.

In 2011, Ukraine became a member of the Energy Community and committed to implement the principles of the European Union (EU) Third Energy Package. The key obligations include; unbundling energy production and supply interests from the network; increasing electricity market transparency; strengthening consumer protection rules; developing more effective and independent national regulatory authorities; and improving cross-border collaboration and investment.

# 1. FRAMEWORK TO IMPLEMENT THE NEW WEM MODEL

## 1.1. DECISION TO IMPLEMENT THE NEW MODEL

Due to the flaws in the single-buyer system, and in light of the obligations under the Energy Community Treaty (ECT), the Government of Ukraine (GoU) decided to implement fundamental reforms in the energy sector. In 2017, the Verkhovna Rada adopted a new Electricity Market Law (EML) and opened the way for the implementation of European rules and standards in Ukraine's electricity market. A new electricity market model was to be implemented.

### 1.1.1. THE NEW ELECTRICITY MARKET LAW

The EML aimed to establish competitive wholesale and retail electricity market segments, compliant with the EU energy acquis. It specifies the legal, economic, and organizational principles of electricity market operations and regulates production, transmission, distribution, purchase and sale of electricity supply to customers. The EML principles consider customers' interests and aim to minimize expenses from electricity supply services, as well as adverse environmental impact.

The EML provides for a new electricity market structure that differs significantly from the single-buyer model. It includes several new segments, such as a retail market for purchase and sale of electricity, the bilateral contracts market (BCM), day-ahead and intra-day markets (DAM and IDM), a balancing power market (BPM), and an ancillary services market (ASM).

Adoption of the EML was a prerequisite for structural changes in Ukraine's electricity sector. It was the basis for industry modernization and the coupling of Ukraine's electricity market with the pan-European electricity market through integration into the ENTSO-E network.

### 1.1.2. FRAMEWORK DETAILS

In accordance with the EML, Ukraine implemented the reform process in two stages: (1) opening the retail market (January 1, 2019) by unbundling the integrated distribution and supply companies (oblenergos), as well as, introducing the Supplier of Last Resort (SLR); and, (2) opening the wholesale market (July 1, 2019), which introduced significant changes to the methods for wholesale electricity trading. SE Energorynok was restructured into three companies: a SE Guaranteed Buyer, a SE Market Operator (MO) and SE Energorynok, the latter of which was responsible for the outstanding debts accrued during the single-buyer model's operation. The transmission system operator (TSO), NPC Ukrenergo, was assigned the roles of commercial metering administrator and settlements administrator.

New market segments included the DAM, IDM and BPM. Among the new state-owned enterprises, the MO was responsible for the DAM and IDM operation and the Guaranteed Buyer was tasked with fulfilling the PSO on household consumer support and managing the RE portfolio under the feed-in-tariff (FIT), or "green tariff" whereas NPC Ukrenergo became responsible from operation of the BPM and ASM.

## 1.2. TIGHT DEADLINES

Although ESP (along with other international stakeholders) recommended postponing the launch of the new WEM by at least a few months, it started on July 1, 2019 as provided for by the EML. The government did not decide whether to delay the launch until late May 2019, leaving slightly more than a month to implement the entire infrastructure necessary for day-to-day WEM operations (including

necessary changes in the market rules, preparation of the IT systems, training of market players, as well as, personnel of market operators).

## 1.3. TOWARDS WEM OPENING

ESP has been actively cooperating with market players, other stakeholders and the donor community in Ukraine throughout the WEM process, and facilitated the market's launch by supporting the development of the regulatory framework, conducting financial modeling and impact assessments, and facilitating roundtables and trainings for market participants, decision-makers and implementers. ESP developed the concept and framework of the 'Safe Mode' based on financial modeling and thorough impact assessments on various segments of the market. With the Safe Mode, the market could open without major operational problems, as well as impacts on consumers.

### 1.3.1. SAFE MODE FOR WEM

Based on the fact that the GoU decided not to postpone the market opening, the Safe Mode aimed to facilitate the launch and avoid any crashes caused by system or market player unpreparedness or by the high market concentration in the generation segment.

High generation concentration already posed risks to market operation and competition during the single-buyer model and was a significant threat to the WEM opening, which would end regulatory control over wholesale energy prices and payments to power producers. As the market opening approached, there were serious concerns about price formation in different WEM segments and their possible impact on end-user energy prices. Specifically, the entire renewable energy portfolio receiving FIT would be managed by the Guaranteed Buyer, with EnergoAtom holding a very significant share in total generation as the main baseload provider. Also, despite the increasing need for power plants capable of providing balancing services (as per the Grid Code reserve requirements) and the high level of intermittent renewable energy penetration, this segment of the balancing market was heavily dominated by a very few players.

The Safe Mode was developed to address these concerns. It stipulated various mechanisms and safeguards for different segments of the market to ensure that the impact of market opening on end-consumers' energy cost remains within tolerable limits. Among them were:

- Reduced functionality;
- Constrained bidding in the DAM and IDM (959.12 UAH/MWh cap for the "night" periods of minimum load and 2,048.23 UAH/MWh cap for the "day" periods of maximum load), based on prices achieved in the previous market model during the three months prior to the opening of the new market.
- Bidding caps in the balancing market (115% of DAM cap for upward regulation and 85 % of DAM cap for downward regulation), and,
- Simplified financial settlement through longer settlement periods.

The rationale behind the Safe Mode was to avoid price shocks, equitably distribute costs, incorporate the PSO and RE support mechanisms, and mitigate the excessive concentration of market power.

In addition, previous experience with wholesale market transitions shows that major software and institutional errors were likely during market opening. Because all segments were going to open

simultaneously (DAM/IDM, BCM and BPM, with ASM shortly thereafter), it was extremely important to put safeguards in place so that any errors would not cause significant disruption.

### 1.3.2. PUBLIC SERVICE OBLIGATION

On March 1, 2017, the household tariff reached 900 UAH/MWh, including VAT (750 UAH/MWh without VAT) for the first block (i.e. 100 kWh) and 1,680 UAH/MWh, including VAT (1,400 UAH/MWH without VAT) for all consumption beyond the first block. At the same time, the Cabinet of Minister of Ukraine (CMU) introduced more subsidies targeting vulnerable customers. In the three years since, no tariff updates or increases were made regardless of market changes and increasing costs. As a result, it has been necessary to further increase subsidization.

The EML stipulated that the subsidies managed by the single buyer are provided by the PSO mechanism imposing obligations on certain players. Accordingly, the PSO was established by the CMU to ease the transition to the new market and maintain the household electricity tariff. The CMU imposed a PSO on the Guaranteed Buyer (GB), the TSO (Ukrenergo), distribution system operators (DSOs) and universal service suppliers, as well as electricity producers EnergoAtom (EA) and UkrHydroEnergo (UHE). Thus, EA and UHE were obliged to sell the GB a significant portion of their electricity generation at fixed prices (EA at 567 UAH/MWh and UHE at 674 UAH/MWh, significantly below the DAM price levels). EnergoAtom was the main source of energy provided for the PSO (started with 90 % of its generation, which decreased later) and expected to provide baseload power, whereas household consumption has an hourly dynamic load profile. This is simply why the EA was obliged to provide a large part of its generation to the GB so that the GB can sell the excess energy in the market and utilize the profit earned to cover the cost of providing heavily subsidized electricity to households (EA provided the rest of the obligated volumes to the TSO and DSOs for network losses). This financial imbalance in the design led to serious issues in the mechanism, which was amended several times starting with the termination of providing cheap electricity to the DSOs and the TSO. The impacts extended to the WEM operation as well, creating significant cost recovery problems for the GB and EA and threatening their financial stability as explained further below.

### 1.3.3. ANCILLARY SERVICES MARKET

Real-time system balance requires stability of frequency throughout the entire power system, which is where the ASM plays a key role. ASM operation relies on the provision of reserves by power plants, as required by the Grid Code. Despite market opening scheduled for July 2019, the power plants were not tested and certified as service providers so that ASM auctions can start and the ASM becomes operational. Therefore, ESP initiated a technical assistance program for Ukrenergo to create conditions for a properly functioning ASM (in particular, to develop test procedures, test the generation fleet, certify the power plants and monitor the provision of ancillary services). Hence, the ASM auctions were able to start in Spring 2020. As of July 2020, 11 power plants have been tested and certified as service providers for primary (i.e. FCR) and secondary reserves (aFRR and mFRR) to maintain the stability of the system. However, the rules on pricing of services and monitoring of the power plants are still far from being effective and need significant improvements for a well-functioning ASM to facilitate ENTSO-E integration. Detailed analysis of ancillary market development is provided in the next section.

### 1.3.4. COMMERCIAL METERING

ESP provided proposals for proper commercial metering. One of the most crucial of these was changing the balancing market's settlement period from daily to monthly to avoid destructive impacts

of financial settlement on market players due to unreliable metering data. The regulator endorsed this proposal, but ultimately adopted a 10-day settlement due to the technical limitations of the TSO's software and the DSOs' inability to provide accurate metered data at D+1 due to lack of automatization and low percent of interval meters within the customer base. Several other issues, such as load profiles, delays in metering data provision and significant differences in metering data sets are yet to be resolved.

### 1.3.5. FINANCIAL IMPACT ASSESSMENT FOR MARKET OPENING

After the launch of WEM, the EML required that consumer transmission tariffs include compensation for the renewable energy FIT. This led to a significant increase in electricity prices for all consumers, especially large industrial consumers connected to the TSO grid as seen below.

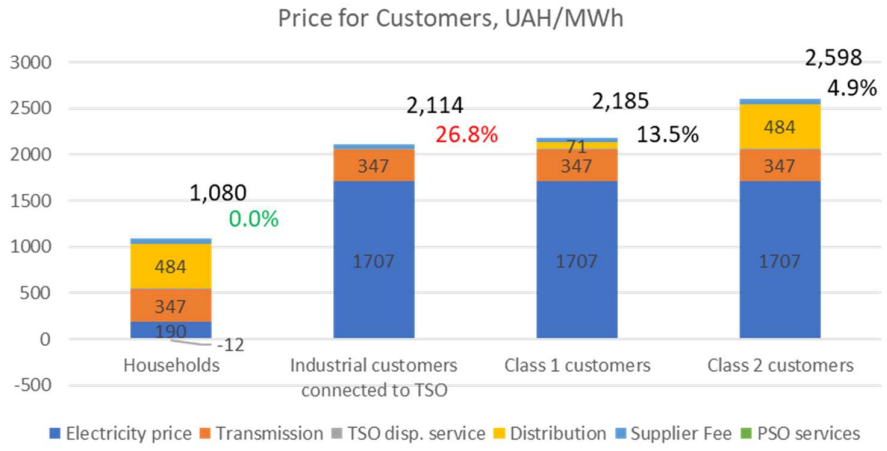



*Figure 1: Price increase due to including FIT costs in transmission tariff*

The price increase occurred as expected with a six-fold increase in the transmission tariff and created outrage among some consumers, especially large industrials. To solve the crisis, ESP proposed to partly transfer this function to the Guaranteed Buyer for a transitional period in addition to the PSO for households. The CMU amended the PSO to reduce the TSO payment to the Guaranteed Buyer and to compensate for renewable energy production with the Guaranteed Buyer's profit from selling a mix of electricity generated by low-cost state-owned nuclear and hydro plants in the DAM. Apparently, this experience highlighted the lack of coordination for the market reform, as well as thorough impact analysis on the market opening.

To assess a wide range of the impact on consumer prices and market player revenues, ESP developed a comprehensive financial model of the electricity market with a set of predefined scenarios for physical parameters and economic indicators (e.g., load forecast, increasing RE share in generation, PSO schemes, generation shares on markets, and prices). The model, which was upgraded several times, was used to develop recommendations for a sustainable wholesale market, continuously sharing and discussing the model's assumptions and results with stakeholders and decision-makers.

### 1.3.6. MARKET MONITORING

Market transparency and protection from manipulation are critical to efficient markets. EU Regulation No. 1227/2011 on Wholesale Energy Market Integrity and Transparency (REMIT) requires electricity and gas producers, sellers, traders and transportation operators exceeding 600 GWh annually to

submit transaction information to the Agency for the Cooperation of Energy Regulators (ACER) in near-real time. Because Ukraine is not yet in the EU, it is assumed that NEURC will assume ACER's responsibilities in the interim. Energy market participants, third parties acting on behalf of market participants and organized markets, or other persons professionally arranging transactions are obligated to report.

Through the project on Electricity Market Monitoring and Surveillance (EMM&S), ESP aims to assist the regulator in the transposition and implementation of REMIT, which sets requirements for market monitoring. Especially due to existing concentration in the generation and partially in the supply segments, market monitoring was of key importance to achieve the liberalization efforts in the market. However, even as of August 2020, the EnCS requirements on (light) REMIT are still not transposed within primary legislation. Hence, secondary legislation to be adopted by NEURC is still pending. In this context, the main objectives of the EMM&S activities are:

- To strengthen NEURC's capacities in information processing and decision-making;
- To ensure the Ukrainian power sector's compliance with national and international market monitoring obligations; and,
- To ensure the WEM's integrity, transparency, sustainability, availability, and competitiveness.

In the meantime, the NEURC has been trying to monitor the market through existing internal capacity and ESP has been supporting these efforts by analyzing the market trends and behaviors of players, developing proposals to mitigate anomalies, to make interventions when needed and to improve the regulatory framework. However, as explained in the next sections of the report, these monitoring activities are ex-post in nature and could allow taking mitigative actions such as improvement of the market rules, lacking proportionate penalties as suggested by REMIT.

### 1.3.7. BILATERAL CONTRACTS MARKET

Developing a competitive bilateral market with physical delivery is necessary for transparency, monitoring and surveillance of the entire WEM, ensuring stability, liquidity and predictability. The bilateral contracts market constitutes around two-thirds of the wholesale market volume and has a key role in the current PSO mechanism based on physical contracts.

From its proposal stage, the Safe Mode concept stipulated the need for a centralized bilateral contracts market with secured financial settlement through the authorized bank via a platform operated by the MO (in cooperation with ProZorro, if needed). Draft resolutions were introduced to use electronic auctions for bilateral contracts on state-owned generation and to create the concept of a PSO special session. The CMU adopted a resolution for centralized auctions for state-owned generation while establishing the GB as PSO administrator. However, the PSO resolution created a new system very similar to the single-buyer model, as the GB buys cheap electricity from state-owned nuclear and hydro generators and sells directly to USSs for household consumption. Furthermore, although clearly described in the Safe Mode proposal, the resolution on electronic auctions did not specify a centralized bilateral market with fully secured financial settlements. As a result, the rules on electronic auctions and the PSO must be revised because they do not align with the targets of increasing liquidity in the market and establishing an energy exchange.

Throughout the project duration, ESP will facilitate the development of clearing services and the establishment of an energy exchange. This will enable trading standard products with physical delivery,

including with universal service suppliers, and hence, increase liquidity in the market by providing reliable price signals.

## 1.4. OPERATION OF SEGMENTS IN THE NEW WEM

In the new WEM, electricity is traded in three organized segments (with 'organized' meaning managed by an operator under rules set by the NEURC, including pricing principles), namely the Day-Ahead Market (DAM), the Intra-Day Market (IDM) and the Balancing Power Market (BPM) with trading in MWh. Electricity trade can also take place through bilateral contracts that are not regulated (including pricing) but must be registered (hourly volumes together with seller and buyer information), forming a physical delivery obligation for the involved parties. This is referred to as the Bilateral Contracts Market (BCM) throughout this report. These segments in which electricity is traded are supported by the Ancillary Services Market (ASM), managed by the Transmission System Operator (TSO) to continuously maintain the stability of the electricity system and, unlike other segments, is based on capacity (MW) payments. Below is brief description about how these segments operate:

### 1.4.1. DAY-AHEAD MARKET (DAM)

The DAM is the first of the two organized segments (DAM and IDM) operated by the Market Operator (MO) and allow all market participants to buy or sell electricity in the day-ahead (D-1) for the following day (D). Buyers and sellers must sign a market participation agreement with the MO to participate in this segment. In principle, a buyer goes to the DAM to buy electricity to cover its electricity consumption (e.g. consumption of its end-user customers or trading counterparty that procured electricity via a bilateral contract) that could not be covered with its existing bilateral contracts to buy electricity. Similarly, a seller goes to the DAM to sell its available electricity (e.g. own production at power plants or excess energy from existing bilateral contracts) to buyers in the market. On D-1, both buyers and sellers participate at the DAM and place their bids to buy and sell electricity. Once the gate is closed for submission of bids, the MO runs the market clearing algorithm and calculates the prices for each hour of the following day (D) based on the marginal pricing principle.

In addition to allowing the market participants to balance their position for the following day, the DAM has a significant benefit for the TSO. Through the process summarized above, the DAM delivers to the TSO a balanced system on D-1, and hence, contributes significantly to the operation of the real-time balancing activities to be performed by the TSO.

### 1.4.2. INTRA-DAY MARKET (IDM)

The IDM is second of the two organized segments (DAM and IDM) operated by the Market Operator and provides market participants the opportunity to adjust their trade positions before real-time.

Once the DAM gate is closed and hourly prices are calculated, each participant has confirmed

supply/consumption volumes (positions) for the following day (D). However, it is quite normal that as the real-time approaches, there might be changes in expected generation/supply or the consumption position of market participants. Therefore, the IDM allows market participants to buy and sell electricity until one hour prior to the delivery time (i.e. T-1) based on an automatic matching principle (unlike the marginal pricing method used at the DAM). So, for the IDM, the indicative price of an hour is a weighted average of the matched bids for that corresponding hour.

In this context, the IDM can be regarded as the platform providing the last opportunity to have a balanced trading position before real-time and avoid being charged imbalance prices for hourly deviations.

### 1.4.3. BALANCING POWER MARKET (BPM)

A critical part of the new competitive WEM is the balancing responsibility of market players as Balancing Responsible Parties (BRP). Both energy suppliers (generators, competitive suppliers) and off-takers (universal service suppliers, customers) should have balancing responsibility in real-time. As electricity supply and demand should be met at all times, imbalances should be discouraged with a pricing scheme and proper planning should be incentivized by not being subject to imbalance fees.

Although the DAM and the IDM provide market participants the opportunity to buy and sell electricity for each hour of the delivery day (D) and form a balanced trading position, it is inevitable to see deviation in generation or consumption during real-time. Therefore, the TSO operates the Balancing Power Market (BPM) in order to maintain the real-time balance of the system by increasing or decreasing the electricity supply. The market participants that can provide the balancing service to the TSO are called balancing service providers (BSP), and submit their bids for up-regulation (increase in generation or decrease in demand when demand response is enabled) or down-regulation (decrease in generation) orders to be issued by the dispatchers of the TSO for each real-time unit (RTU), which is specified as 15-minute periods during an hour.

For each RTU, up-regulation bids are ranked in ascending order and the TSO's dispatchers issue these orders starting from the cheapest one when they see that supply looks to be less than demand. Accordingly, the BSPs receive orders and are paid by the TSO the marginal price calculated for the RTU for which they provided service. Alternatively, down-regulation bids are ranked in descending order and dispatchers issue these orders starting from the most expensive one when they see that supply is higher than demand. Accordingly, the BSPs receive orders and pay the TSO the marginal price calculated for the RTU for which they provided service. The reason for paying to the TSO in the case of down-regulation is as follows: normally, say a generator is expected to produce electricity during an hour, and before the designated delivery time it sold this electricity at the BCM, DAM or IDM and realized revenues for this hour of trading day. Then, issuance of a down-regulation order implies that the electricity volume corresponding to the order will not be generated but rather bought from the TSO so that the commitments to sell are fulfilled. Since the prices of down-regulation bids must be lower than the DAM price for the same hour, the generator obtains a positive margin by paying back a price lower than the DAM price, which motivates it to follow the dispatch orders issued by the TSO.

Although this is an usual mechanism in a typical BPM, during the first year of the WEM, several circumstances led to concerns like "air trading" as explained in the next chapter and NEURC had to take certain actions to resolve the problem.

As explained above, up- and down-regulation orders are issued to balance the system against deviations in generation or consumption. While BSPs are remunerated for providing the balancing services to the TSO, players (i.e. BRPs) that cause the imbalance are charged accordingly. The hourly imbalance fee (price) for their deviations are calculated as the weighted average of the marginal prices calculated for each RTU in the corresponding hour. Between July 2019 and March 2020, the hourly imbalance price was calculated for each hour as a single price for both positive (more/less

generation/consumption compared to confirmed trading position) and negative (more/less consumption/generation compared to confirmed trading position) imbalances. Then, effective March 2020, dual pricing started to apply for imbalances (i.e. different prices for positive and negative imbalances).

Positive imbalance practically means providing electricity to the system in real-time, and corresponding BRPs "are paid" the imbalance price (UAH/MWh) for their positive imbalance volumes (MWh). On the contrary, negative imbalance practically means withdrawing/consuming electricity from the system in real-time, and corresponding BRPs "pay" the imbalance price (UAH/MWh) for their negative imbalance volumes (MWh). As explained in the next chapter, a single imbalance price applied until March 2020 caused significant problems and was replaced by a dual-pricing mechanism developed by the ESP.

### 1.4.4. ANCILLARY SERVICE MARKET (ASM)

As explained in the BPM section, supply and demand levels in the electricity system deviate from values planned before real-time and the TSO utilize BSPs in the balancing market to control the small mismatches in generation and consumption by increasing or decreasing generation. Hence, effective balancing market operation can maintain the balance of the system at the least possible cost. However, sometimes available sources in the balancing market might be insufficient (e.g. time-lags in provision of balancing energy, low ramp-up/down speed or insufficient available volumes) to maintain stable voltage and frequency levels in the system. In order to help recover the system balance in cases such as the loss of a generator, transmission capacity or load, TSOs utilize the Ancillary Services Market (ASM) to provide the system with required reserves (e.g. frequency containment reserve - FCR and automatic/manual frequency restoration reserve – aFRR/mFRR). Therefore, balancing energy and ancillary services are different services provided in the market while both aim to maintain the balance in the system. Similarly, monitoring and remuneration of these two services are carried out separately. Balancing energy is measured and paid on a delivered energy basis in the balancing market (i.e. UAH/MWh). Hence, the cost of balancing energy is paid by balancing market participants that cause the imbalance in real-time. Ancillary services like FCR and aFRR/mFRR are offered on a capacity basis and remunerated accordingly (i.e. UAH/MW), and the cost is reflected in the transmission services (i.e. the dispatch tariff) that are covered by all system users.

While the remuneration for ancillary services are based on capacity, the corresponding prices are determined through auctions conducted by the TSO for each service type as per the Grid Code and Market Rules approved by NEURC.

# 2. FIRST YEAR OF THE NEW WHOLESALE MARKET

## 2.1. VOLUME AND PRICE FIGURES

Electricity traded on the market since the July 2019 market opening is summarized in the table below.

*Table 1: Volume of electricity traded through WEM from July 1, 2019 to June 30, 2020*

| Month | DAM | Share | IDM | Share | BM | Share | BCM | Share | Total |
|---|---|---|---|---|---|---|---|---|---|
| | (Million kWh) | (%) | (Million kWh) | (%) | (Million kWh) | (%) | (Million kWh) | (%) | (Million kWh) |
| Jul 2019 | 4348 | 26 | 104 | 1 | 350 | 2 | 11899 | 71 | 16701 |
| Aug 2019 | 3815 | 22 | 121 | 1 | 313 | 2 | 12850 | 75 | 17099 |
| Sept 2019 | 4089 | 23 | 109 | 1 | 428 | 2 | 13360 | 74 | 17986 |
| Oct 2019 | 3660 | 18 | 97 | 0,5 | 589 | 3 | 15993 | 79 | 20339 |
| Nov 2019 | 4137 | 19 | 202 | 1 | 524 | 2 | 17439 | 78 | 22302 |
| Dec 2019 | 4434 | 18 | 103 | 0,4 | 992 | 4 | 18966 | 77 | 24496 |
| Jan 2020 | 5438 | 24 | 127 | 1 | 987 | 4 | 16382 | 71 | 22933 |
| Feb 2020 | 4348 | 21 | 240 | 1 | 1038 | 5 | 15492 | 73 | 21117 |
| Mar 2020 | 4217 | 17 | 361 | 1 | 2441 | 10 | 18003 | 72 | 25022 |
| Apr 2020 | 2821 | 14 | 478 | 2 | 2465 | 12 | 14141 | 71 | 19905 |
| May 2020 | 2536 | 13 | 654 | 3 | 2020 | 11 | 13757 | 73 | 18967 |
| Jun 2020 | 2162 | 11 | 385 | 2 | 2241 | 11 | 15106 | 76 | 19894 |
| **TOTAL** | **46005** | **19** | **2983** | **1** | **14387** | **6** | **183388** | **74** | **246763** |

*Source: MoE*

The table shows a growing share of the balancing market at the expense (reduction) of day-ahead market volumes and slight increase in the bilateral contract market. This is not a normal trend as the BPM is not a marketplace to trade electricity but rather a mechanism to mitigate inevitable, yet small, deviations in supply and demand, and hence maintain the stability of the system. The size of the BPM was limited to 2-3% of the market until the end of 2019, and this was a reasonable figure. From the financial perspective, a higher BPM share translates into losses for the BRPs as imbalances (positive or negative) lead to worse positions compared to trading at the DAM. Thus, normally, it is expected that imbalanced BRPs, learning from imbalance results in a period, revise their positions/behaviors for the

next periods. Unless there is a structural problem in the market, the BPM share is expected to return to reasonable levels. However, as explained in the next sections, during the first year of the WEM, some structural anomalies were observed and led to a very high BPM share. For instance, systematic surplus in the system caused by decreased (due to several reasons) demand and very high RES penetration due to high FITs caused unmatched/unsold generation (mostly nuclear generation offered by EA and the GB and RES generation offered by the GB) volumes (and hence decreased DAM price levels) at the DAM and a persistent surplus in the system in real-time. As a result. while some BSPs started to obtain positive margins (based on their normal or sometimes "inflated" generation levels due to their trading positions at the BCM or the DAM/IDM) through the down-regulation orders issued by the dispatchers, EA and the GB ended up selling their energy well below the already decreased DAM prices due to being positively imbalanced in real-time.

The total traded amount clearly increases in winter months. However, shares of the day-ahead, intraday, balancing and bilateral contract markets remain stable over the period.

There is an increase in the bilateral segment shares starting at the end of Spring and reaching almost 75 % of total volume. This correlates with decreasing prices in the day-ahead market, leading to volume shifts toward the bilateral segment, which consequently deteriorated the level of prices further. The BCM figures include volumes sold by the GB to the USS to supply households under the regulated tariff, totaling approximately 3 GWh per month.

The table below shows that imports and exports have a limited share in total consumption. This implies that measures to limit imports from Belarus and Russia affected volumes, while technical limitations at Burshtyn Energy Island (BEI) were the main cause for moderate cross-border volumes in the island itself.

*Table 2: Electricity balance from July 2019 to May 2020*

| | Millions of kWh per month | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jul 2019 | Aug 2019 | Sept 2019 | Oct 2019 | Nov 2019 | Dec 2019 | Jan 2020 | Feb 2020 | Mar 2020 | Apr 2020 | May 2020 |
| Consumption *(Gross)* | 10,144 | 10,189 | 9,886 | 10,943 | 11,613 | 12,478 | 12,509 | 11,712 | 11,323 | 9,928 | 10,781 |
| Consumption (Net) | 9,313 | 9,370 | 9,094 | 9,724 | 10,234 | 10,900 | 11,025 | 10,566 | 10,150 | 9,083 | 8,895 |
| Generation | 11,603 | 11,675 | 11,201 | 12,374 | 13,038 | 14,220 | 14,102 | 13,216 | 12,935 | 11,169 | 10,868 |
| Import | 275 | 311 | 351 | 601 | 661 | 499 | 561 | 551 | 442 | 151 | 33 |
| Export | 492 | 490 | 476 | 618 | 629 | 714 | 697 | 740 | 774 | 238 | 125 |

*Source: MoE, Ukrenergo*

## PRICE LEVELS

One of the major goals of the market opening was the formation of competitively determined reference prices in different market segments to provide signals to market participants, potential investors, and decision- and policy-makers. At the same time, Safe Mode constraints were aimed at protecting market participants from significant price fluctuations and to avoid abrupt price increases.

On July 1, 2019, the DAM opened with bidding caps of 959.12 UAH/MWh for the "night" periods of minimum load and 2048.23 UAH/MWh for the "day" periods of maximum load, which were developed by ESP and adopted by NEURC. Similarly, up- and down-regulation bids were capped at +/-15 percent of the day-ahead bidding caps, respectively.

Based on the market trends and monitoring results, some adjustments to the DAM bidding caps were made, such as including 8:00-9:00 am to the day zone as load increases and the recent increase of the night zone bidding caps to 60% of the day-zone. These steps contributed to the mitigation of distortions in price formation or improved the price signal at the DAM. In this regard, although Safe Mode measures achieved the intended goals, it should be noted that they were designed to be temporary and to be replaced by more market-oriented efforts such as the marginal cost of most expensive unit, value of loss load (VOLL) or similar. In doing so, the demand-supply dynamics are better reflected in price formation, providing improved price signals.

### *Day-Ahead Market*

After the market opening, the weighted average price during the summer months, September and October remained above 1,500 UAH/MWh. However, increasing supply and mild winter conditions led to price decreases. A price recovery would normally be expected in the spring, but quarantine measures due to COVID-19 led to a decrease in demand. Combined with significant increases in renewable generation under power purchase agreements (PPAs), this caused weighted average prices to decrease by around 30 % compared to their maximum levels in 2019. Since then, prices have stayed between 1,200 and 1,250 UAH/MWh. The opposite is observed in the BEI bidding zone; prices remain high most of the time, being significantly above the average levels in the IPS bidding zone.

Comparing Ukrainian DAM prices with those in neighboring countries' markets shows a correlation with the IPS bidding zone: winter peaks, slight decrease due to COVID-19 measures, and trends toward the alignment of price levels. BEI price levels do not mirror neighboring countries' prices to the same extent due to the specifics of this trading zone leading to limited supply options and thus competition.

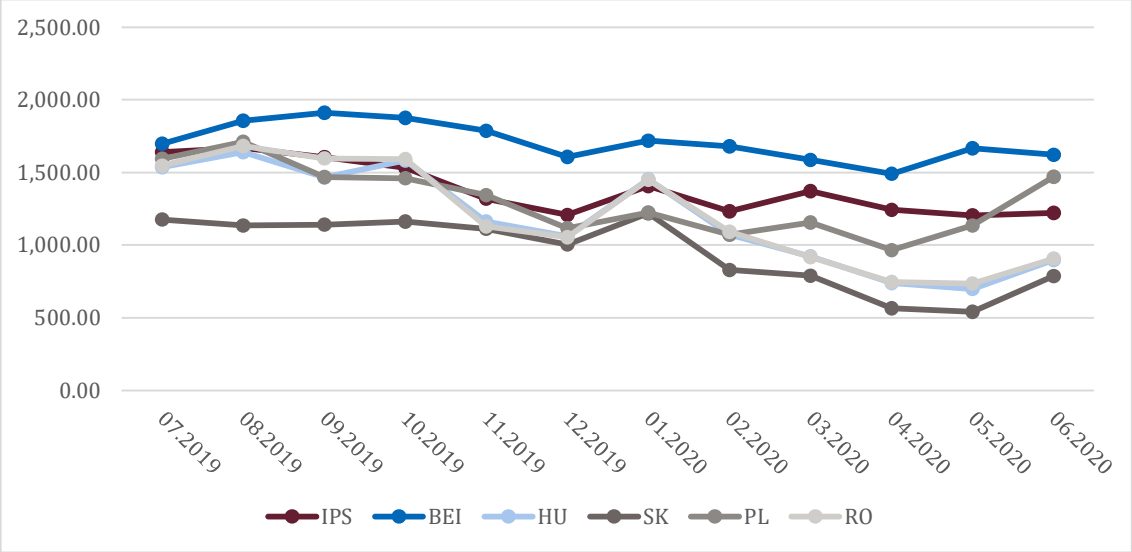



*Figure 2: DAM prices*

### *Intra-Day Market and Balancing Power Market*

Comparison of near-real-time data from the IDM and BPM segments with Poland's market highlight similarities between Poland and Ukraine such as significant inflexible baseload generation and fossil fuel dominated fuel mixes.

IDM prices in all three markets (BEI and IPS in Ukraine, as well as Poland) have seen a downward trend. However, in relatively young markets (as is Ukraine's), the IDM segment often suffers from low liquidity because market participants usually need time to get accustomed to adjusting their trading positions closer to real-time developments.

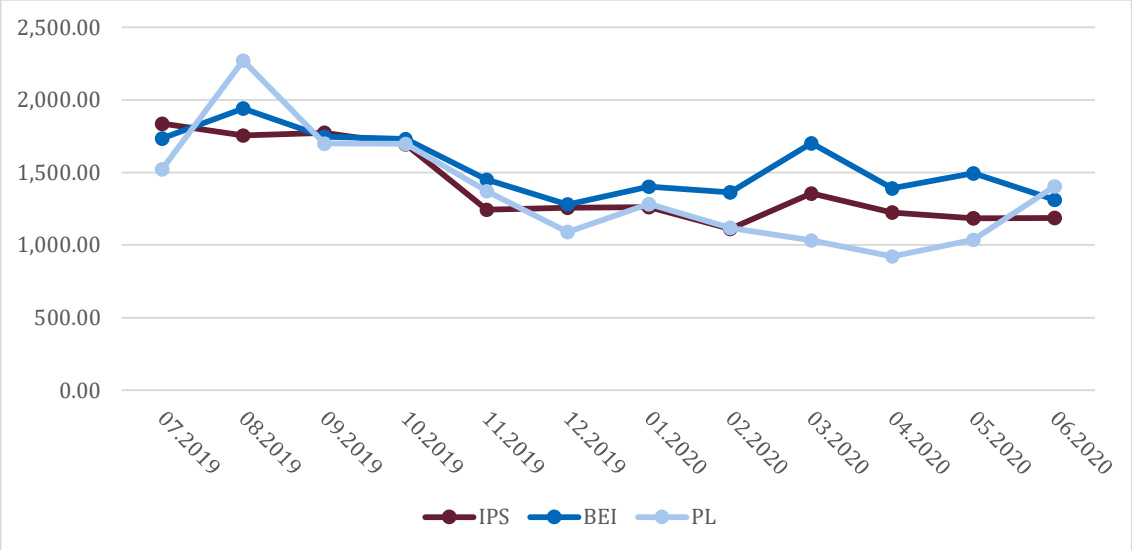



*Figure 3: IDM prices (Source: Data from the Market Operator and TGE websites)*

The balancing market prices in Ukraine demonstrated a high volatility as shown in the figure below, which depicts the level of imbalance prices in real-time. The balancing market is also subject to bidding caps, which establish price levels for balancing service providers (BSPs) to offer their bids to the TSO. During the first year, the caps underwent significant changes, but they still depend on actual DAM prices to a large extent.

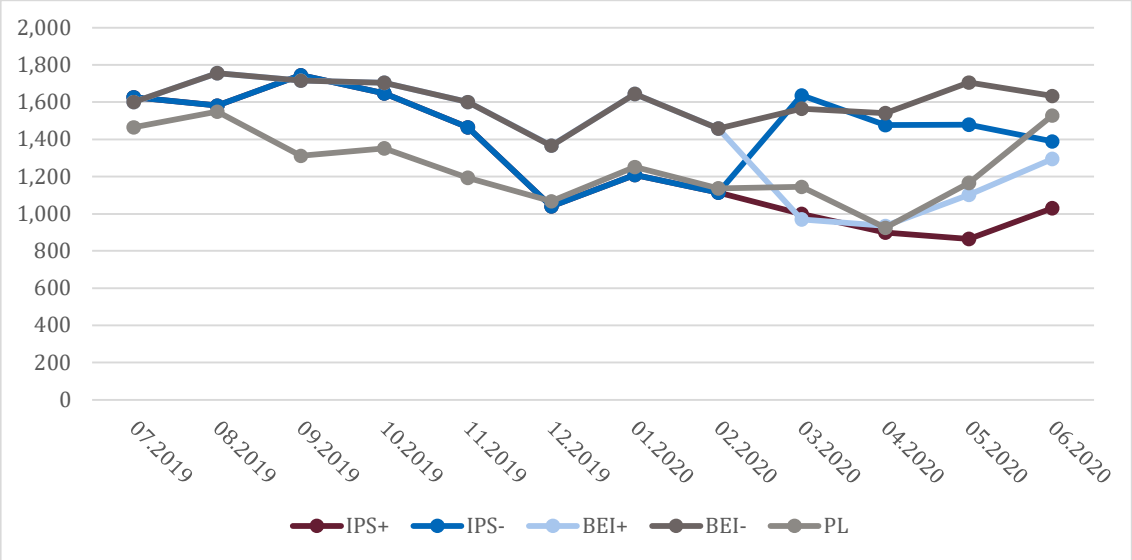



*Figure 4: Real-time imbalance prices (Source: Data from Ukrenergo and ENTSO-E transparency platform websites)*

The figure above shows that imbalance prices are separated into two components starting from March 2020. In July 2019, the BPM started with hourly settlement periods and a single imbalance price for each hour. It was formulated to be the weighted average, using the marginal real-time-unit based (RTU, 15 minutes) prices and the amount of activated balancing energy in every RTU. After half a year, it became clear that the single price did not reflect the full cost of TSO balancing and that it failed to provide sufficient stimulus to the balancing responsible parties (BRPs) to properly retain their balances. Based on ESP's analysis and recommendations, the NEURC introduced dual imbalance pricing (separate prices for positive and negative imbalances) effective as of March 2020. A dual imbalance pricing approach is applied in many developed markets and can achieve better price signals.

## 2.2. PROBLEMS DURING THE FIRST YEAR AND MITIGATIVE ACTIONS

### 2.2.1. DEFAULT OF MARKET PARTICIPANTS AND DEBT ACCUMULATION

According to the market rules of the BPM, market participants must provide security covers (financial guarantees) to secure financial settlement in the BPM; payments to cover the cost of imbalances can be secured without debts being accumulated. At the same time, the DAM and IDM operates based on pre-payment and are not imposed to non-payment risks. As of June 2020, there were 33 market players (MP) with default status for a variety of reasons (e.g. lack of financial guarantee, non-payment to the settlement administrator, bankruptcy and liquidation of the company).

The customers of defaulted suppliers are transferred to the supplier of last resort (SLR). Although this is a common practice in other countries for operational sustainability of retail, as well as wholesale markets, the special circumstances of the Ukrainian electricity market exacerbated the problem, simply

due to the inactivity of relevant decision-makers as explained below and now poses a huge risk for financial stability of the WEM, threatening its operation.

Systematic violation of the financial discipline by some market players caused a critical financial situation leading to the inability of the TSO to fulfill its payments to the Balancing Responsible Parties) (BRP) and Balancing Service Providers (BSP). As of June 2020, BRPs debts to the TSO reached 2.6 BUAH, SLR (Ukrinterenergo) being the largest debtor, exceeding 1 BUAH. Out of 2.6 BUAH total debt, approximately 1.8 BUAH appears to be debts caused by "protected customers".[1] This customer group, including coal mines, chemical facilities and water utilities (like Voda Donbasu) cannot be disconnected from the system due to non-payment, due to government dictate. Even the SLR's debt is mostly caused by these protected consumers for the periods they were served. Moreover, DSOs providing service to these customers also suffer from non-payment and accumulate debt against the TSO in the BPM.

The fact that these customers run loss-making businesses due to unprofitable coal mines or lacking in payments for their water supply services might be an external problem for the electricity market, but it clearly threatens the market's financial sustainability. The measures for protected consumers have been stipulated in laws including the EML; there is also, for example, a CMU resolution[2] on Voda Donbasu prevents disconnection due to non-payment but the required steps to limit its consumption and provide funds for their electricity bills remain unaddressed. It must be noted that debt accumulation in the WEM was also the most significant problem in the old single-buyer model that led to over 30 billion UAH in mutual debts. Therefore, relevant government bodies should not postpone further addressing the issue of protected consumers as described in the EML and other relevant legislation.

### 2.2.2. FINANCIAL SETTLEMENT GAPS IN THE BALANCING POWER MARKET

Total debits and credits of the TSO as the Settlements Administrator (SA) as a result of financial settlement calculations for BPM cannot lead to a zero-sum due to different prices applied for up and down regulation orders issued for power plants to balance the system, as well as positive and negative imbalances in real-time. Therefore, the Market Rules formulate the implementation of "Uplift" accounts (provisions 5.21 - 5.24) to distribute the net balancing costs to load representatives and hence avoid the gap between payables and receivables of the SA. Similarly, the calculations for penalizing the BSPs due to non-compliance with balancing orders issued by the dispatchers are also described in the Market Rules (provision 5.19.3).

As of June 2020, the total amount of the gap to be distributed to load representatives through the uplift account reached 1.6 BUAH, simply because the market management software could not perform this function.[3] This, combined with the issue of protected customers, naturally worsened the problems of the TSO to make payments to corresponding BRPs and BSPs timely and in full, threatening their financial status (especially the BSPs that provide balancing energy upon dispatch orders and

[1] Based on BPM financial settlement data and ESP estimation.
[2] Resolution of the Cabinet of Ministers of Ukraine dated July 5, 2019, No. 570 establishes the request to find a source for financing of Water of Donbass (https://zakon.rada.gov.ua/laws/show/570-2019-%D0%BF)
[3] Based on financial settlement data and ESP estimations.

players like EA and GB involved in the PSO mechanism and often sell energy in the BPM instead of DAM/IDM due to the surplus in supply).

In July 2020, the results of the retroactive uplift account calculations were sent by the TSO to the market players and created significant concern due to its size and the questions raised about the balancing market operations performed by the TSO leading to financial gaps to be covered through uplifts. Some of the players even opened court cases challenging the implementation of the uplift account calculations. Currently, the issue is still unresolved, The NEURC is urged to investigate the dispatch orders and the financial gap that must be closed.

Also, uplift account provisions of the Market Rules on penalizing the BSPs for non-compliance with balancing orders issued by the dispatchers are yet to be implemented. These provisions are key for providing the critical discipline in the BPM that operates on a real-time basis and to decrease the total cost of balancing via payables due to the TSO issued penalties.

In sum, it is critically important for the NEURC and Ukrenergo to resolve the issues in the uplift account calculations and continue close monitoring of the payables to the TSO to mitigate the financial settlement gap and related difficulties.

### 2.2.3. PRICE INCREASES FOR END-CONSUMERS AND THE PUBLIC SERVICE OBLIGATION (PSO)

The new WEM changed the way prices are formed, which affected consumers while the PSO maintained the tariff for households at their previous level. Compared to the previous model, the WEM prices for consumers could decrease with the opening, and this reduced the cost of the unregulated market segment, particularly for large industrial consumers. However, the application of marginal pricing in the DAM and the addition of RE FIT costs into the transmission tariff caused end-user prices to increase significantly as explained in the previous chapter. Consequently, several large industrial consumers-initiated court cases against the transmission tariff increase, resulting in the court's decision to reverse the tariff increase for the applicants.

ESP proposed a solution to the abrupt transmission tariff increase. The proposed solution stipulated that transmission tariffs are decreased to more acceptable levels and cover part of the RE FIT support costs via profits obtained by the GB through the PSO mechanisms. With the transmission tariff decrease, the GB's financial obligation to the USSs significantly decreases and thus allows profits from selling the excess energy obtained from state-owned generators under the PSO mechanism to be used to compensate for part of the RE FIT. The proposal was adopted and allowed for the initial price shock due to the transmission tariff increase simultaneous with the market opening to be addressed.

#### GENERAL CONCEPT OF THE PSO FOR HOUSEHOLDS

The PSO concept was developed by the European Union in the Third Package of Directives as a temporary measure to enable some member countries to 'catch up' in developing their internal electricity markets without overly impacting vulnerable customers. A PSO means the delivery of a service, which otherwise should be supported by the state, often at a favorable (i.e., not cost-reflective) price. Within the EU, PSOs are considered to distort energy market operation and are generally not acceptable as long-term policy.

## THE PSO IN THE CONTEXT OF UKRAINE

The CMU adopted the PSO resolution on June 5, 2019 with a design to address two major challenges resulting from the WEM opening:

- To protect households from electricity price shocks caused by the removal of cross-subsidization, upon WEM opening; and
- To ensure market sustainability in the context of a rapid increase in RE generation due to high FITs guaranteed by the state (added later upon the tariff shock explained above).

The current version of the PSO stipulates that the GB buys electricity generated by low-cost state-owned nuclear and hydro plants through electronic auctions under price caps. The GB then sells the electricity to USSs for household consumers at prices low enough to keep the tariffs the same as before the WEM opening.

This mechanism is often referred to as a physical PSO, because the energy for the households is not actively traded on the market. The regulated prices of electricity for household customers vary widely by supplier and region. However, all are well below the price at which the GB purchases the electricity from EA. To offset this loss, EA is mandated to sell additional amounts of electricity to the GB at cost, which the GB then resells in the market at a profit. As a result, the GB's profit is contingent on the amount of additional energy it can buy from EA at cost and the electricity market prices.

In the beginning, when the EA was generating and selling adequate amounts of electricity to the GB and spot market prices were relatively high, the GB made enough profit not only to compensate the PSO loss but also to partially cover the RE FIT obligations. However, the situation deteriorated significantly towards the end of 2019.

## THE RENEWABLE ENERGY CONTEXT

In Ukraine, the GB is also responsible for the purchase and sale of all renewable energy. The difference between the renewable FITs and the WEM price is included in all customers' tariffs as a surcharge on the transmission charge. The TSO collects the surcharge and transfers it to the GB (under a special service contract) to compensate for the loss from the GB's renewable energy operations.

Because the amount of the green energy surcharge is not disclosed in customer bills and consumers are not aware of the size of their contribution to the renewable energy sector in Ukraine, the GB's renewable operations are often wrongfully considered to be part of the PSO mechanism.[4]

[4] By definition, a PSO mechanism is designed to provide support to the end customers, while in this case the GB is only administering customer support for the renewable energy producers.

## THE GB'S FINANCIAL DIFFICULTIES

Following a substantial decrease in electricity demand due to the mild winter and COVID-19, a decrease in nuclear generation, and a fall in spot market prices, the GB's spot market profit could no longer offset the loss from its household PSO transactions. In addition, the GB incurred a substantial loss from its renewable energy operations due to several factors, including:

- Too much renewable capacity was contracted at FITs that are very high by global standards. There was no cap on renewable energy capacity from independent power producers, and the prices proved to be very attractive to investors. Prices for wind and solar energy are between 200 and 250 percent higher than the Bloomberg New Energy Finance global averages;
- The TSO tariff did not increase enough to cover the GB's financial gap from renewable energy;
- Some Ukrainian heavy industries refused to pay the TSO tariff and tied their payments up in litigation; and,
- With decreasing demand, the TSO was unable to invoice and collect all of the forecasted renewable energy costs that were planned in the revenue requirements used for the 2020 tariff.

At the end of June 2020, the GB had accrued a 6 billion UAH uncompensated loss from its household PSO transactions and 17.8 billion (including VAT) in payable obligations for supporting the RE FIT.

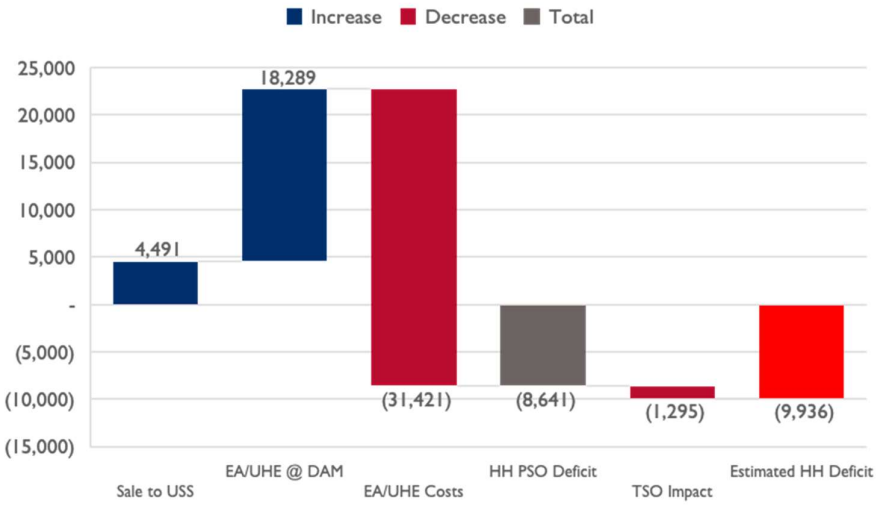



*Figure 5: Projected household PSO deficit in 2020 (million UAH)*

Losses of this magnitude threatened the PSO mechanism's continued functioning, as well as the solvency of the renewables industry. Consequently, the PSO resolution was amended several times to provide operational and financial improvements. Yet, the improvements did not go beyond providing quick fixes to critical problems like EA's deteriorated cash flows and undermined the financial stability of the mechanism as a whole.

The growing financial problems in the PSO mechanism led to the accumulation of huge outstanding payments to the EA by the GB and starting from March 2020, the EA significantly decreased the volume of energy sold to the GB below the mandatory level stipulated in the CMU's PSO resolution. This situation led to reduced electricity sales by the GB in the WEM and, hence, reduced profits required to offset the cost to purchase electricity from RE and to fulfill the household PSO obligations, especially during April and May.

In this context, the latest changes in the PSO resolution changed the mechanism as follows:

- The price of electricity sold by state-owned producers (EA and UHE) has changed and was set as 10 UAH/MWh (i.e. practically free). Previously, the price was set at the level of the average weighted price of electricity at which the respective producer sold electricity during April-May 2019 period (566.7 UAH/MWh for NPPs and 673.76 UAH/MWh for HPPs).
- The mandatory volumes to sell by EA and UHE were updated as follows:
    - Hourly selling volumes of EA to the GB are set at the level of volumes necessary to meet household consumption only. In the previous version of the resolution, EA was obligated to sell 80% of its production to the GB.
    - Hourly selling volumes of UHE are set at the level 30% its production instead of 35% in the previous version of the resolution.

Mandatory sales by EA through special sessions via electronic auctions for large consumers (through bilateral contracts) is maintained at 5% of its production.

The amendments removed the obligation for EA to sell 8 % of its production to the GB, which means it will have more volumes to sell on the BCM (mandatory volumes to sell on the DAM are determined in the EML), and simply aim to improve its cash flow through achieving a weighted average selling price that can cover the costs of EA (e.g. between 600-700 UAH/MWh).

The mechanism to sell in competitive segments of the market are provided via a new clause, which stipulates that in order to ensure the implementation of the PSO, EA and UHE must ensure a "weighted average price" of electricity sales at levels not lower than the price required for cost recovery defined via a formula introduced in the amendment: However, for the formula to be applied, there is no exact definition of "the full cost of electricity production" in EA's financial plan while there are several other definitions of costs. At the same time, the price for cost recovery according to the formula is expected to be between 1,100 - 1,400 UAH/MWh, which looks quite difficult to achieve under current market conditions. Previously, EA could sell Naftogaz 50 MW of baseload power through bilateral contracts for the delivery periods of 07/22/2020 - 07/31/2020 and 08/03/2020 - 08/31/2020 at the price of 948 UAH/MWh, calling into question the achievability of the 1,100 to 1,400 price range. So, besides undermining the financial stability of the PSO mechanism in full, the amendments risk not being able to improve the cash flow of EA unless further revisions are made.

### WAYS OUT OF FINANCIAL DIFFICULTY FOR THE GB

Measures for resolving the GB's financial difficulties can be classified into four groups:

- Completely redesign the PSO mechanism;

- Increase the GB's profit from the sales of electricity in the markets (via utilizing bilateral contracts and optimizing the trading activities at the DAM);

- Decrease the GB's loss from its renewable operations by including all required green energy surcharges in the transmission tariff or other support mechanisms outside of the GB; and

- Decrease the renewable FIT (recent MoU and law amendments provided some decrease).

Redesigning the PSO mechanism assumes the replacement of the physical PSO with a financial PSO (F-PSO). Under this approach, USS losses from household operations (purchasing electricity at market prices and selling it to households at regulated prices) will be compensated by EA based on contracts for differences (CfD). ESP supports this idea and has developed a comprehensive action plan together with a roadmap for the introduction of a financial PSO as soon as possible. However, the success of a financial PSO depends on the following prerequisites:

- Eliminating the deficit in the system, to ensure that EA will generate sufficient profit from its sales in the electricity markets to compensate for the loss of the USSs from their household operations.

- Rigorous independent performance monitoring of all USSs to ensure that their losses from household operations are minimized and that there is stringent administration and enforcement of all contracts for differences.

- A competitive bilateral market, regulated and monitored by the NEURC (to reduce potential imbalance in the spot market), and amendments to the market rules to make sure the electricity market can adapt to the substantial increase in EA's market power concentration.

ESP's analysis, based on comprehensive financial modeling, shows that introducing a financial PSO before these conditions are fulfilled seriously threatens the financial stability of the electricity market.

The advantage of the current physical PSO is that the system deficit is ultimately allotted to EA, which in the short-term has the highest tolerance for deficit because the share of cash required in its total cost of operations is the lowest of all market players (including only payroll and debt service requirements).[5]

The introduction of a financial PSO will transfer the system deficit to the USS's, whose deficit tolerance is much lower because their cash requirements are determined by the payments for their market operations. The system deficit may also increase due to the lower level of supervision over USS household operations and potential market manipulation as a result of the increased concentration of

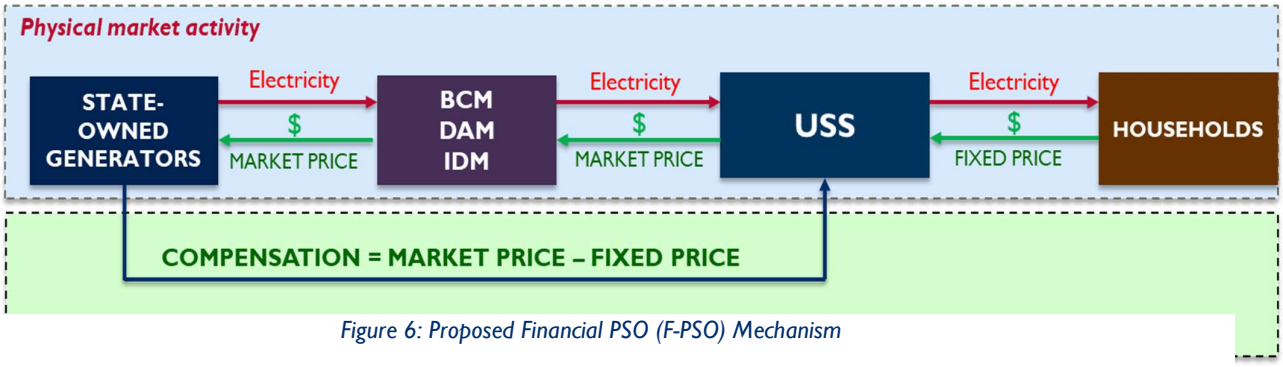



*Figure 6: Proposed Financial PSO (F-PSO) Mechanism*

[5] To avoid potential cash flow problems at EA in the medium term, ESP has recommended that EA be offered a revolving line of credit secured by its receivables and guaranteed by the GoU.

market power. That is why ESP recommends strictly following the action plan and roadmap to implement the financial PSO mechanism, which was sent to the GoU by the Energy Community Secretariat in cooperation with ESP. Proposed F-PSO mechanism based on financial swap contracts between state-owned generators and USSs are shown in the figure below.

The proposed F-PSO mechanism can be implemented in Ukraine through quasi-swap contracts designed as service contracts between involved entities as shown in the next figure. In order to be able so successfully switch from the current physical PSO to the F-PSO, the following steps must be taken first:

*Table 3: Required steps for implementation of the F-PSO*

| | |
|---|---|
| **Avoid mechanisms based on financial swaps** | To require fewer legislative changes and avoid taxing issues do not consider CfD type financial swap contracts and utilize "service contracts" |
| **Adopt new CMU Resolution** | • Impose PSO on USSs and state-owned generators whereby USSs will provide service to ensure affordability of electricity to households and receive compensation from generators<br>• Avoid overregulation and cost+ approach as in tariff making, ensure smooth operation relying on market mechanisms and principles |
| **Competitive Bilateral Contracts (Forward) Market** | State-owned generators have a large market share. Day-ahead market dominated freely by these generators led to huge pricing problems in 2019 and 2020. So, they should sell certain volumes through bilateral contracts **under transparent and competitive trading rules regulated by NEURC** (standard products and contracts **"open to everyone"**) to achieve higher churn rates, liquidity and accountability. |
| **Working Capital Gap of USSs** | Current tariff structure of USSs doesn't accommodate the working capital required for energy purchases in the market. Advance payments in the PSO mechanisms or cost recognition in the tariff structure is needed. |
| **Prerequisites to avoid "immature" switch to FPSO to avoid the obvious failure** | • Address current "financial gap" in the physical PSO and outstanding payments to Energoatom under PSO and balancing market and make sure F-PSO works as planned<br>• Avoid using TSO tariff as a back-up for insufficient funds for F-PSO. This leads to a new cross-subsidy<br>• Ensure physically and financially balanced **energy balance.** Avoid allocation of energy to specific customer groups from state-generators. This leads to problems for PSO and constitutes a market intervention.<br>• Transparent and accountable bilateral contracts trade rules and platform<br>• Working capital arrangement for USSs to buy energy in the market under F-PSO.<br>• Carefully analyze market specifics and DSO tariffs to ensure smooth operation. |

Considering that the costs of the PSO depend on the subsidy provided to households, the following three steps are recommended to be an integral part of the decision to switch to F-PSO: **(1)** Remove the first tariff block (0-100 kWh) in the household tariffs that provides a heavy subsidy; **(2)** Design a multi-year phase-out program for the PSO to ensure full cost-reflectivity in the retail segment while addressing affordability (e.g. as in the graph in the bottom right of figure below); **(3)** Maintain required financial support to vulnerable consumers.

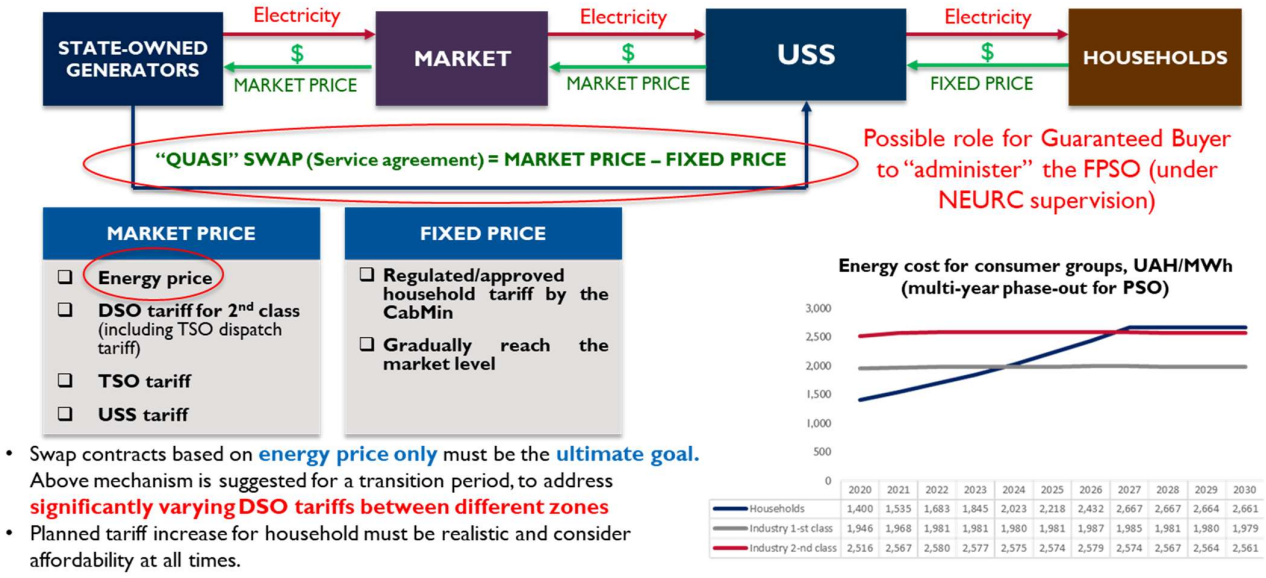



*Figure 7: Operation of the proposed F-PSO Mechanism in Ukraine*

### 2.2.4. FORMATION OF MARKET PRICES

Throughout the first year of operation, market price formation at the DAM/IDM and BPM came under stress due to several factors, such as moderate demand due to mild winter conditions while seeing an increase in the supply, quarantine measures due to Covid-19, misleading imbalance price signals based on market rules, increase in bilateral contract volumes due to low DAM prices, increasing surplus on the supply due to rapidly growing RE generation under high FITs, deficiencies in setting bidding caps for BPM, etc. Some of the critical issues and corresponding mitigative actions are explained below.

#### 2.2.4.1. DOWN-REGULATION BIDDING CAPS AT BPM

The TSO is responsible for balancing the system utilizing the Balancing Services Providers (BSPs, mostly generators) in the BPM to mitigate mismatches in supply and demand by increasing or decreasing generation levels.

Accordingly, BSPs provide bids for BPM for up- and down-regulation. When the system is in deficit, the TSO activates the least expensive up-regulation bid. When the system is in surplus, the highest paying down-regulation bid is activated. As part of real-time balancing market activities, TSO dispatchers issue ramp up and ramp down regulation orders to generators, to generate more or less than their current levels, respectively. Notably, all generators are obliged to follow these orders.

As a part of the Safe Mode framework, down regulation bid prices of the generators were capped at 85% and up regulation caps at 115% of the DAM cap levels (i.e. 959.12 UAH/MWh for the night, and 2048.53 UAH/MWh for the day periods) on an hourly basis. Later, down-regulation caps decreased to 70% and 55% of DAM caps in January and March 2020, respectively. ESP supported the initiative and recommended to continue decreasing it gradually, compliant with the Safe Mode framework.

When demand was high during the summer and early Autumn of 2019, DAM prices were very close to the caps. Therefore, the margin between the day-ahead prices and down regulation prices were

positive, which means down regulation orders issued to maintain the stability in the system led to positive gains for generators, motivating them to follow the orders as expected (see the graph below).

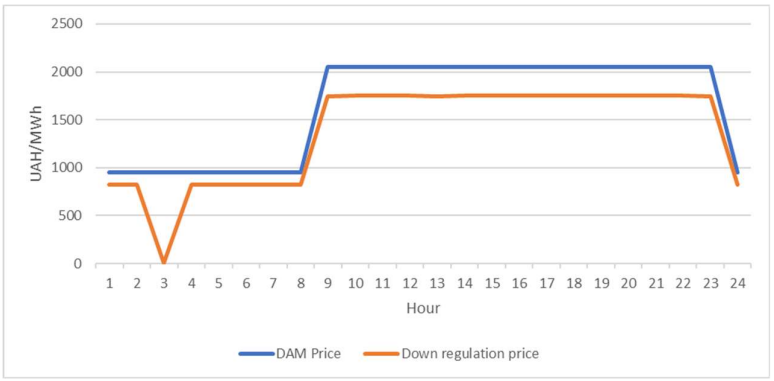



*Figure 8: DAM prices and down-regulation prices at DPM in July 2019*

Considering that the DAM prices might go down in the near future, due to supply-demand dynamics, and down-regulation caps linked to the DAM caps might lead to undesired losses for generators when they follow a dispatch order, ESP suggested to link the down-regulation caps to the DAM prices instead of the DAM caps. Required amendments were adopted in late November when negative margins for generators due to the down-regulation caps started to occur (see the graph below). As a result, generators following the TSO's down-regulation orders started to lose money as they had to buy the electricity at a higher price than they sold at the DAM. This was simply because down-regulation caps were linked to the day-ahead market caps (i.e. 959.12 UAH/MWh for night and 2048.53 UAH/MWh for day periods) instead of actual DAM prices, which are low compared to levels in previous months.

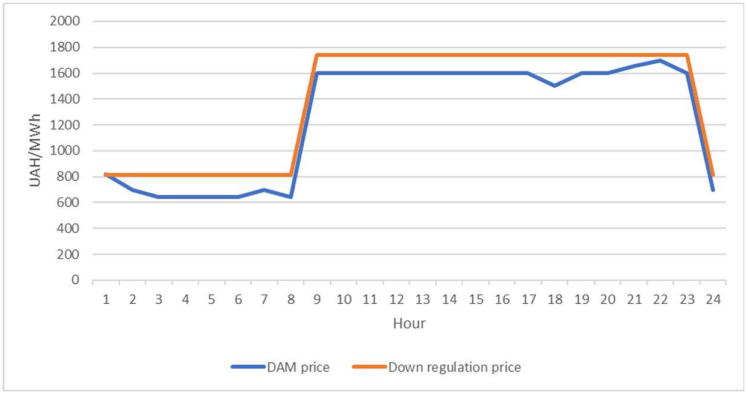



*Figure 9: DAM prices and down-regulation prices at BPM in November 2019 (first 20 days)*

### 2.2.4.2. PROBLEMATIC IMBALANCE PRICING APPROACH IN MARKET RULES

In January 2020, when the power system started to have surpluses (mostly due to high nuclear generation base and a relatively warm winter), some market players adopted a trading strategy of selling in the DAM large volumes while buying energy from the BPM to close their position at lower prices, earning profits from arbitrage (see figure below). This led to controversial discussions in the market referred to as start of "air trading" since artificial supply volumes caused abrupt decreases in

DAM prices, impacting adversely the power producers, the GB (due to trading RE and nuclear energy portfolio) and the workings of the PSO mechanism.

The case referred to as 'air trading' can be described as follows. Normally, a buyer in the DAM/IDM buys electricity to close its position (e.g. to fulfill the required volume of a bilateral contract for selling electricity or simply to cover the consumption of its end-user customers) while a seller in the DAM/IDM sells electricity to offer available energy to the market/buyers (e.g. to be generated at its power plants or purchased through bilateral contracts/imports). Then, if in real-time the seller cannot provide the committed volumes, it is expected to pay the imbalance price to the TSO, which is expected to be higher than the corresponding DAM price. When the imbalance price for negative imbalances (e.g. not providing the committed hourly energy volumes in real-time) was lower than the DAM price due to the surplus in the system in real-time, some market participants started to sell energy at the DAM that they did not have and had negative imbalances in real-time. When the imbalance price for negative imbalance was lower than the DAM price, they simply earned a profit margin from their non-existing energy and this trend was referred as air-trading by market participants/decision-makers. As the volume of such transactions increased, the DAM prices artificially decreased due to offering of non-existing energy as supply.

Although arbitrage, per se, is not an issue under liberalized market conditions, this problem was not the result of market dynamics but rather the direct result of the wrong pricing approach/formula for imbalances in the Market Rules. Specifically, the Market Rules did not differentiate the price for positive imbalances and negative imbalances (i.e. the tool market players used to close their open positions) and applied a single price for all imbalances.

Required amendments were introduced in late February 2020, effective from March 1, 2020. The adopted approach allowed for different pricing for positive and negative imbalances and ensured that any type of imbalance results in a financial loss, providing the proper required signal to traders. Hence, the problem caused by wrong price signals was resolved immediately upon application of the new approach.

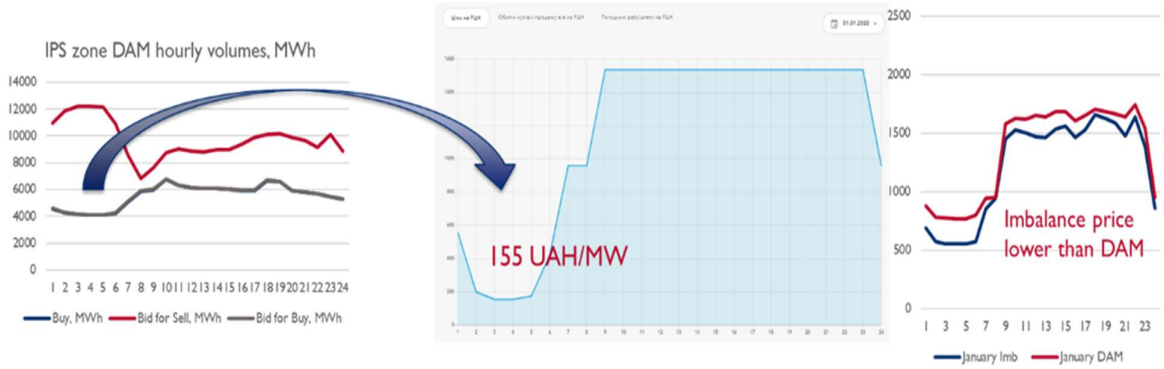



*Figure 10: Market price distortions in January 2020*

### 2.2.4.3. NIGHT TIME BIDDING CAPS AT THE DAM

Bidding caps at the DAM/IDM adopted as a part of the Safe Mode aimed at avoiding price shocks in the market upon opening, considering the fact that generation segment is significantly concentrated. The cap levels were determined to also allow power producers to have similar revenue levels compared to the previous market model. Accordingly, two different cap levels were adopted for night and day time zones.

Starting from the market opening in July, the level of night zone caps was regarded as low by the baseload generators (except EA whose generation costs are also very low). Consequently, supply bids from these generators were low during the night hours and the TSO had challenges to maintain the required level of ancillary services and balancing reserves. When the DAM prices started to decrease starting from the late Autumn 2019, the problem with the night zone caps grew. In order to address the issue, NEURC linked the BPM up-regulation bidding caps to the DAM cap levels instead of actual DAM prices.

Although this initiative provided some comfort for the balancing service providers, it did not resolve the problem completely. ESP suggested to revise the night zone bidding caps at DAM and link the bidding caps at BPM to actual DAM prices. Indeed, analysis of pricing at the DAM for March and the first half of April showed that DAM prices tend to decrease in the daytime zone, while prices during the night hours generally approach the level of the bidding caps. This result shows that pricing is not entirely market-driven during night hours (compared to daytime hours with similar demand levels) and is constrained through an artificially imposed restriction due to bidding caps. Accordingly, ESP ran simulations by regenerating the hourly supply-demand curves for different night zone bidding cap scenarios and recalculated the expected DAM price levels as seen in the table below.

*Table 4: Night zone bidding cap scenarios for DAM*

| | Scenario | | Input data | | Average weighted (March) | | | Average weighted (April 15 days | | | Price increase (March) | | | Price increase (April 15 days) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NPC/DPC | Night price cap (NPC) | Daily price cap (DPC) | DAP | DAP night | DAP day | DAP | DAP night | DAP day | DAP | DAP night | DAP day | DAP | DAP night | DAP day |
| | | % | UAH/MWh | UAH/MWh | UAH/MWh | UAH/MWh | UAH/MWh | UAH/MWh | UAH/MWh | UAH/MWh | % | % | % | % | % | % |
| 1 | Night price cap | 100% | 2048.23 | 2048.23 | 1549.69 | 1549.47 | 1549.79 | 1397.22 | 1416.81 | 1389.72 | 13% | 62% | 0% | 11% | 53% | 0% |
| 2 | Night price cap | 60% | 1228.94 | 2048.23 | 1451.47 | 1224.44 | 1549.79 | 1335.36 | 1193.59 | 1389.72 | 6% | 28% | 0% | 6% | 29% | 0% |
| 3 | Night price cap | 50% | 1024.12 | 2048.23 | 1390.94 | 1024.12 | 1549.79 | 1283.4 | 1006.06 | 1389.72 | 1% | 7% | 0% | 2% | 9% | 0% |
| 4 | Current night cap | 47% | 959.12 | 2048.23 | 1370.54 | 956.61 | 1549.79 | 1261.13 | 925.71 | 1389.72 | 0% | 0% | 0% | 0% | 0% | 0% |

The analysis found that overall price levels in the DAM can be improved by addressing the pricing during night hours, which will help market participants (especially the GB and BSPs) to reach a financially sustainable level. More importantly, the market price signal becomes more reliable. Therefore, ESP suggested to change the night zone bidding caps by triggering automatically based on the DAM price levels e.g., when the weighted average DAM price goes below 1300 UAH/MWh (considering the minimum required price level for the household PSO based on the previous energy balance) in the previous day/ or decade (10 days). Thus;

- If the market functions well during the quarantine period, then the night cap can remain low. If not, then it can increase automatically to 60% of the day cap;
- If, after the quarantine period, the market does not exhibit recovery, then the night caps are set high to support sustainability of baseload generation, balancing service providers and the PSO.

On July 29, 2020, the NEURC increased the night zone bidding caps (for one week) to 60% of the day zone caps to test the results. The table below shows DAM prices during the night hours. As can be seen from the table, the market reacted quite moderately to the new bidding caps, and hourly prices mostly remained at levels observed before the change. In just two hours, the price exceeded the previous bidding cap. The increase compared to the previous cap was limited to 2.8%, whereas the bidding cap increased by 28%.

*Table 5: Night zone DAM prices after new night zone bidding caps*

| Hour | 1 | 2 | 3 | 4 | 5 | 6 | 7 | … | 24 |
|---|---|---|---|---|---|---|---|---|---|
| Date | UAH/MWh | | | | | | | | |
| 30-Jul | 905.00 | 905.00 | 855.00 | 815.00 | 810.00 | 810.00 | 905.00 | … | 906.00 |
| 31-Jul | 951.00 | 949.99 | 951.00 | 949.99 | 949.99 | 949.99 | 949.99 | … | 935.00 |
| 1-Aug | 955.59 | 904.99 | 903.00 | 903.00 | 903.00 | 903.00 | 903.00 | … | 903.00 |
| 2-Aug | 950.00 | 937.99 | 950.00 | 920.00 | 902.99 | 902.99 | 902.99 | … | 900.00 |
| 3-Aug | 958.37 | 937.00 | 958.37 | 937.00 | 903.00 | 937.00 | 959.11 | … | 900.00 |
| 4-Aug | 986.84 | 957.36 | 984.15 | 958.00 | 952.79 | 957.36 | 957.36 | … | 900.00 |
| 5-Aug | 958.00 | 936.99 | 958.00 | 958.00 | 903.00 | 936.99 | 936.99 | … | 900.00 |
| Previous night bidding cap | | | 959.12 | | New night bidding cap | | | | 1,228.94 |

At the same time, the table below shows the maximum IDM prices during the night hours. As can be seen from the table in eight hours, the price exceeded the previous cap by 3.9% at the maximum, whereas the bidding cap increased by 28%.

*Table 6: Night zone IDM prices after new night zone bidding caps*

| Hour | 1 | 2 | 3 | 4 | 5 | 6 | 7 | … | 24 |
|---|---|---|---|---|---|---|---|---|---|
| Date | UAH/MWh | | | | | | | | |
| 30-Jul | 959.12 | 959.12 | 959.12 | 959.12 | 959.12 | 959.12 | 959.12 | … | 959.12 |
| 31-Jul | 959.12 | 959.12 | 959.12 | 959.12 | 959.12 | 959.12 | 959.12 | … | 959.12 |
| 1-Aug | 965.15 | 894.00 | 898.00 | 898.00 | 898.00 | 898.00 | 898.00 | … | 912.02 |
| 2-Aug | 959.50 | 935.39 | 959.50 | 929.20 | 884.90 | 884.90 | 884.90 | … | 909.00 |
| 3-Aug | 959.12 | 0.00 | 959.12 | 959.12 | 959.12 | 959.12 | 959.12 | … | 959.12 |
| 4-Aug | 996.71 | 966.93 | 993.99 | 967.58 | 919.00 | 966.93 | 966.93 | … | 909.00 |
| 5-Aug | | | | | | | | … | |
| Previous night bidding cap | | | 959.12 | | New night bidding cap | | | | 1,228.94 |

As a result, the NEURC extended the application until the end of the quarantine measures.

### 2.2.4.4. QUARANTINE IMPACTS ON PRICE LEVELS

As seen in the figure below, as demand decreased due to quarantine measures introduced in early Spring 2020, a significant surplus started to occur in the system (combined with the increasing RE generation). Since consumption decreased and the system was in surplus, DAM price levels decreased significantly, which led to some producers selling more volumes on the DAM, IDM and BCM and waiting for downward instructions from the TSO, relying on the significant difference between the DAM price and the BPM downward price. Similar behavior happened for traders as well, and some players started to sell at the DAM and close their positions at the IDM, where price levels were lower than the DAM due to the expected surplus in real-time. This trend was referred to as another way of "air trading" as artificial selling volumes were being observed (see the section on the bilateral contracts segment for further elaboration).

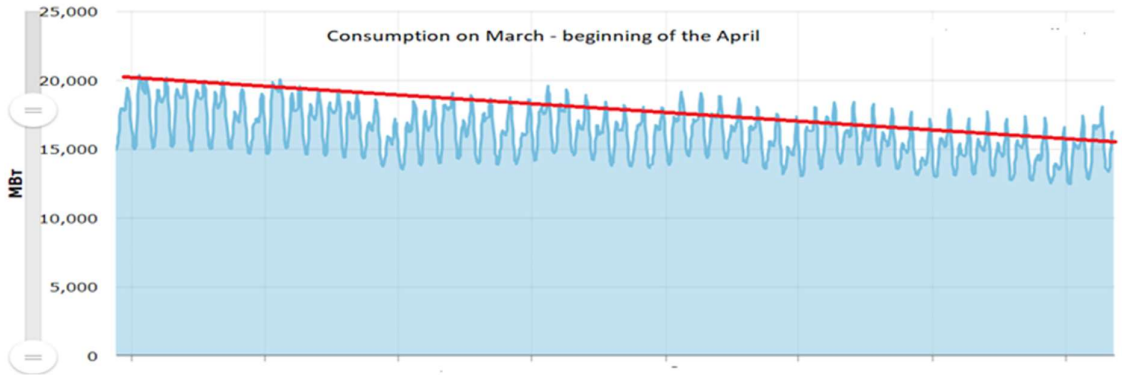



*Figure 11: Consumption decrease during COVID-19 quarantine (Source: public data from Ukrenergo web-site)*

In order to address this situation, following ESP proposed the following measures.

- Link the BPM upward bidding cap to the DAM price instead of DAM caps;
- Increase the downward bidding caps (e.g. 80 – 90% of DAM cap);
- Limit the DAM/IDM sales with available generation and bilaterally purchased energy (including imported volumes).

In response to the quarantine impacts and proposals, the NEURC adopted several measures and introduced checks for the physical availability of volumes to be sold, increased the downward bidding cap to 80% of actual DAM prices, and reduced the up regulation bidding cap to 105% of the DAM bidding caps. As a result, market prices restored to levels around 1300 UAH/MWh and opportunities for air trading were diminished.

### 2.2.4.5. PRICE LEVELS IN BURSTYN ZONE

As explained in Section 2.1., market price formation in the IPS demonstrated different characteristics based on time of the year and market conditions. Moreover, several factors including quarantine measures and mild weather conditions led to significant price decreases, driving prices to go well below the levels observed following the WEM opening in July 2019. However, these developments have almost never been observed in the Burshtyn pricing zone (BEI); prices remain high most of the time, being significantly above the average levels seen in the IPS.

Domestic generation in BEI is very limited and the electricity market in this zone is heavily concentrated. The diversity in supply can be provided, practically, only by imports. An added complexity is that per the requirements set for synchronization of BEI with the ENTSO-E zone, some units within the existing single large thermal power plant must be operational at all times to provide the required volume of reserve. Although sometimes active cross-border trade (import and export) can be observed, limitations set by the capacity allocation rules combined with decreasing demand and price levels in neighboring countries led to a situation in which cross-border trade could not provide a substantial diversity for supply for BEI during the first year of WEM operation.

Daily capacity auctions in Ukraine are held on D-2 and on the same day the volumes are registered on the electronic platforms. At the same time, auctions in neighboring countries for the cross-border capacity are held at other times and are not synchronized with auctions in Ukraine (for example, in Slovakia, the results of the auction are known at 10:45 SET D-1). Consequently, the cross-border capacity cannot be utilized effectively to increase the diversity in supply as non-synchronized auctions lead to the purchase of different cross-border capacity by contractors on different sides of the border.

On D-1, the auction office conducts an assessment of the operational safety of the power system, which consists of assessing the required reserves and the operation of generation. In certain periods, these assessments can lead to restrictions on utilization of the allocated cross-border capacity. Therefore, it is vitally important to expedite the efforts to establish common (coordinated) cross-border capacity auctions as suggested by the Energy Community Secretariat. Accordingly, required primary and secondary legislation should be adopted as soon as possible.

ESP has been supporting the cooperation between the Market Operator in Ukraine and its counterparts in Hungary, Romania and Slovakia, and fully supports the Energy Community activities towards achieving common cross-border capacity auctions. Until Ukraine's full integration to ENTSO-E is completed, market coupling of the BEI zone with neighboring ENTSO-E countries can be achieved and the issue of high DAM prices in the BEI can be mitigated using a market-oriented approach.

### 2.2.5. ANCILLARY SERVICES RESERVES

ESP has been working closely with Ukrenergo on testing the generation fleet towards certification for provision of ancillary services and developing the ASM. In this context, ESP is undertaking activities to support ancillary services in the following areas specifically to ensure system stability and in support of ENTSO-E integration:

- Determining the available ancillary services reserves specifically FCR (primary) and FRR (secondary) reserves to be used for stabilizing the system. FCR and FRR electricity frequency support is needed for the overall grid stability and the specific flexibility for intermittent renewable energy integration;

- Testing and certification of generators as ancillary service providers so that they can start providing reserves to Ukrenergo and be remunerated accordingly; and,

- Developing monitoring procedures to ensure the ancillary services provisioning meet the quantity and quality requirements.

As of July 2020, with ESP assistance, Ukrenergo issued Ancillary Service (AS) certificates to eight UkrHydroEnergo hydropower plants and three coal TPPs. ESP provided the methodology, success criteria and specialist oversight of the testing process to Ukrenergo. With these licenses, UHE and

other AS providers will be able to offer reserve support to the power grid, through a competitive contract with Ukrenergo.

*Table 7: Power plants with certified reserve volumes.*

| Ancillary Service Provider | Reserve volume, MWs | | | |
|---|---|---|---|---|
| | FCR | aFRR | mFRR | RR |
| Required by TSO as per the Grid Code | ±119 | ±372 | 628 | 1000 |
| Currently Certified | ±115 | ±724.5 | 3696 | 4263 |
| Dnyprovska-1 HPP | 0 | 183 (±91.5) | 495 | 495 |
| Serednyodniprovska HPP | 0 | 178.8 (±89) | 300 | 344 |
| Kanivska HPP | 0 | 144 (±72) | 264 | 264 |
| Kahovska HPP | 0 | 197 (±98.5) | 317 | 317 |
| Dnyprovska-2 HPP | 0 | 199 (±99.5) | 479 | 479 |
| Kremenchutska HPP | 0 | 142 (±71) | 542 | 645 |
| Kyivska HPP | 0 | 176 (±88) | 336 | 336 |
| Dnistrovska HPP | 0 | 0 | 460 | 460 |
| Kurahivska TPP | ±88 | 230 (±115) | 230 | 380 |
| Kharkivska CHP | ±27 | 0 | 90 | 180 |
| Zaporizska TPP | 0 | 0 | 183 | 363 |

The current amount of frequency restoration reserve (FRR) and replacement reserve (RR) is well above the required levels per the Grid Code. The required frequency containment reserve (FCR) level is expected to be reached as soon as the upcoming unit tests on the thermal power plants are completed.

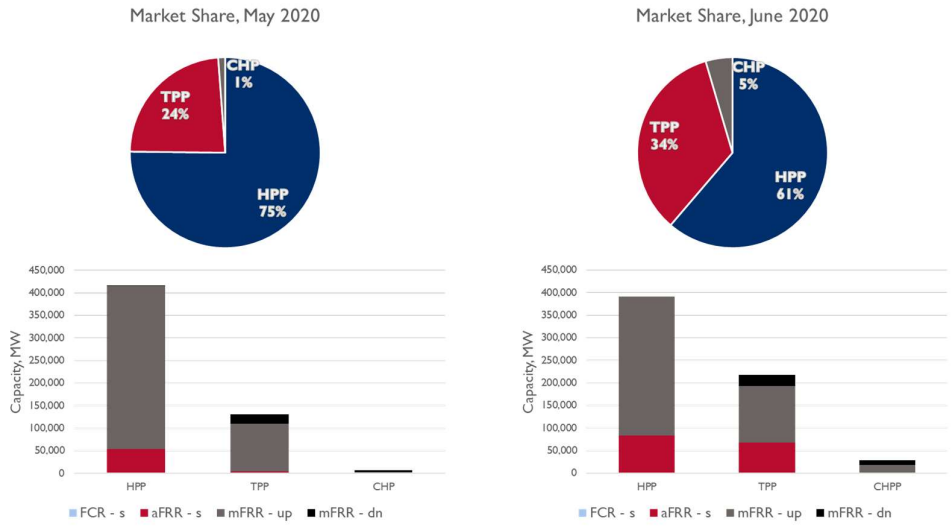



*Figure 12: AS market share by generation type*

Considering that there are mostly HPP's that operate with limitations due to water conditions and restrictions, Ukrenergo needs more sustainable sources of reserves; these can be provided by the coal-fired TPP's.

Following the UHE certification, as more generators (e.g. the remainder of the coalfired TPPs and nuclear units) are certified in due course, Ukrenergo will not need to use only UHE plants to support the system with required reserve amounts. This should allow water resources available to UHE to be used more effectively in the market.

Currently, all reserves have the same bidding caps and thus manual reserves (mFRR) are more attractive due to the simplicity of certification and provision of service. Since mFRR is fully procured, competition on this segment drives prices down and pushes market participants to provide automatic reserves (FCR, aFRR); a promising increase of aFRR volumes is being observed.

ESP developed an economic analysis of ASM results and developed the recommendations for differentiation of auction bidding caps with incentive price signals for automatic types of reserves (i.e. FCR and aFRR). Ukrenergo supported ESP's approach and sent it to the NEURC for adoption. The proposal does not increase the annual budget for ASM. Briefly, the proposals suggests changing the price caps for FCR and aFRR via 45% increase while decreasing mFRR caps to 45% of the existing level. Hence, required interest to FCR and aFRR auctions can be achieved by providing a reasonable profit margin (e.g. 3%) to cover the cost of providing AS reserves (see figure below). This proposed approach does not lead to any increase for the total allocated budget for ASM. Further ASM development will contribute to decrease dependence on the Russia power system as currently both systems work synchronously, and to facilitate the process for integration with ENTSO-E.

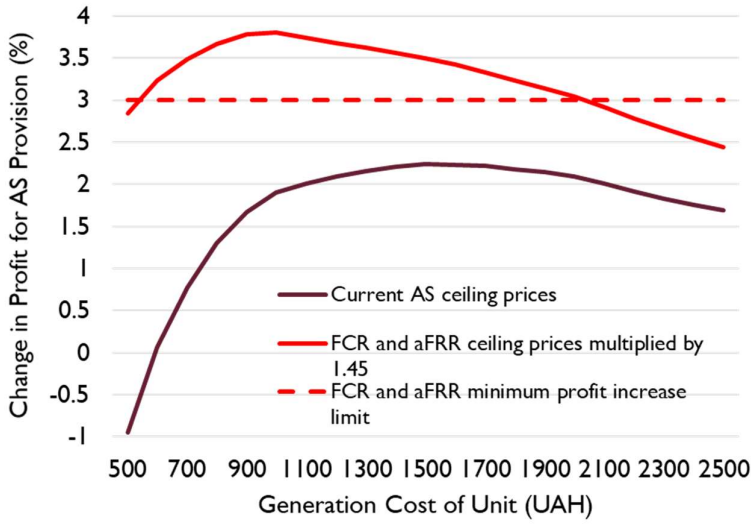



*Figure 13: Impact of proposed price caps for FCR and aFRR based on generation costs*

### 2.2.6. ENTSO-E INTEGRATION

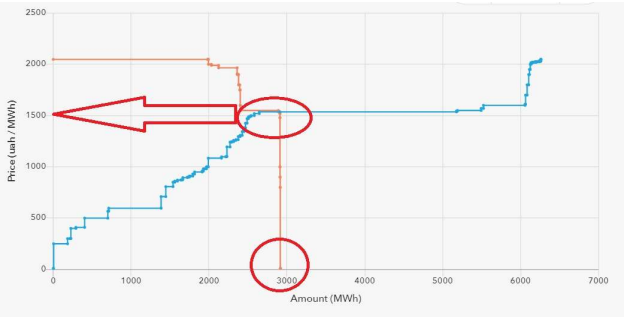
As a strategic goal, the ESP assists Ukrenergo with ENTSO-E integration via development of network models for flow and stability studies, analysis of island mode operation, least-cost generation scenarios and long-term network planning towards successful fulfillment of the catalogue of measures to join

ENTSO-E in 2023. Interconnection with the EU grid will mitigate the Kremlin's influence and further improve the IPS' operational reliability and market development.

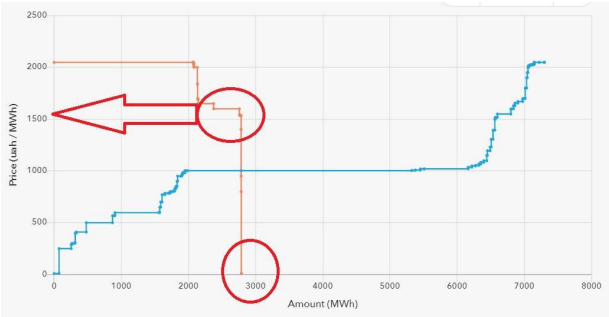
The ENTSO-E, Project Group (PG) for interconnection of Ukraine & Moldova is performing a variety of analyses. ESP provides support to Ukrenergo in its role on the PG and participates in the PG meetings together with Ukrenergo to evaluates results, assess risks presented by the PG, as well as evaluate proposed solutions for efficiency, applicability and cost (of installment and operation). These analyses mainly require detailed mathematical models of important power plants in the Ukrainian network, especially the NPPs. In this regard, the ESP already developed specific procedures for testing AVR systems of the NPPs (via discussions with PG, Ukrenergo, Energoatom and manufacturers, given the sensitivity of testing at the NPPs), and started to perform the field tests and develop initial models in August 2020 in support of the ENTSO-E PG.

### 2.2.7. BILATERAL CONTRACTS SEGMENT ISSUES

At present, the electricity bilateral contracts market is not organized and is not properly regulated (except for bilateral contracts of state-owned generators). There is only one platform for trading in these types of contracts where the disclosure of trade information is limited. Thus, transparency in this segment has been very low with hourly contracted volumes not known by market participants before DAM gate closure. Below is a typical consequence of this situation observed in July 2020, leading to significant financial consequences for all market players, especially the GB, which is tasked with the PSO and RE FIT payments:




Price at a level around 1500 UAH/ MWh




Price at a level around 1000 UAH/ MWh

*Figure 14: Price formation at DAM*

In the figure above, demand at the DAM is almost the same (around 2800-2900 MWh), and the market price can be formed around 1500 UAH/ MWh. The large bidding blocks (most probably by the GB as they have a large portfolio at the DAM with renewable energy and energy obtained from EA under the PSO mechanism) sets the price around either1500 UAH/MWh or around 1000 UAH/ MWh. Although the load forecast for the following day is known, the information on how much of this load is covered by bilateral contracts is not known by the GB (or other players). As a result, bidding strategies cannot be determined accurately, leading to decreased DAM prices and increased volumes for the BPM to be sold as positive imbalances and to be paid at prices lower than the already low DAM prices. Consequently, the financial stability of the GB, EA, and thus the PSO mechanism is impacted.

In addition, when DAM prices are low as above, thermal power plants are motivated to either shut down the units or sell energy in bilateral contracts with prices linked to DAM prices and expect down-regulation orders from TSO dispatchers in real-time since the system will undoubtedly be in surplus due to nuclear and renewable generation that could not be sold on the DAM. From a trading

perspective, the latter is naturally preferred as the margin between DAM price and down-regulation will lead to trading profits. The mentioned trading behavior by certain market players might look normal from a market perspective but can impact the stability of the market if not resolved by market dynamics. This is exactly what happened in the market starting from the late Spring 2020 and led NEURC, as suggested by ESP, to increase the down-regulation caps to 80% of DAM prices and introduce physical availability checks by the TSO to confirm the bilaterally contracted volumes.

In sum, it must be noted that the bilateral contracts segment constitutes more than two-thirds of the wholesale electricity market and impacts on other segments are inevitable. Given, the concentration in the generation segment, ESP has been stressing the importance of a well-structured and regulated (not prices but trading rules including standard products) bilateral contracts market in Ukraine. Accordingly, trading can take place at any platform under the standard rules and contracts securing financial settlement, bid-offer matching becomes transparent and proper reporting/monitoring for market surveillance purposes is guaranteed. Moreover, this can facilitate the development of the forward contracts market towards a power exchange in the near future, with possible integration of a financial clearing mechanism later on.

In this context, aiming to ensure transparency, monitoring and surveillance at the WEM, the following are recommended:

- Organization of the market of bilateral agreements according to the principles of transparency and non-discrimination, including the development of new licensed BCM platforms with standardized products including physical delivery obligation.
- Development of a market segment where new product price indicators will be formed, which will allow moving away from the current direct link for electricity prices in bilateral contracts to the DAM price.
- Creation of mechanisms for guaranteeing financial settlement under concluded bilateral agreements.
- Publishing and reporting the required information in accordance with its license, trading rules and applicable primary and secondary legislation.

### 2.2.8. RENEWABLE ENERGY SUPPORT MECHANISM IMPACTS

Because of state support and a relatively high tariff, there has been tremendous investor interest in Ukraine's renewable energy market. Reverse auctions have not been implemented yet as stipulated in the law. Meanwhile, because of the relatively high FITs and lack of caps on renewable energy capacity, the total cost of RE has increased in line with increases in RE generation. This situation has two main market aspects: the effect on the WEM and impact of RE support mechanism costs.

### 2.2.8.1. CAPACITY DEVELOPMENT, FIT OBLIGATIONS AND GB DEFICIT

The RE share of the generation has been growing rapidly in the last few years despite the decreasing trend of the FIT, which yet remains very high compared to other countries (see figure below[6]).

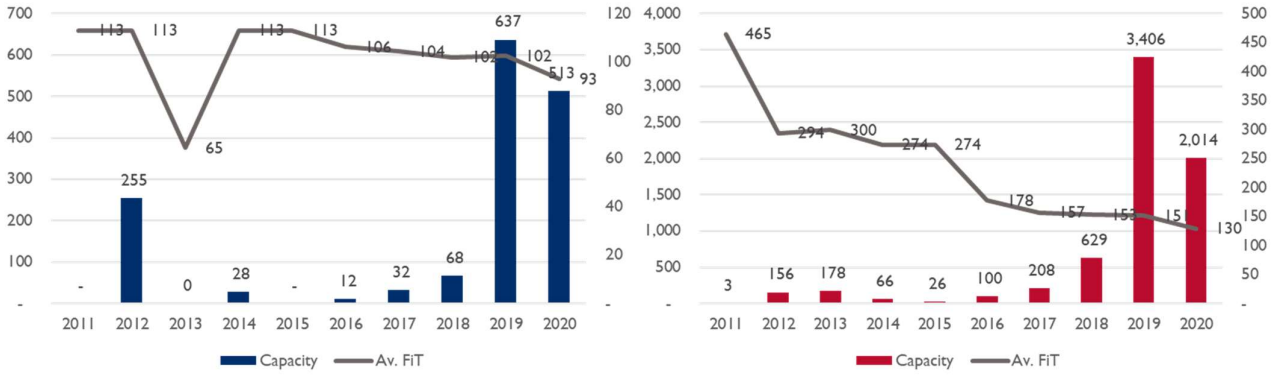



*Figure 15: Wind and Solar Generation capacities as of July 2020 (Capacity in MW, FiT Euro/MWh)*

The main source of cash generation for the GB for payment of the FIT is the proceeds of the sales of such RE energy at the DAM. However, it should be noted that the FIT are significantly higher than the market price and that this is expected to continue going forward. As FIT levels remain high compared to market price levels (see figure below), the GB and the TSO (through the transmission tariff) are obliged to cover the gap as per the EML. Since the average DAM prices are 2-2.5 lower than the average FIT, the subsidy is higher than the proceeds from the market sales. The largest share of subsidy is for solar energy producers. The GB incurs additionally the cost of imbalances of RE producers in real-time until RE producers gradually become responsible for their imbalances as specified now in the recently adopted Law #810.

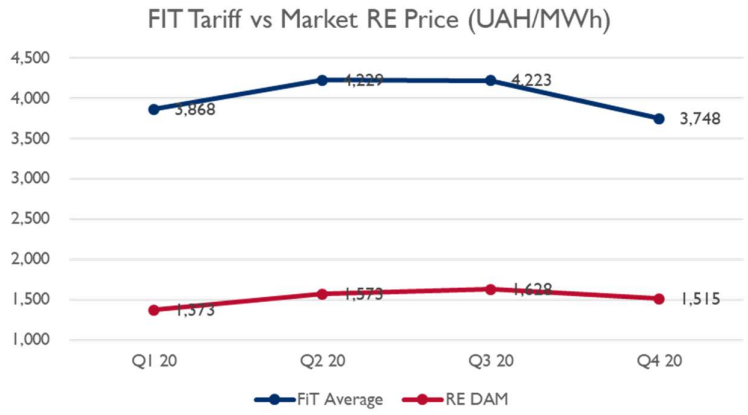



*Figure 16: Feed-in-tariff vs. average RE portfolio selling price at DAM*

[6] Solar rooftop volumes and support are excluded in this analysis. They are also supported but through a different surcharge in the TSO tariff.

Considering the MoU signed with RE producers and the consequently adopted law, the deficit of the GB for the renewable support mechanism in 2020 is estimated to be around 6 BUAH (~ 200 M EUR). The impact of the following actions were considered in the estimate:

- FIT Restructuring – July 1, 2020 – 2.6 Billion UAH
- TSO Tariff Increase – August 1, 2020 – 9.7 Billion UAH
- Deferral of 60% of AR to RE producers – August 1, 2020 – 9-10 Billion UAH.

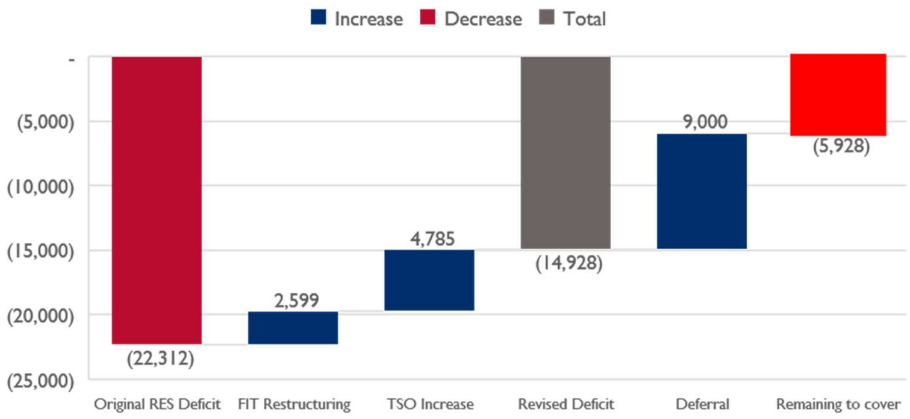



*Figure 17: Deficit in RE support mechanism in 2020 (MUAH)*

This deficit may be covered by loans from IFIs and other institutions to be obtained by the TSO. Deferral should be included in determining the revenue requirement for the TSO for 2021, i.e., the tariffs should remain at such a level for at least an entire year.

The deficit going forward will depend highly on what capacities from the already signed pre-PPAs will be completed and come into commercial operation as this will increase the support needed for RE producers since the restructured FIT tariffs continue to be at least two times higher than market prices.

The following are estimates based on an assumed additional 4,000 MW wind facilities completed in 2021 and 2022, with no further assets constructed.

Additionally, the deficit is estimated at the revised level of the TSO charge for RE remaining constant going forward indicating the need for further loans, State Budget support as provided for under Law #810, and/or TSO tariff increase to ensure timely payment of the amounts due to RE producers.

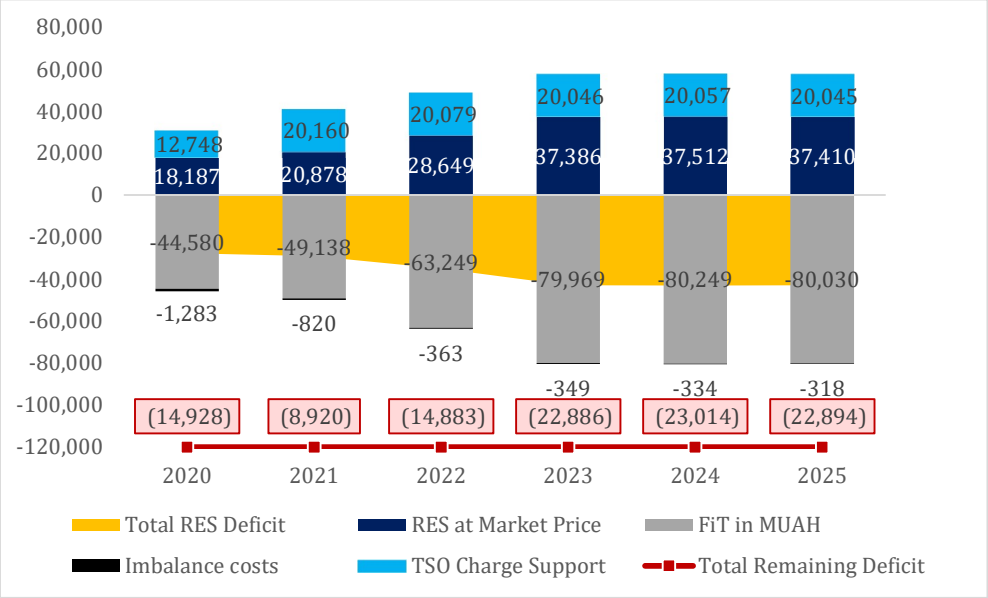



*Figure 18: RE Deficit Projection (Million UAH)*

Law #810 foresees State Budget support to the GB at the level of at least 20% of the gross costs of RE. At present, the process of setup and utilization of such support is unclear, being highly dependent on the Law on State Budget, Ministry of Finance and the budget performance. Depending on the availability of State Budget support, the TSO tariff is forecasted to have the trend depicted in the figure below through 2025.

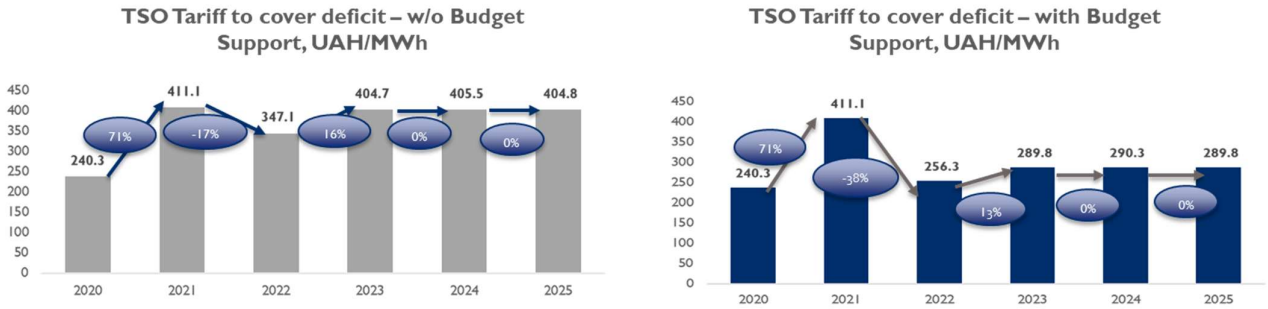



*Figure 19: Transmission tariff to cover the RE support gap (without and with State Budget support)*

### 2.2.8.2. IMPACTS ON WEM OPERATION AND PRICES

The figure below shows the mid-July electricity generation by source and consumption levels for 2019 and 2020. While the consumption level looks almost the same, renewable energy peak generation level tripled by an additional 2,000 MW output. Until the recent change in the EML in July 2020, the GB could sell the RE generation under PPAs only at the DAM under rules approved by the NEURC. According to these rules, the GB could offer this supply at DAM only at 10 UAH/MWh, hence practically with a zero bid, acting as a price taker.

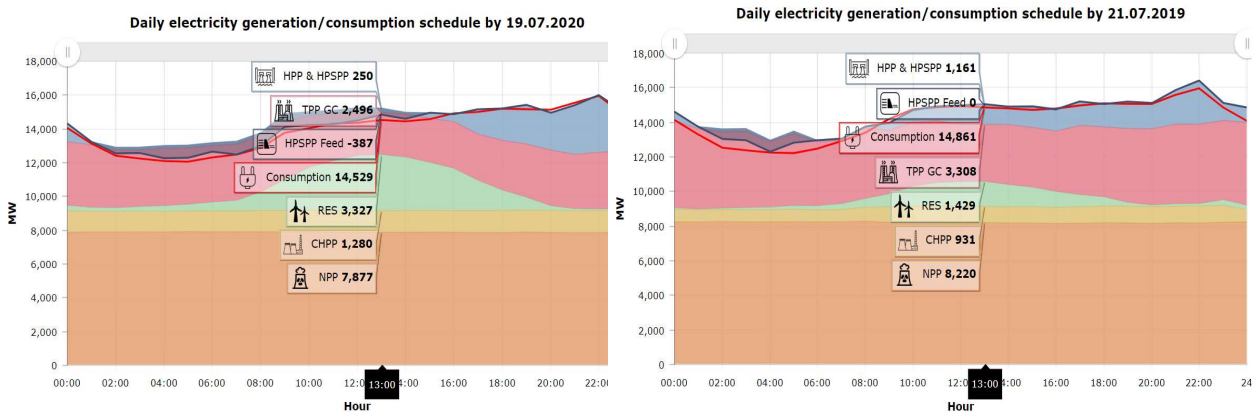



*Figure 20: Electricity Generation and Consumption levels in mid-July 2019 and 2020*

Combined with the decreased demand due to quarantine measures introduced in the Spring of 2020, significantly increased renewable generation expectedly caused the DAM prices to decrease. Indeed, record low levels of around 600 UAH/MWh were observed in the market. Impact on financial sustainability of the WEM aside, the GB's costs to cover the renewable energy support mechanism increased dramatically which, in turn, led to non-payment to EA for the energy procured for PSO purposes, as well as payments to RES producers. Therefore, ESP suggested to the NEURC to revise and increase the bidding caps for the RES portfolio managed by the GB and provided the analysis below to maintain reasonable bidding cap levels. Consequently, the NEURC adopted changes for the RES bidding caps.

*Table 8: Analysis on GB bidding caps at DAM for RES*

| | Scenario | Input data | Average weighted (April 16-30) | Average weighted (May 01-19) | Price increase (April) | Price increase (May) |
|---|---|---|---|---|---|---|
| | | GB bidding cap | DAP | DAP | DAP | DAP |
| | | UAH/MWh | UAH/MWh | UAH/MWh | % | % |
| 1 | GB bidding cap (75 % DAM cap) | 1536.17 | 1296.38 | 1311.44 | 6% | 0% |
| 2 | GB bidding cap (NPP cap in PSO) | 567.00 | 1228.02 | 979.78 | 0% | -25% |
| 3 | GB bidding cap (10 UAH/MWh) | 10.00 | 1188.73 | 789.16 | -3% | -40% |
| 4 | Current GB bidding cap* | | 1225.75 | 1310.45 | 0% | 0% |

* Current bidding cap: April 16-30: 567 UAH/MW, May: 75% of daily DAM cap

As shown in the above table, simulations run for April and May by reproducing the supply-demand curves for each hour suggests that RES bidding caps should be set reasonably high to avoid plummeting DAM prices. Also, since phasing-out of these caps after the quarantine can lead to very low DAM prices, new cap levels should be carefully designed based on supply-demand dynamics in the market.

The impact of RES penetration combined with decreased (or at least not increased compared to 2019) demand causes a persistent energy surplus in the system. Therefore, the energy balance was updated to address the surplus and the share of nuclear in the balance decreased. This step did not mitigate the problems and both balancing market and bilateral contract volumes increased significantly as shown in the section on market figures. This issue was mentioned in the previous section in the context of bilateral contracts and led the NEURC to introduce physical volume checks and increased down-regulation bidding caps.

The situation with the high RES penetration highlights the need for allowing the GB to sell renewable energy through bilateral contracts in advance, the importance of a well-designed BCM with physical delivery, establishment of a WEM data/transparency platform and making RES producers active market participants in day-ahead and balancing markets (e.g. via contract for differences approach explained in the next section).

#### 2.2.8.3. MARKET PARTICIPATION OF RES PLANTS

Currently, all RE procuders under PPAs managed by the GB are members of the balancing group of the GB. However, as the RES portfolio under PPA grows rapidly this creates challenges for the GB in managing the portfolio, trying to sell at the DAM the entire RE generation often exceeding half of the matched demand at the DAM while being responsible for the imbalances. Morever, the significant RES fleet cannot respond to system conditions and price signals in the market, providing mutual benefits for the system operator and the RE producers.

In order to address this challenge, implementation of a Contract for Differences (CfD) scheme can be considered for RES generators (existing and future) instead of fixed FIT payments (see figure below). Then, RES producers act as market participants, optimizing their generation revenues and imbalance costs. RES producers are motivated to establish or join balancing groups that can manage real-time imbalances of the associated portfolio better than the GB and thereby support system balancing for the TSO. The proposed mechanism can also allow improvements in RES generation forecasts and bids.

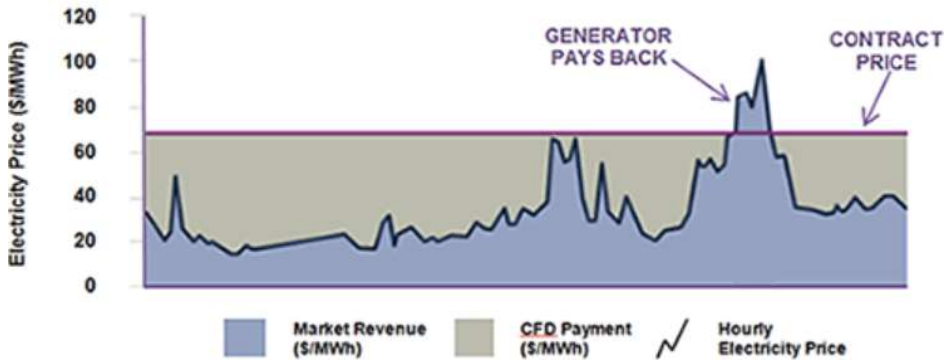



*Figure 21: Concept of the Contracts for Differences (Source: McCarthy Tétrault LLP study "Renewable Generation Incentives in Alberta Contracts for Differences: The Way Forward?" By Kimberly Howard, Kimberly Macnab, Seán O'Neill and Michael Weizman")*

Moreover, an "additional premium" based on the market prices can be provided to RES generators with existing PPAs that "voluntarily" choose to act as regular market players.

The level of additional premium should be chosen so that total cost of the provided incentives is less than, or equal to, the total expected imbalance cost of the corresponding RES generators if they stay in the balancing group of the GB.

#### 2.2.8.4. RES CURTAILMENT COMPENSATION

As installed capacity of RE has been rapidly growing, dispatchers sometimes curtail the RE generation to maintain system stability. According to the EML, all curtailed volumes should be compensated at the FIT level as if the volumes were not curtailed. Long discussions were held during the first half of

2020 to adopt the methodology for calculation of such compensation, but the methodology stipulated in the law is still not adopted. As Law #810 stipulated that associated costs must be covered through the transmission tariff, the methodology should be adopted to allow the dispatchers to curtail RES generation when needed and protect RES producers from revenue losses due to the lack of a compensation mechanism.

While the curtailment methodology is adopted, the following aspects should be considered:

- Transmission tariff payments should be divided into two separate parts – payments for the TSO`s transmission services and RE surcharges (including FIT payments for generation and FIT compensation for curtailment), which was also recommended by the Energy Community Secretariat in its analysis of the transmission tariff (i.e. the compliance note 1/2020 Ukraine – electricity transmission and dispatch tariff with respect to the tariffs for export and import).

- The solution on RES curtailment compensation should take into account providing the opportunity for RE producers to leave the GB's balancing group (without losing "green" tariff support), increasing imbalance responsibility and accounting for dispatcher's down regulation/curtailment instructions while calculating the GB's imbalances (based on existing scheme of GB's balancing group activity).

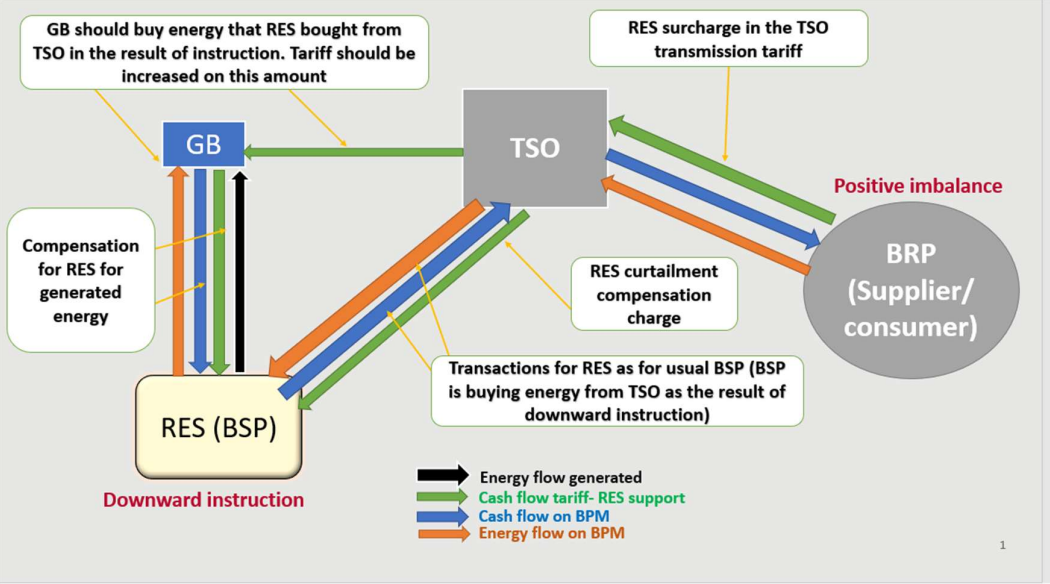



*Figure 22: Proposed scheme for RE curtailment compensation*

Due to the accumulation of outstanding payments from the GB, EA significantly decreased the volume of energy sold to the GB below the mandatory level stipulated in the CMU resolution for the PSO. This situation led to reduced electricity sales by the GB in the WEM and, hence, reduced profits required to offset the cost to purchase electricity from RES and to fulfill household PSO obligations, especially during April and May. To improve the situation, ESP developed recommendations and legislative amendments for the CMU resolutions. These recommendations address the PSO, electronic auctions, and COVID-19 protection measures that would, if adopted, create an obligation to use standard bilateral contracts for the purchase and sale of electricity between state-owned generators and the GB, as well as the opportunity for the GB to sell electricity under bilateral contracts. They

would also prohibit state-owned generators from reducing electricity sales to the GB. ESP's recommendations were partially adopted and the PSO operation returned somewhat back to normal.

## 2.3. SUMMARY OF THE FIRST YEAR OF WEM OPERATIONS

In summary, the reformed WEM in Ukraine proved to be a relative success story, compared to the previously operating market and also in light of international experience with similar market openings.

Numerous problems occurred in the meantime, which notably would impact any market structure in Ukraine, for example:

- General illiquidity of the system and unwillingness of decision-makers to introduce harsher approaches to some of the legacy problems seen in Ukraine (such as poor end-user bill collection ratio for the state-own enterprises, which plays a social role, unwillingness to establish collaterals against all transactions, etc.)

- State policy towards RE, which was not capacity controlled or market oriented and resulted in mushrooming RE capacity, with high FIT tariffs (excessive relative to international benchmarks), rather than a healthy auction-based system which were present around the world for at least the past decade.

- Overburdening the GB with a number of costly obligations, only partially supported by the state-owned generation from EA and UHE. These onerous and unsustainable in the mid-run obligations include: (i) servicing the FIT system for RE and (ii) providing coverage for low cost electricity for households which in turn led to a difficult financial situation at EA. Apart from EA and UHE supporting this overall flawed subsidy scheme, the business and industrial customers shared the cost of the remainder of the subsidy through the transmission tariff.

- Coupled with the impacts from Covid-19 which negatively affected consumption of such solvent customers, the financial problems of the electricity delivery chain have ensued.

Where needed, ESP provided proposals to decision-makers on possible remedies and solutions, as well as drafted resolutions or amendments to be able to adopt decisions for implementation of the proposals. In its proposals, the ESP attempts to balance the sustainable financial condition in the WEM while protecting end-use customers from rapidly growing prices. ESP also hosted trainings, seminars and roundtables with stakeholders to discuss proposals and overcome impediments.

Despite these efforts, the system works imperfectly and is accumulating debts. Socially oriented tariffs for the households, protected customer non-payment and excessive support for RE, led to low revenues from consumers and excessive expenditures for a certain type of generation which were planned to be covered by state-own types of generation. In practice, these revenues were insufficient to cover such state obligations. Further, some market participants' abuse of the imperfections in the design and market rules combined with the lack of transparency on the WEM sometimes led to distortions in the price formation and thus, price signals in the market

Until the decisions to remove the flaws mentioned above are taken, the problems plaguing the electricity sector will remain, notwithstanding the WEM structure being put in place. Pushing problems around to different stakeholders in the electricity supply chain can provide only temporary fixes and can threaten the financial stability of the overall electricity sector (e.g. impact on EA and UHE due to PSO, debt accumulation due to protected customers, etc.)

# 3. HIGLIGHTS OF THE FIRST YEAR AND THE ROADMAP FOR FUTURE

## 3.1. FIRST YEAR PERFORMANCE OF THE WEM

The transition to a new electricity market model was a step toward complying with European rules and standards, as Ukraine has committed to implement. The new model has faced many problems and too often decision-makers have implemented piecemeal solutions through minor amendments (without taking into account the unintended consequences) rather than addressing broad systemic challenges. However, the market in general demonstrated notable success by completing its first year of operation with improvements and advancements throughout this period. The new model has a significant advantage in that pricing is taking place in markets, where competitive forces are driving down prices. This is an important development compared to the prior single-buyer model and its manual regulation from generation to consumers. Manual market and pricing management shouldered political, investment and corruption risk, including abuse of monopoly.

The introduction of the new model also unbundled some vertically integrated market participants (a requirement of the Third Energy Package), which reduced monopolization by forming competing electricity suppliers. This allows consumers to choose their supplier on a competitive basis, rather than being tied to a monopolist dictating terms and prices.

As problems and challenges for the market, the following issues must be highlighted:

- Financial imbalance, which is due to several interrelated factors:
    - RES increase: Rapid growth of installed capacity and generation from renewable energy sources in addition to high RES feed-in tariffs.
    - Very low household tariffs: Tariffs for household end-users are kept low due to the PSO mechanism, as well as the fact that industrial and commercial customers subsidize household tariffs.
    - Decreased consumption: COVID-19 restrictions led to declining consumption throughout the country and accelerated the industrial and commercial sector's decreasing share of energy consumption compared to household users. Because household tariffs are so much lower than industrial/commercial tariffs and end-user tariffs vary based on consumption, this has led to decreasing revenue.
- Market distortion caused by the physical PSO and the crisis of settlements between key market players such as the Guaranteed Buyer and EnergoAtom.
- Gaps in financial settlement (i.e. between the Settlement Administrator, groups responsible for balancing and balancing service providers) mainly caused by the problems due to the unaddressed issue of protected customers, such as Voda Donbasu. Compared to the old structure, the main debtors and their behaviors have not changed with the market transition, and they continue generating debts.
- Insufficient market transparency and opportunities to manipulate the market exacerbated by the market monopoly. The market lacked such transparency measures as hourly bilateral contract volumes (which affect day-ahead market price formation), timely publishing of

balancing market operation results, up/down-regulation volumes, marginal up/down-regulation prices, imbalance prices, etc.

- High market concentration in generation, especially in the real-time balancing market, dominated by a few market players. This was the primary reason for introducing bidding caps under the Safe Mode scheme to facilitate market opening and avoid a possible crash.

### 3.2. THE WAY FORWARD

In order to improve the performance of the WEM, advance the operation of its segments, mitigate the negative impacts of external factors such as protected customers and ensure a financially sustainable market environment for market participants and key market players, the following suggestions should be considered:

- Revise the bidding caps at the DAM, IDM and BPM with a market-oriented approach to ensure that price formation in these segments is based on supply-demand dynamics and to provide reliable price signals to market players;

- Improve the risk assessment and financial guarantee requirements for the BPM to ensure that the financial settlement mechanism is secured and payments by the SA are made on time and in full.

- The financial settlement mechanism must be implemented with the "zero-sum" principle as described in the market rules. Therefore, settlement operations must be aligned with the market rules to avoid any financial gap leading to lack of payments to BPM participants, especially balancing service producers.

- Establish a Market Data/Transparency Platform providing transparency about operation of all market segments, especially BPM and BCM. Ensure a level playing field and avoid distortions in the DAM price formation due to lack of information by market players. This will also contribute to sustainable operation of the PSO and RE support mechanisms.

- Establish a REMIT compliant WEM monitoring mechanism (as required by the Energy Community Secretariat) to detect and to avoid manipulations in the market. Adopt required primary and secondary legislation on an urgent basis.

- Adopt required primary and secondary legislation to improve the cross-border transmission capacity allocation and to start common auctions to mitigate the pricing issues in the Burshtyn zone.

- Complete the testing and certification of generators to increase the provision of reserves for the ancillary services market (ASM).

- Improve the rules on pricing at the ASM to ensure that technically reasonable costs of service providers are covered and required reserve levels are provided for system operation as per the Grid Code.

- Address the issue of protected customers as described in the EML and other relevant legislation and ensure that this external problem does not further threaten the financial sustainability of the WEM.

- Revise the PSO mechanism using a comprehensive approach. Expedite the switch to a financial PSO mechanism (F-PSO) suggested by the Energy Community Secretariat without skipping the required steps outlined in this report.

- Adopt a multi-year plan to phase-out the household PSO, starting with the removal of the heavily subsidized tariff block while maintaining support to vulnerable consumers.

- Address the problems associated with non-standard and not transparent trading activities in the Bilateral Contracts Market (BCM). Adopt rules facilitating "competitive" trading of standard products (with physical delivery obligation) under standard contracts and ensure transparency by proper regulatory reporting.

- Address the financial deficit in the RE support mechanism for 2020 and onwards and adopt the methodology for compensation of RE curtailment must be adopted to avoid growing problems for RE and system operation.

- Expedite the process for the GB to sell electricity procured from the RES portfolio via bilateral contracts signed through a competitive trading mechanism at the BCM segment (as indicated above) so that the GB can optimize trading of RES electricity. Also, facilitate increased participation of RES and improvements for the support mechanism operation (e.g. incentivized contracts for differences - CfD).

Recognizing the progress that has been made, even though not without serious problems, the WEM provides the foundation that can be built on further, to enhance competitive forces and strong economic signals for the electricity market. Adopting on an urgent basis the suggestions provided above will be a major positive step forward to ensuring the WEM is able to meet the objectives intended and supports further integration with the EU.