SELECTED HIGH-IMPACT MEASURES

Reforming Ukraine's electricity market

by Dr. Matti Supponen

Low Carbon Ukraine

Implemented by
Berlin Economics

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Motivation and project background

This policy proposal is part of a series which was elaborated in the framework of the project Low Carbon Ukraine (LCU) supporting more ambitious paths for selected energy and climate policy areas.

The idea to develop the present ten "Policy Proposals" arose in the course of LCU's support for the Ministry of Energy of Ukraine in setting up a National Energy and Climate Plan for Ukraine. While Ukraine's climate targets are partially very ambitious, we often observed a lack of underlying analysis and concrete policy measures to achieve those targets. For the most crucial topics, we provide a comprehensive analysis and propose concrete policy measures based on international experience.

Each Policy Proposal was written in a multi-stage process: a first draft of LCU experts or invited professionals was discussed over summer and early autumn 2020 with Ukrainian experts and stakeholders. Results of those discussions were taken into account when updating the Policy Proposals. It is important to note, that the presented results reflect the view of the authors and not necessarily the position of the BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety).

We hope that the present analysis and proposals will contribute to a fruitful and constructive discussion and help Ukraine to develop ambitious, yet realistic energy and climate policies.

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Low Carbon Ukraine is a project with the mission to continuously support the Ukrainian government with demand-driven analysis and policy proposals to promote the transition towards a low-carbon economy. It is part of the International Climate Initiative (IKI) and is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) on the basis of a decision adopted by the German Bundestag. The project is implemented by BE Berlin Economics GmbH.

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Contents

Executive summary

The Ukrainian electricity market opened in July 2019. The market started with limited functionalities as some elements were not yet operational while others where constrained to address structural shortcomings.

In this Chapter, we assess the recent market development based on the experience of the first year of market opening. After looking into the **History of market opening and exploring** and **Why it is important to have an EU-compatible electricity market in Ukraine**, we address a number of issues that we deem critical for ensuring the development of a stable, transparent and competitive market.

Summary of key challenges and recommended measures

i. Improving monitoring and regulation

Perhaps the biggest problem in Ukraine's electricity market is the lack of *regulatory stability* in a often uncertain business environment. This hinders, consequently, major foreign investments in the electricity market. While this is not surprising for a young market and it is important to implement corrective actions when needed, it is now time to consolidate the market - especially since prolonged uncertainty favours big players and keeps foreign investors out of the market.

Most importantly, Ukraine should gradually remove *price caps* and replace them by implementing a robust market monitoring system, supported by tools provided in the REMIT legislation: In section "**Addressing anticompetitive behaviour in a highly concentrated market"** we shed light on how to enable effective and transparent monitoring and regulation. Proper market monitoring requires putting the monitoring infrastructure in place and providing the independent regulator with sufficient investigation resources and sanctioning powers to fulfil its role effectively and to ensure the success of the market. Assistance from outside is important for a young regulator (see section "**Strengthening regulatory authority"**).

The implementation of a robust market monitoring system should be supported by "**Introducing REMIT regulation to improve transparency"**. This is important:

- to prevent generators from abusing their dominant position, which is a considerable risk in Ukraine's highly concentrated market;
- to create trust in the market for existing and potential new actors.

Implementing the EU REMIT regulation might be even more important than fundamental data transparency in the Ukrainian.

ii. Power generation sector: Tackling overcapacities, market concentration and security of supply

The Ukrainian electricity market is characterised by *considerable overcapacity* (see section **"The problem of excess capacity"**). The Ukrainian government should therefore introduce a programme to dismantle obsolete or mothballed old power plants, that due to high subsides significantly distort prices. Their reappearance in the market should be prevented. The programme, moreover, should include measures to alleviate the social and economic consequences of closing old coal-fired plants and coal mines. Part of the jobs lost in the coal sector can be transferred to the energy sector, but new jobs also need to be created.

High *market concentration* in the Ukrainian electricity market makes it vulnerable to anticompetitive behaviour (see section **"Market concentration in Ukraine's electricity market"**). A small number of private players owns the price-setting power plants. Reducing market concentration should thus be a priority and considered in any merger or privatisation case. Foreign investments should be promoted. There

should be a roadmap for *removing price caps* and replacing them with active market monitoring to detect and sanction anticompetitive behaviour.

The *Generation Adequacy Report* that is set up by the TSO should encourage the right kind of investments and should be based on transparent modelling and wide stakeholder involvement to be a credible base for decisions. Attracting foreign investors would be particularly important and could be achieved by a Generation Adequacy Report based on transparent modelling and wide stakeholder involvement (see section "**Fostering security of supply and investment certainty through a transparent Generation Adequacy Report"**).

iii. Trading electricity and providing services

The Ukrainian market is *heavily regulated with price caps and with public service obligations (PSOs)*. Therefore, room for non-distorted market-based price formation is limited. A big share of electricity is supplied to the end customers through a PSO at fixed prices, bypassing the market but still influencing the market outcome. It is thus important to make PSOs selective, addressing the consumers who really need them. They also should be gradually replaced by social measures made outside the electricity market.

Though the opening of the electricity market led to the creation of many independent *retail supply* companies (see section "**Making retail supply competitive – a look into DSOs, PSOs, the need for long-term contracts and competition"**), retail sales are currently dominated by companies linked to the regional distribution system operators (DSOs). Thus, it is important to unbundle retail suppliers from DSOs, since the DSO activity might subsidise the retail supply arm of a company. Also, authorities should invite more market players, in particular owners of price setting thermal plants to participate in the spot market.

The retail market development is currently also slowed down by *missing metering infrastructure*. Additionally, the regional distribution companies are responsible for the settlement of all supply contracts in their grid - also for their competitors. This gives them an advantage over independent suppliers.

Day-ahead and intraday markets are fundamental for any electricity market. They give the price signal for dispatching of power plants. Ukraine should undertake several measure to make those markets more competitive (see section **"Making day-ahead and intraday markets competitive"***)* by inviting more market players, in particular owners of price setting thermal plants to participate in the spot market.

Forward markets are not developed either due to lack of trust in the short-term market, immaturity of the financial market and limited enforceability of contracts. To promote long-term markets, the Ukrainian government could invite the big international exchanges to set up a branch in Ukraine. This would bring know-how and credibility to the country's power trading. The government should then increase volumes in the long-term market by various measures, such as using market makers (see section **"Developing long-term markets"**).

A *balancing market* allowing wide participation is not yet operational. We recommend to swiftly implement a balancing market open to all potential participants. Consumers should receive smart meters, starting with customers who have the biggest potential to benefit from competition or who have potential to be active customers with self-production, self-consumption and storage. The balancing markets should be aligned with EU rules as soon as possible (see section **"Improving balancing markets and ancillary services"**).

iv. Re-structuring cross-border supply

Synchronisation with the central European system should be energetically pursued. In the meantime, the Ukrainian government should investigate the possibility to introduce a market-coupling type of capacity allocation for the trade between the Burshtyn Electricity Island and the EU. *Changes in the import rules regarding Russia* have created uncertainty. This is important as the potential import capacity from Russia is high enough to have a significant influence on market prices in Ukraine (see section **"Re-structuring cross-border supply").**

Background

I. History of market opening

Though market opening took place in 201, the market is still characterised by regulatory features (PSO, price caps) dealing with country-specific problems.

The Ukrainian electricity market was opened 1 July 2020 after quite some debate on whether the necessary preconditions to open the market were in place. The market rules are following EU legislation. However, the market contains many unique features which intend to take the Ukrainian special conditions into account. Most of these features are regulatory measures; most important are the price caps and public service obligations to sell to household and small consumers at a regulated price.

Unbundling of the electricity system in Ukraine took place by creating Ukrenergo for transmission, regional grid companies for distribution, Energoatom for producing nuclear power and Ukrhydroenergo for producing most of the hydropower. Other power production assets are in the hands of both state-owned and privately-owned companies.

Unbundling left large market power for regional distributors, who still also act as suppliers.

One important feature in the unbundling was to allow the regional distribution companies to continue to supply electricity, side-by-side with independent, mostly new electricity suppliers. This situation, not unknown from EU electricity markets, creates tensions in the retail sector. The problem is aggravated by the fact that the metering infrastructure is still in development. This gives a central role to the regional distribution companies, themselves suppliers, to settle the sales of competing suppliers. It creates a conflict of interest in which the distribution company might be tempted to cross-subsidise the sales activities from grid activities.

Market faces legacy problem: large unpaid debt of public utilities.

The open market inherited several legacy issues from the past. A financially important legacy issue is the debt that has accumulated mainly from the unpaid bills by public utilities who could not pay for their electricity and from supplying electricity in the occupied areas. Collecting money to cover this debt is important for the market because, depending on the way it is done, it might have a big influence on how the market is working.

This paper discusses how well the market has developed based on the experience of one year of market opening.

II. Why it is important to have an EU-compatible electricity market in Ukraine

Ukraine is committed to implement the EU's so-called third energy package rules from 2013, being a member of the Energy Community. There is a plethora of rules which need to be transposed into national legislation. Even if the rules are the same for each country, how well the idea of the market is implemented can vary considerably. Some member states try to take all the benefits from the market, while others rather try to just implement the minimum, conserving the old structures as much as possible.

For Ukraine, it could be argued that a modest level of ambition in implementing the EU electricity market rules has some advantages. The EU electricity market is a complex system requiring a lot of effort to follow the current rules and their development in the future. There is a risk that the implementation becomes just a bureaucratic effort, creating a lot of rules on paper but not actually impacting the electricity system.

There are also arguments which speak strongly in favour of a wholehearted implementation of the EU legislation. The perspective of Ukraine becoming a full member of the EU speaks for itself. This would also mean that Ukrenergo becomes a full member of ENTSO-E. An EU-like electricity market would also attract international investors and would lead to better investment decisions overall.

Ukraine is already an important node in the Central European electricity system. With synchronisation it will become even more important. To take full benefits of cross-border trade, Ukraine needs to be integrated to the European-wide market coupling system in one way or another. This is not possible without applying the EU electricity market rules, at least the essential parts of them.

Ukraine needs to implement essential EU market rules to become member of the EU.

For any open market competition is the aim that justifies introduction of markets to formerly fully regulated sectors. Competition is supposed to bring the benefits to the end consumers through efficiency gains in electricity production and sales. Being part of the European electricity market would dramatically reduce the market power of incumbents and would make it more likely that also Ukrainian suppliers would compete to deliver the best service at the lowest price to consumers.

With a proper implementation of the electricity market the system costs would be lower, and this benefit can be passed on to consumers.

Improving monitoring and regulation

I. Addressing anticompetitive behaviour in a highly concentrated market

The electricity market is a complex market which is split into several markets based on products of different time horizons, interacting with each other. It strongly differs from other markets due to the need to always balance production and consumption, because storing electricity is very expensive and technically difficult. Anticompetitive behaviour is a serious concern in electricity markets, proven by countless past examples.

The usual categories of anticompetitive behaviour are:

a. abuse of market power through capacity withholding or abusing bidding behaviour,

b. missing transparency or use of *insider information*,

c. anticompetitive agreements with competitors and

d. reducing customers' choices with *anticompetitive contracts* (foreclosure).

Large market concentration gives Ukrainian actors the power to influence and abuse their market position.

The risk of anticompetitive behaviour is especially high in the power generation part of the market. This becomes clear when looking at the marginal price setting plants and can be explained by the *high market concentration* in Ukraine's power generating sector. Two companies, Energoatom and DTEK, are in a pivotal position which means that their capacity is most of the time needed to meet the demand. In peak demand situations, smaller companies may also temporarily be in a pivotal position. Similarly, Ukrhydroenergo is providing much of the balancing power and is in a pivotal position regarding balancing markets.

Insider information is another important issue in Ukraine stemming from the high market concentration and giving the large players a big advantage over many small players in the supply market.

However, (potential) anticompetitive behaviour is not limited to the power generating sector but is rather possible for most of the actors in the market. Even a regulated company such as the TSO can abuse its position. For example, while the TSO has the obligation to provide transparent and market-relevant information, the TSO acts at the same time as the sole buyer of balancing power.

Regarding end customers, it is worth noting that several power-intensive customers belong to a major power producing group (DTEK), while trading of certain state-owned generators appears to be coordinated with major private consumers. This presents an extra challenge regarding transparency of the market.

II. Introducing REMIT regulation to improve transparency

Transparency is an important element for any market to function. The availability of information on the market's products and prices is a crucial requirement for efficient and precise decision-making by market participants. A lack of transparency on the other hand has negative economic implications, such as inefficient investments and daily dispatch decisions. Transparency furthermore helps to remove information asymmetries and thus raises incentives for market entry and investments. It makes market monitoring more efficient, thus allowing to detect and prevent misbehavior on the market more easily. Transparency also allows consumers, their political representatives and market participants to easier react on what is happening on the market.

In the EU, there is extensive legislation requiring transparency in the form of a variety of market information. This holds true especially for markets with either an obvious need for consumer protection, for example for food or medical devices, or markets of outstanding economic importance, for example financial markets.

Challenge: electricity markets are highly complex with many kinds of actors and different time horizons

Electricity markets are demanding regarding transparency for several reasons. Firstly, the electricity system involves many kinds of parties: generators, consumers, grid companies, traders, service providers and regulators. To ensure an efficient coordination of actions in this complicated system, information needs to be shared timely between parties. Secondly, electricity markets involve trading in several time periods from long-term products of several years to real-time balancing products. The price level and dynamics depend on the product, thus having different requirements for transparency information. Thirdly, the system itself is complex which makes it difficult to understand even for large players. Providing reliable publicly available information would allow individual parties to save in data collection and to invest in making best use of that information.

The EU electricity market transparency requirements have developed alongside with the progress of opening the market for competition. At the market opening in 1999, the transparency rules were still of a very general nature. In 2006, together with the rules on congestion management (Regulation 2006/770/EC), a set of rules on information to be published by the TSOs entered into force. These were enhanced and updated in 2013 in a separate legislation (Regulation 543/2013). This regulation required market participants to publish market relevant information, including on availability and use of their power plants. ENTSO-E (European Network for Transmission System Operators) was given the responsibility to develop a platform to publish this data.

The EU requires its members to publish data via the REMIT regulation with ENTSO-E (does not yet apply to Ukraine).

A major step to improve transparency in energy markets was taken in the aftermath of the financial crisis in 2011. The so-called **REMIT regulation** (Regulation 1227/2011 on Wholesale Energy Market Integrity and Transparency) is meant to prevent market manipulation in electricity and gas markets. REMIT requires market participants to report all trades to the regulator and ACER (Agency for Cooperation of Energy Regulators). The national regulators and ACER analyse the information and start investigations if something strange is detected. Most of this information is not publicly available but is only available to the national regulator and ACER.

As a member of the Energy Community, Ukraine is committed to implement the EU electricity market legislation, including Regulation 543/2013 on fundamental data transparency. However, REMIT does not yet apply to Ukraine.

Ukrenergo, as the Ukrainian TSO, has the key role in implementing the EU rules on fundamental data transparency on the electricity market by collecting and publishing data on the ENTSO-E transparency platform. Still, some key data, for example on power plant availability, is missing. REMIT is not yet implemented.

III. Strengthening regulatory authority

The Ukrainian energy regulator **NEURC** is young but already loaded with an impressive set of tasks. The anti-monopoly commission and the financial regulator also have important tasks regarding the electricity market's surveillance. The government's most important concerns should be these regulators' resources and independence.

Ukraine's regulator NEURC must be well-equipped and independent.

The Ukrainian regulator has limited resources compared to many of its European colleagues even if the number of employees is among the highest in Europe. The energy market is relatively large with many regulated companies and organisations.

Another important topic is the independence of the regulator. The nomination of the regulator is a political subject in most European countries. What makes the difference is the independence of the regulator *after* it has been nominated. Examples of political influence on the NEURC´s task of setting distribution tariffs indicate substantial room for improvement in the independence of Ukrainian regulators.

It remains to be seen where the Ukrainian regulator is situated on this scale. The recent example of political influence on NEURC´s task of setting distribution tariffs is not very encouraging in this respect. Similar cases exist in the EU; there is a court case against Germany and Hungary on excessive involvement of the governments in setting tariffs.

IV. Recommendations

To Do's: strengthen transparency through implementation of REMIT and a transparent Generation Adequacy Report, limit concentration, create an effective authority to monitor market players

Publishing of data on the transparency platform should help Ukraine to fully meet European requirements. This will increase confidence in the market overall, and among potential newcomers and foreign investors. Ukraine should **implement the REMIT regulation without delay**. Implementing REMIT is particularly important to enable the regulatory authorities to monitor the transactions made by dominant incumbent companies.

Especially in the context of a highly concentrated market as in Ukraine, it is decisive that a **competent authority** gets all the information from the behaviour of the companies as required by the REMIT regulation to enable detecting any abuse. In addition of the possibility to sanction anticompetitive behaviour, this would also have an important preventive effect.

The authority should have **enough resources and sufficient power** to investigate and to sanction when necessary. As the electricity market is young, it is difficult to find skilled and experienced people for the different tasks at the regulator. It is noteworthy, that power companies are able to attract experienced people with significantly higher salaries than in the state sector. Thus, it is extremely important to seek help for example from the European colleagues in order to educate young people and to provide assistance in the most complicated tasks.

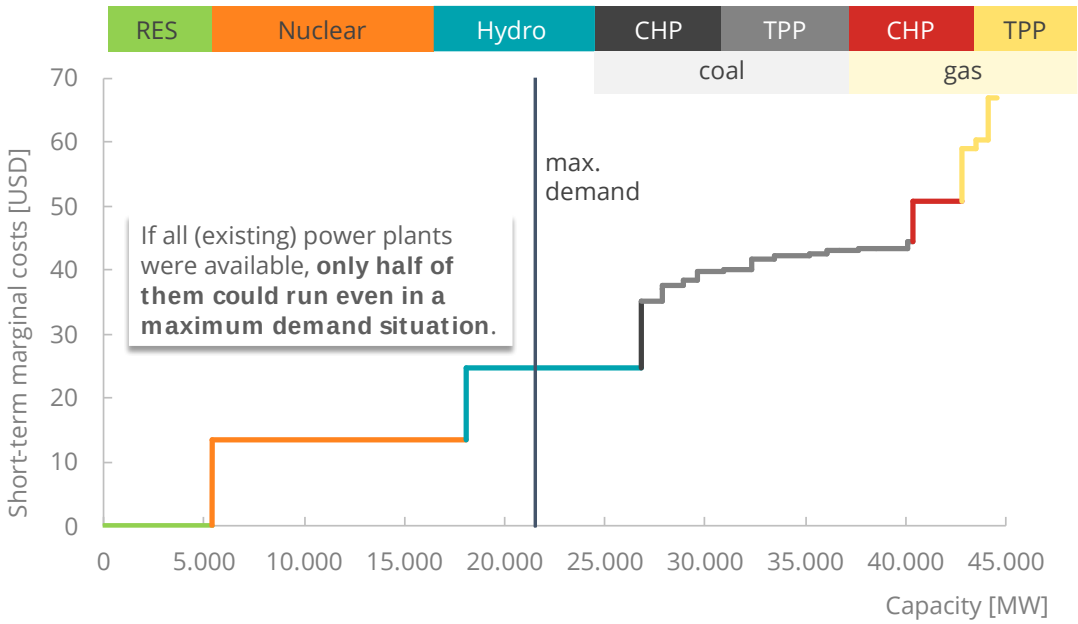
Power generation sector: Tackling overcapacities, market concentration and security of supply

I. The problem of excess capacity

From Figure 1, depicting the merit order (see below: Background info – Merit Order), we can clearly see a problematic feature of Ukraine's electricity market: a significant overcapacity in electricity production, meaning that there is too much offer in the market. The marginal costs of all plants above the price-setting power plant cannot be covered. In other words, prices are not high enough to pay back investments of those plants.

Ukraine's over-capacity causes prices to be too low for a financially sustainable energy system. Thus, coal plants must be shut down.

Figure 1: Merit order - electricity production capacity in Ukraine ranked by (increasing) short-term marginal costs of production



Note: This is a simplified representation of the merit order in Ukraine. Nominal capacities are displayed. See Annex for details.

Source: Own calculation based on World Bank (2007) and Low Carbon Ukraine (2020)

A closer look reveals that, if all power plants were available, only half of them could run even in a maximum demand situation. The overall installed capacity in Ukraine is 47.000 MW while the maximum demand by mid-2020 was 22.000 MW. It has to be noted, that wind, solar or hydro power plants can obviously run only when their respective power source is available. But even taking this into account, there is much more excess capacity in Ukraine than we usually observe in other European countries.

In Ukraine, the problem of overcapacity aggravated as demand declined dramatically (by approximately 50%, 300 TWh) from 1990 until today. Consequently, many power plants are forced to stay idle. At the same time, a significant amount of renewable energy capacity is built supported by government programmes. Taking into account aspects of efficiency and climate protection, there is only one conclusion to draw: there is a strong need to close the oldest coal power plants.

Background info

Merit Order

Electricity production capacity needs to be constantly adjusted to the demand fluctuating between minimum and maximum demand. The so-called merit order (see Figure 1) represents the idea that power plants with lower short-term marginal cost are the first to be used to meet (low) demand, while power plants with high short-term marginal costs will only run when the demand is high. Respecting the merit order in general will minimise the overall cost of electricity production.

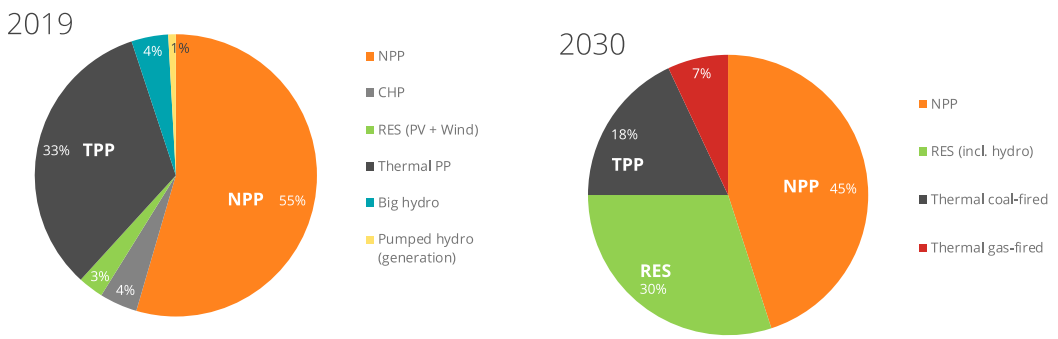
A specific feature of Ukraine's market is the high share of nuclear electricity production (55% of electricity production in 2019, Ukrstat, 2020). Nuclear has high capital costs but low short-term marginal costs. This means that nuclear power plants tend to run as many hours as they can. They stop only for service periods used for maintenance and refuelling, or because of an incident.

The share of nuclear in Ukraine is so high that nuclear plants sometimes need to reduce their power in order to avoid too much electricity in the grid (leading to network congestion). This is visible in international statistics: the forced reduction in Ukrainian nuclear power plants at low demand periods lead to an overall reduction of their annual utilisation ratios. The same phenomenon an be observed in France where the share of nuclear is even higher than in Ukraine (71% of electricity production in 2019).

The merit order for Ukraine is depicted in Figure 1. It is clearly visible that coal fire-plants are the marginal plants, featuring the flexibility that is needed to meet the fluctuating demand. This means that coal-fired plants are most of the time the price-setting plants.

According to own calculations, coal-fired thermal capacity could be strongly reduced by 2030 while renewable capacity could grow considerably (see Figure 2). Gas-fired generation would gain an important share to provide more flexibility in power generation.

Figure 2: Electricity generation mix in Ukraine, 2019 and the potential 2030 electricity generation mix



Within a decade, coal-fired thermal power plants could be largely replaced by RES and gas-fired plants

Source: Own calculation

II. Market concentration in Ukraine's electricity market

For any open market **competition** is the aim that justifies introduction of markets to formerly fully regulated sectors. Competition is supposed to bring the benefits to the end consumers through efficiency gains in electricity production and sales. It requires a reasonable number of players in the market. Consequently, market concentration limits competition and makes market outcomes less favourable.

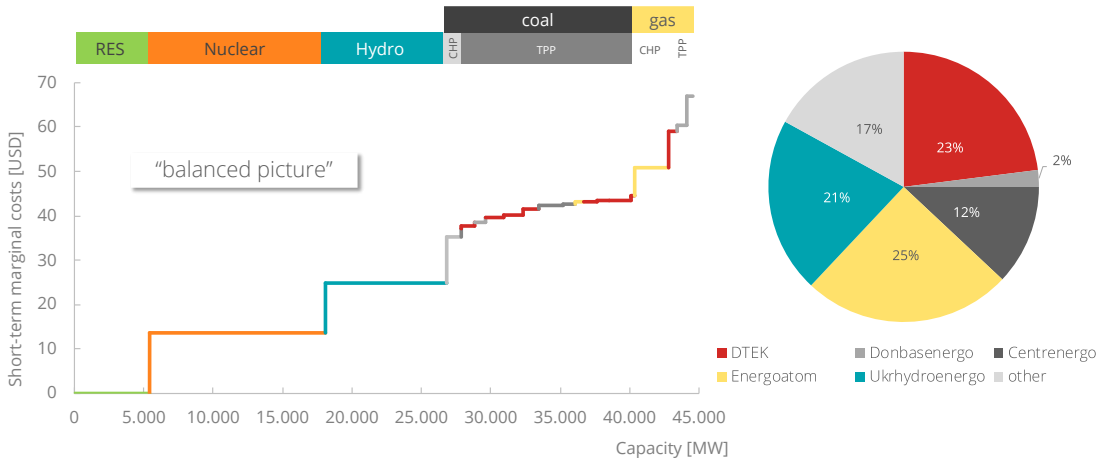
Many **power markets** in Europe are **oligopolistic**, which means that there are only a few players in the market. Ukraine is in this respect an extreme case. Energoatom and Ukrhydroenergo have technology-specific portfolios and have only low marginal cost production capacity. They are influencing the market through the volumes they offer, but they are not setting the price. Prices are set most of the time by hard coal plants, and they are owned by only a few companies.

A few companies owning Ukraine's hard coal plants determine the electricity price. Together, they form a strong oligopoly.

Ukraine's high market concentration is clearly visible from Figure 3 and Figure 4. If all capacity is considered, the situation looks relatively balanced, see Figure 3. However, if we instead look only at *marginal cost plants*, the situation looks completely different, see Figure 4. Among the marginal cost plants, DTEK represents 2/3 of the production capacity. The only other company that owns a significant amount of coal fired power production, is Centerenergo.

Figure 3: Market concentration in Ukrainian power production

Simplified representation of the merit order in Ukraine (left) and ownership structure of plants (capacities) by companies (right)

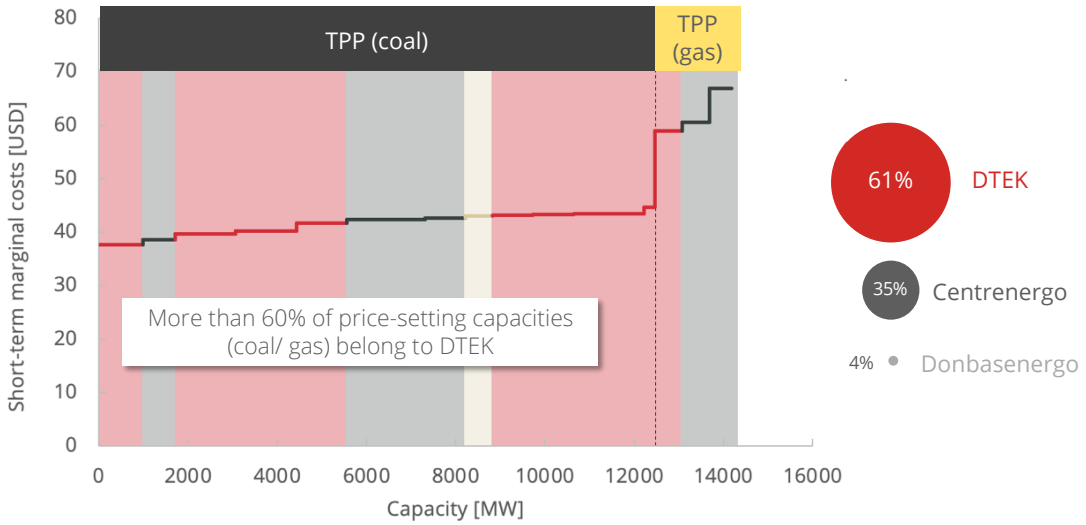


Note: See Annex: Construction of the merit order for details on the merit order in Ukraine.

Source: Own calculation based on World Bank (2007)

Figure 4: Market concentration in the Ukrainian thermal power generation

Excerpt of the merit order showing price-setting capacities (left) and respective ownership of those capacities (right)



Note: This is a simplified representation of the merit order in Ukraine. See Annex for details

Source: Own calculation based on World Bank (2007) and Low Carbon Ukraine (2020)

DTEK's dominant position in the power market is obvious and well-known. The question is whether sufficient tools are in place to monitor its behaviour, and whether authorities are ready to act when they detect any misbehaviour by DTEK.

III. Fostering security of supply and investment certainty through a transparent Generation Adequacy Report

Many Ukrainian power plants are old and need to be (partly) replaced.

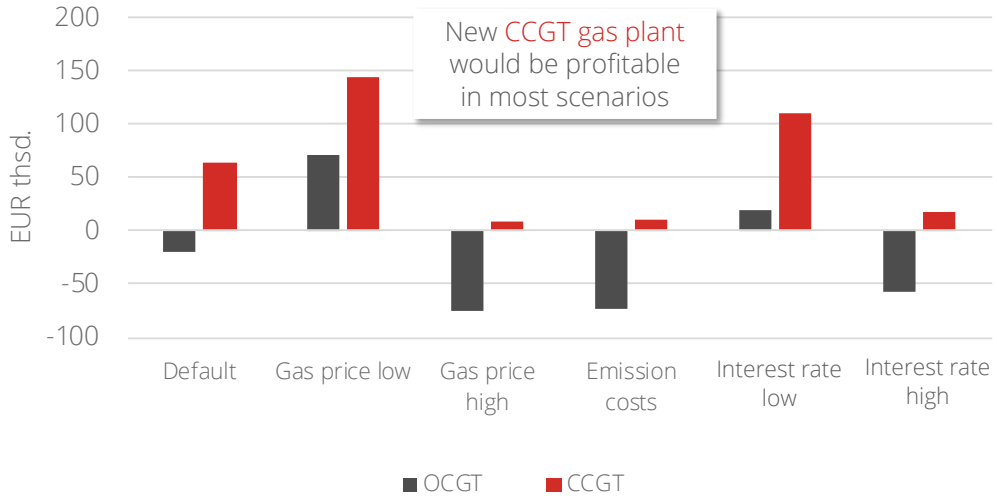
At the moment, Ukraine has a relatively high share of electricity production capacity compared to actual consumption. Thus, a security supply risk related to available power generation capacity does not exist. However, many power plants are old and will probably not be renovated due to high costs and environmental concerns. The question is, to what extend and by which technologies this outdated capacity will be replaced in the future.

Renewables and Combined Cycle Gas Turbine power plants would be the preferred technologies for a low-carbon replacement of outdated capacity.

It is obvious that renewables will (and should) play a role in this process: renewable energy support programmes have already brought a considerable amount of renewable capacity into the market. Another technology to be considered are Combined Cycle Gas Turbine (CCGT) power plants, as this could be (beside renewables) another means to rapidly reduce greenhouse gas emissions in Ukraine. Calculations based on current market prices indicate that, in most scenarios, investment in Combined Cycle Gas Turbine (CCGT) power plants would be profitable (see Figure 5 and Table 1).

Figure 5: Calculation of the profitability of a new CCGT gas plant in Ukraine

hypothetical, annual net profits: July 2019-June 2020)



Source: Own calculation based on ENTSO-E (2020)

Table 1: Assumptions for scenarios of gas plant profitability

Scenario	Industrial gas price [EUR/tcm]	Emission costs [EUR/tCO2]	Interest rate
Default	218	0.4	10%
Gas price low	150	0.4	10%
Gas price high	280	0.4	10%
Emission costs	218	30	10%
interest rate low	218	0.4	5%
interest rate high	218	0.4	15%

Crucial role of Ukrenergo's Generation Adequacy Report

Whether or not a certain investment will be done in the future strongly depends on the available information to enable investors making sound and rational decisions. In this context, the **Generation Adequacy Report** is of high importance for both Ukraine's future security of supply and for investors seeking information on the future energy system of Ukraine. The Report is being prepared by Ukrenergo and presents scenarios of electricity generation capacities in Ukraine in 10-year perspective. It considers planned activities for the generation development, introduction of demand response systems, ensuring the operational security and the analysis of disruptions in the grid's operation.

It is important that this strategic document is set up with utmost transparency and stakeholder involvement to gain the trust of all market players needed for future investments.

IV. Recommendations

Old coal power plants must be not only mothballed, but shut down to prevent market uncertainty.

Due to massive *overcapacity*, many power plants stay idle or are mothballed. Idle power plants, however, are an obstacle for new investments, as they create uncertainty for the profitability of new plants. It would be better to dismantle old power plants so that there is no more threat that they reappear in the market. Thus, government policy needs to close much of the outdated, inefficient and emission intense coal-fired capacity.

Support for hard-hit coal regions required

As many coal mines and coal plants are situated in economically vulnerable areas, a programme to alleviate the consequences of closing old coal fired plants and mines is necessary (Zachmann, Temel, von Mettenheim, 2021).

Part of the jobs lost in the coal sector can be transferred to the energy sector, but new jobs also need to be created. Lessons from EU countries with similar challenges could be valuable for Ukraine.

Any more mergers must be prevented if they make market concentration worse

The first thing to do regarding *market concentration* is to make sure that the situation does not become worse. This means that no more mergers and acquisitions should be approved if they worsen market concentration.

Either break up existing companies or support new electricity business-ses from Ukraine and abroad

The government could also actively reduce market concentration. In extreme cases it should take measures to structurally reduce market concentration. Examples of this kind can be found in the UK during the beginning of market liberalisation when the whole sector was reorganised into six generating companies. In Italy, the dominant incumbent company was obliged to sell an important share of its capacity. Other measures have been taken in France and Belgium, such as obliging the dominant company to sell capacity to its competitors in the form of virtual power plants.

Another way to reduce market concentration is to favour investments by newcomers, i.e. applying *positive discrimination to attract new players.* Attracting foreign investors would be particularly important as they require more transparency, tend to scrutinise the market rules and challenge anticompetitive features of the market. The Ukrainian government should thus invite foreign investors by identifying and supporting suitable projects.

Base Generation Adequacy Report on transparent modelling to create trust and lay open investment needs.

In the EU, the *Generation Adequacy Report* is set up by the TSOs together with ENTSO-E and is an important tool to inform the market players, stakeholders, authorities, and potential investors about the actual state of the electricity system. This increases transparency and provides a better base to consider investments in the power sector. Ukraine should follow this example. A Ukrainian Generation Adequacy Report should be based on transparent modelling and wide stakeholder involvement in order to be a credible basis for decisions. One should also consider other measures, for example applying positive discrimination to attract new players to become electricity producers and to enter the market. Attracting foreign investors would be particularly important as they tend to require more transparency and challenge the anticompetitive features of the market.

Trading electricity and providing services

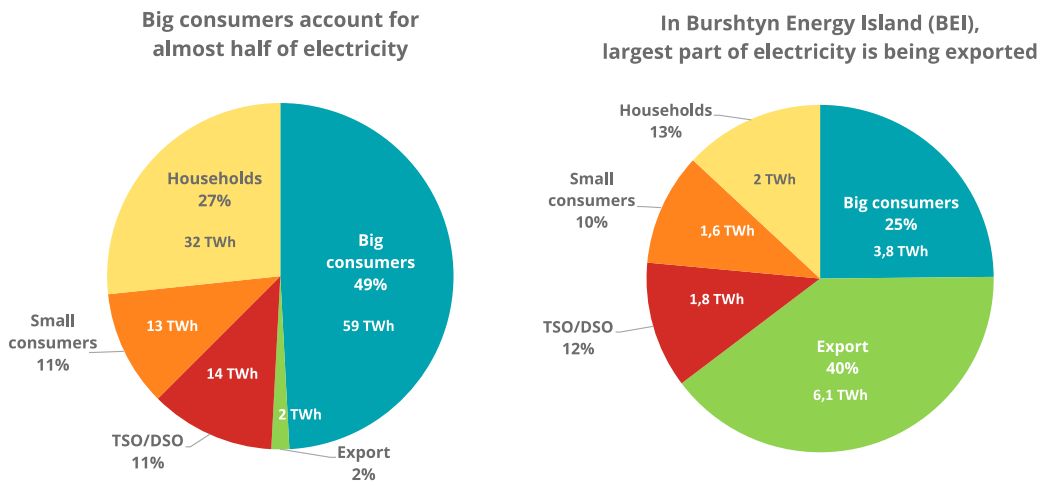
I. Making retail supply competitive – a look into DSOs, PSOs, the need for long-term contracts and competition

In Ukraine, big consumers cover almost half of the electricity consumption, which is a high share compared to other European countries. Heavy industry is in large parts vertically integrated, i.e. companies receive electricity from power production facilities inside the own industrial group.

Large industrial companies often receive cheap electricity from other companies within the same group, while households benefit from cheap PSO prices.

Household consumption represents about 25% (see Figure 6). Electricity for households is significantly subsidised, because many households are socially vulnerable. All households (as most small consumers) enjoy a heavily subsidised PSO price. In result, household tariffs for electricity are among the cheapest in Europe.

Figure 6: Electricity volumes and shares per customer group based on forecasted electricity balance for 2020 (left: IPS, right: BEI)



Source: Mykhailenko, Vereshchynska, Mukha, Avetyan and Zachmann (2020)

The opening of the electricity market created many independent retail supply companies. This is potentially good news regarding competition. However, retail sales are dominated by companies linked to the regional *DSOs (distribution system operators)*, and it is not uncommon that power production cross-subsidises sales activities, because margins in the retail supply are generally small. It remains to be seen how independent suppliers manage to gain market share from the regional DSOs and from the vertically integrated companies who own electricity generation. Even if most suppliers buy their electricity from the same sources, small differences in prices can be crucial as the margins in retail supply are generally small. Captive customers acquired through network activities or own power production can grant distribution companies and incumbent generators a competitive advantage.

Regional DSOs control retail market due to influence on consumers via their grid and power over producers.

Independent retail suppliers cannot rely only on the *day-ahead market* as this would expose them to a mismatch between the contract period in buying and selling electricity. Electricity contracts based on *hourly spot markets* require smart metering with at least hourly resolution – this kind of contract is increasingly popular in the EU. However, smart metering is not widely in place yet in Ukraine. There is thus a need to have *long-term products* as the price reference for selling to end customers. Consequently, from an independent retail supplier's point of view, it is crucial to get access to long-term electricity.

Retail suppliers need long-term contracts to secure their operations.

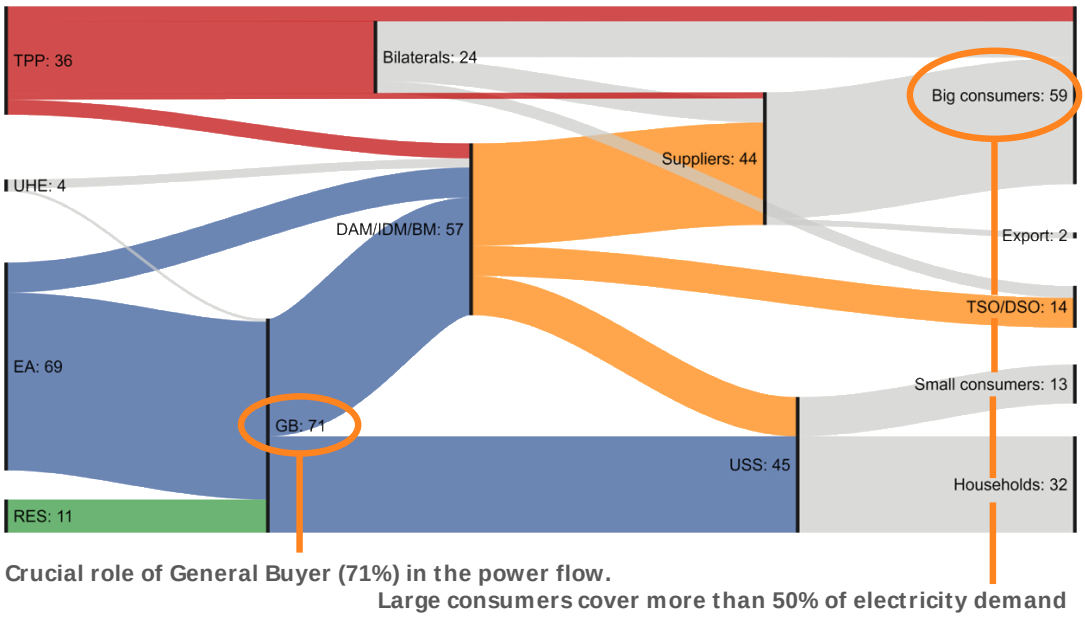
Crucial role of the General Buyer in the retail market

The *General Buyer* plays a crucial role in the retail market, what is clearly visible from Figure 7. In Ukraine, large consumers cover more than 50% of electricity demand, more than in most EU countries.

Figure 31 schematically explaining power flows from production to end customers in Ukraine. One can also see that to be competitive in retail it is most important to get access to electricity passing through the General Buyer.

In Ukraine, large consumers cover more than 50% of electricity demand, more than in most EU countries

Figure 7: Power flow from production to end customers in Ukraine, projection for 2020



Note: BM = Balancing Market, DAM = Day-Ahead Market, DSO = Distribution System operator, EA = Energoatom, IDM = Intraday Market, RES = Renewable Energy Sources, TPP = Thermal Power Plants, TSO = transmission System Operator, UHE = Ukrhydroenergo, USS = Universal Service Supplier

Source: Mykhailenko, Vereshchynska, Mukha, Avetyan and Zachmann (2020)

The Ukrainian PSO is discriminatory and harmful to competition.

The *Public Service Obligation (PSO)* to sell to households and small customers at a subsidised price is understandable as a transitional measure. However, Ukraine's public service obligation is based on cross-subsidisation which is discriminatory:

- The measure *lacks selectivity* as even wealthy consumers have access to subsidised electricity.
- Low prices also reduce the incentive for end customers to save electricity.
- It *harms competition* because households and small customers have no incentive in seeking new suppliers as the price would not change anyway.
- The *incumbent companies* (that currently supply PSO customers) have less incentives to be active on the market. They *would like to avoid competition* and just keep the customers in the portfolio as passive as possible. We observe such a phenomenon also in EU countries: In France, for example, the heavily regulated prices have reduced competition in the retail market among households and small customers to a minimum.

Price-comparison portals are mandatory in the EU and a great tool to foster competition in the retail market.

In many EU countries, the retail market started very slowly. It took time before the customers started to switch the supplier. Little by little, the incumbent players began to lose their customers to competitive suppliers. There were several reasons for this. To maximise profits, the incumbents kept prices relatively high for the historical customers. This gave an opportunity for newcomers to propose attractive contracts. High prices appeared regularly in the press causing customers to switch in waves towards newcomers. The regulators started *price comparison portals* (which are now mandatory in the EU). These portals facilitated

the comparison between different offers, overcoming the jungle of different terms and clauses included in the contracts.

Finally, it is important to understand that the fundament to get competition into the retail market is to improve ***the liquidity of the long-term market*** in various timeframes: this allows incoming retail companies to source their electricity at a competitive price.

Liquidity of the long-term market needed for competition in the retail market

II. Making day-ahead and intraday markets competitive

The day-ahead and intraday markets are fundamental for any electricity market. They give the price signal for dispatching of power plants. By bidding into the day-ahead market, the power plant owner can ensure that she is not running the power plant at loss but gets at least the short-term marginal costs covered. In the intraday market companies can further adjust their positions acquired in the day-ahead market to optimise their power plant portfolio.

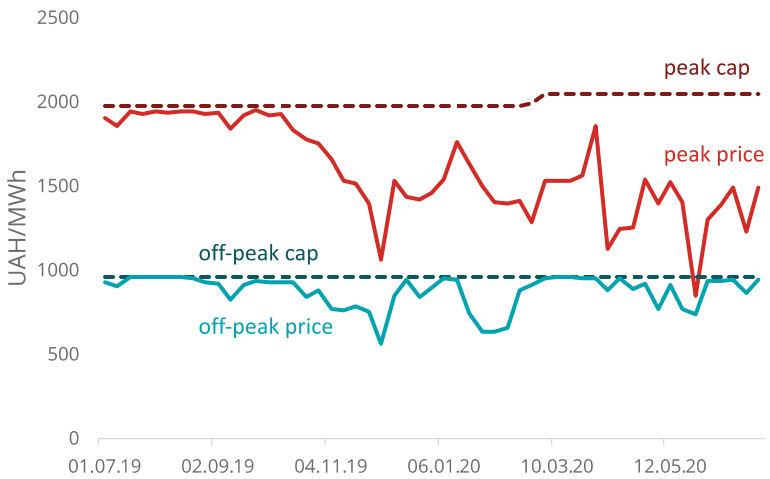
Day-ahead and intraday markets are needed to form the price and give certainty to elec-tricity producers.

In addition of being instrumental for dispatch decisions, the day-ahead market is the reference for long-term markets. The long-term markets are in fact based on expectations of future day-ahead market results. They are also the building block for financial markets for electricity. In a financial market no physical electricity is traded, but the price of electricity is locked in by buying hedging products. Hedging is beneficial for both power producers and power consumers. It gives certainty over production revenues or consumption costs for the chosen hedging period.

Regulations like price caps and obli-gations for the Ukrainian single buyer to trade on the day-ahead market make prices rather volatile around the caps.

The Ukrainian electricity market itself resembles very much the day-ahead and intraday markets as we know them from other European countries. However, the prices are heavily regulated which means that there is a strong government interference in the market price. Also, there is an obligation for the so-called 'single buyer' to trade in the day-ahead market which brings a lot of electricity to the selling side of the market. This could be one of the reasons why the prices have been rather volatile. Peak prices remained close to the price caps in the beginning. However, from October 2019 on, the peak prices have decreased while off-peak prices remained close to the cap, see Figure 8.

Figure 8: Average weekly day ahead prices of electricity in IPS



After October 2019, peak prices decreased, while off-peak prices remained close to cap.

Source: Mykhailenko *et al.* (2020)

Price cap kills incentives for potentially needed investments in peaking capacity.

The effect of price caps is clearly visible in Figure 9 that compares the Ukrainian day-ahead prices to prices in neighbouring countries. The so-called duration curve of the day-ahead price is smooth for all countries except for Ukraine. In Ukraine, the curve is clearly influenced by the price caps: Flat horizontal parts of the curves represent prices close or equal to price caps – they dominate Ukrainian market results. Consequently, there are periods when the price cap leads to an increase of prices, and periods when the tight cap pushes them down. The price duration curve also indicates that the price cap kills incentives for potentially needed investments in peaking capacity such as peaking power plants, batteries or flexible demand. From the curve for Ukraine, the usual high price zone due to scarcity, on which providers of peaking capacity make their revenue, is totally cut off due to the price cap.

Figure 9: Hourly day-ahead prices of Ukraine and neighbouring countries (July 19 to June 20; sorted in descending order)

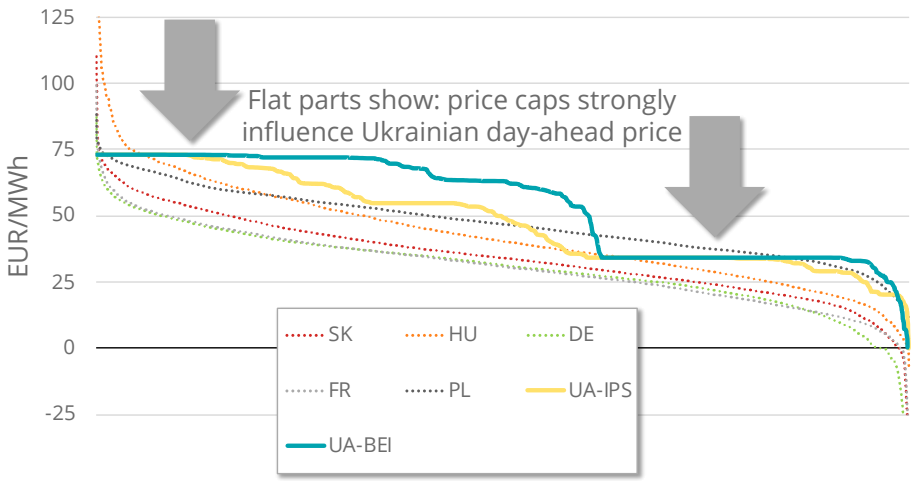
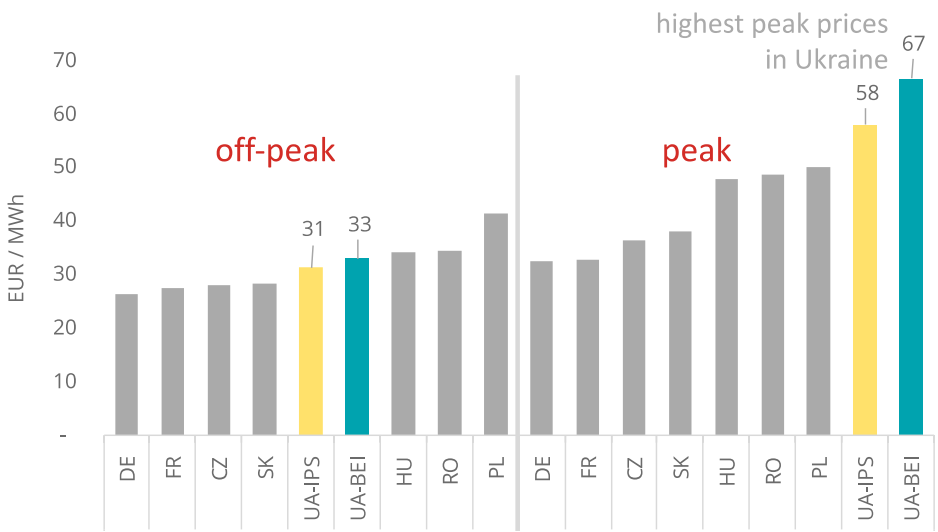


Figure 10: Average peak and off-peak day-ahead prices of Ukraine and neighbouring countries (July 19 to June 20)



Source: Mykhailenko *et al.* (2020)

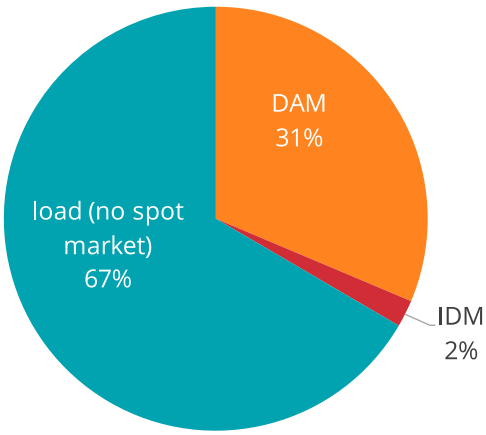
Under normal circumstances, companies have a natural interest in trading in the spot market. In most European countries, day-ahead markets are voluntary and part of the overall consumption is traded in the day-ahead market. If the volume is reasonable, let us say 20% of total load, this gives a price signal upon

which also bilateral trades are concluded. In principle, this criterion is fulfilled in the Ukrainian electricity market. However, the Ukrainian market has many special features, including the price caps, which make companies hesitant to participate in the spot market.

Another issue is the volume traded in the day-ahead market (see Figure 11). In most European countries the day-ahead markets are voluntary. This leads to the fact that only a proportion of the overall consumption is traded in the day-ahead market. If the volume is reasonable, say 20% of total load, this gives a price signal upon which also bilateral trades are concluded. In principle, this criterion is fulfilled in the Ukrainian electricity market. However, the fact that on the selling side the main actor is the single buyer, distorts the price signal. It would be most important that the owners of marginal cost power plants, which are mainly coal-fired plants, would participate in the market. Thus, the day-ahead market does not truly reflect the market situation and does not give a trusted price signal.

Day-ahead market does not give true price signal, since the usually price-making thermal power plants do not participate in it.

Figure 11: Average traded volumes of electricity in relation to load in the day-ahead and intraday market in IPS (Jul.19-Jun.20)



Source: Mykhailenko *et al.* (2020)

In a well-functioning market, the volume traded in the day-ahead market would give a reliable price signal for both forward and bilateral markets. However, as Ukraine's day-ahead prices mostly follow the price caps, forward and bilateral markets are seemingly disconnected from the short-term markets. This is a serious handicap for reaching an efficient market. Volumes in intraday markets are insignificant, but this could be a temporary situation before market players understand the benefits of the intraday market.

The consequence of this heavily constrained market is that it does not fulfil its primary task to reveal the efficient price which would optimise the use of resources. In fact, the price caps are too high in average situations, and thus grant windfall profits to the producers, and too low in situations of scarcity thereby preventing entrance of the needed flexible units and hence endangering security of supply in the long run.

Main goal of day-ahead market: price signal for an effective use of resources – Ukraine's market can't fulfil this function due to price caps.

Rigid stepwise price caps also potentially distort the optimal dispatch within the 24-hour cycle. Based on the analysis of production costs (reference) it seems that coal-fired power plants, which should usually be the marginal producers, make considerable profits at the peak price cap but cannot cover their marginal cost at the off-peak price cap. This might lead to capacity withdrawal in the off-peak hours. If generators find the bidding cap too low, they might simply abstain from bidding, causing lower supply and higher prices. The low off-peak price cap might also lead to excess demand in off-peak hours. All potential buyers will not get electricity at the regulated price, but must seek it from bilateral markets, at a higher price.

Burshthyn Energy Island does not benefit from lower prices in neighbouring countries due to low import levels.

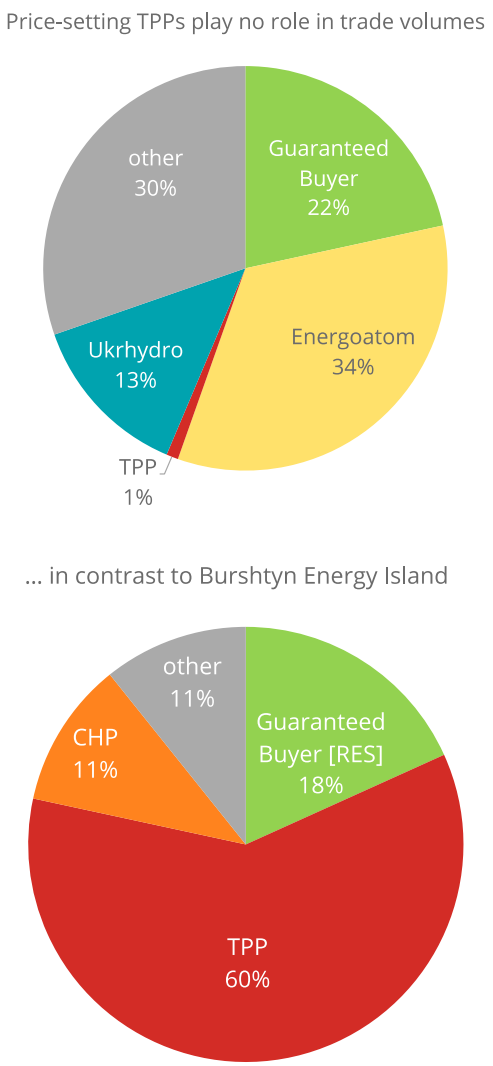
Regarding competition, the price caps are a double-edged sword. On the one hand they prevent bidding at a high price, but on the other hand they might guide bids to be aligned to the caps even if the market situation would suggest lower bids. The dominant position of some companies allows this to happen. In the Burshtyn Electricity Island there is a stable increase in average prices, probably due to capacity withdrawal during off-peak hours. Thus, peak hours have a higher share in overall trade volumes. Imported electricity volumes continue to be negligible and therefore do not have a major influence on the price.

Ukraine has highest prices in the region, due to ineffective market regulation.

The reasons above contribute to the fact that Ukraine has the highest electricity prices in the region.

Figure 12 confirms that the spot market is dominated by a few players: while marginal costs of TPPs prevalently determine the supply price, the volume of bids of these "price-setters" is negligibly small. For proper market functioning, coal fired power plants should be more active in the spot market.

Figure 12: Trade volume shares in the day ahead market in IPS (*top*) and in the Burshtyn Electricity Island (*bottom*) in June 2020



Source: Mykhailenko *et al.* (2020)

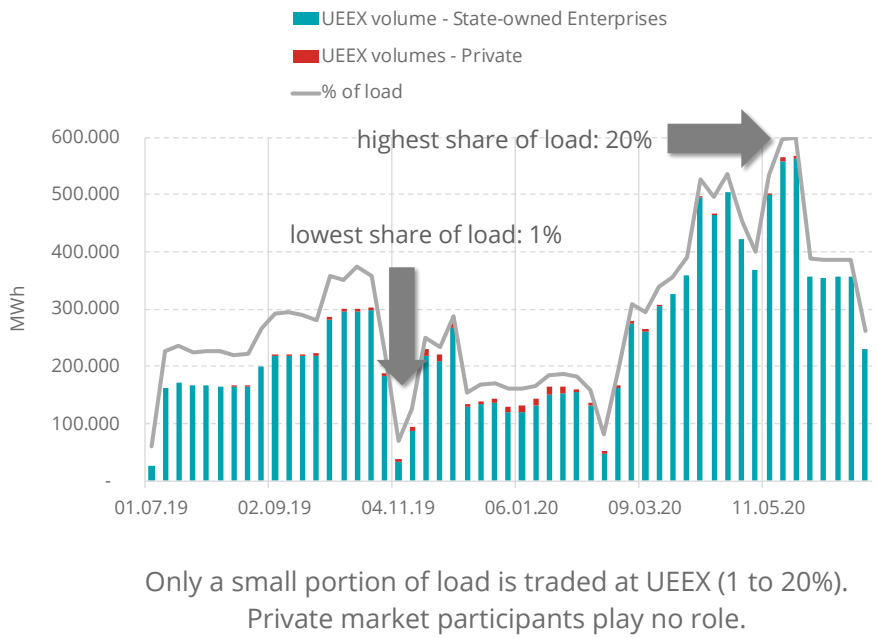
III. Developing long-term markets

In the EU, the bulk of electricity is traded in long-term contracts. The link between long-term contracts and day-ahead and intraday markets was explained in the previous section on day-ahead and intraday markets. The way the long-term contracts are made differs from country to country. In most developed markets, the long-term contracts are financial, and traded and settled in power exchanges. In other countries, bilateral contracts are common. Bilateral contracts include less trading fees, but they can be less secure regarding counterparty risks etc.

Ukraine's long-term market open since July 2019, so far only represents 10% of consumption.

Since the start of the market in July 2019 the Ukrainian Energy Exchange (UEEX) has conducted bilateral auctions as an interim provider upon a decision of the Ukrainian government. Long-term contracts represent only about 10% of consumption at UEEX. State-owned generators have been most active in trading in the UEEX. While the UEEX is open for any private market players, their interest has been limited so far: the share of private market participants was about 1% of consumption (see Figure 13). This means that most of the electricity is traded bilaterally outside the organised market or inside industrial groups.

Figure 13: Traded volumes at the UEEX bilateral exchange (IPS)

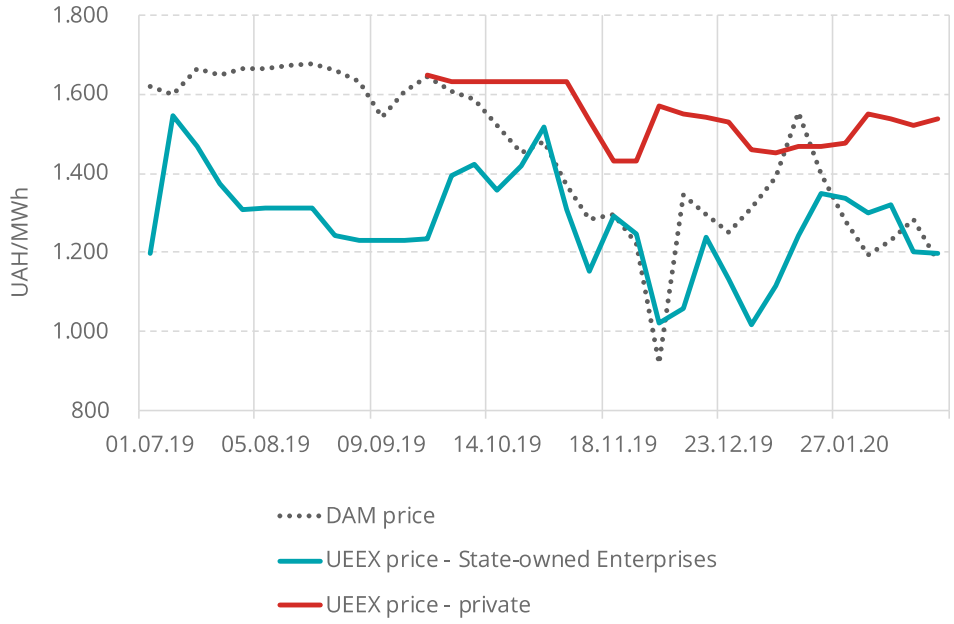


Source: Mykhailenko *et al.* (2020)

Off-peak price cap on DAM and IDM too low.

Figure 13 compares UEEX prices with day-ahead and intraday prices. Usually, clearing prices for bilateral agreements auctions should not be higher than the day-ahead and intraday prices. The figure confirms the previous statement that the off-peak price cap seems to be (too) low.

Figure 14: Price comparison between the day-ahead market and UEEX bilateral contracts



Source: Mykhailenko *et al.* (2020)

IV. Improving balancing markets and ancillary services

The balancing and ancillary services market was opened in only 2020, i.e. *after* the day-ahead and intraday markets. This is understandable because of the complexity of balancing markets. Balancing markets gain importance with increasing amounts of variable renewable energy coming into the system.

In case of integration with European electricity grid, balancing markets will also be integrated.

Balancing markets play a crucial role in the integration into the EU, because automatic and manual frequency restoration reserves are subject to central coordination on common platforms. The principle is that the cheapest available bids in the balancing market are activated to the extent as interconnector capacity allows this to happen. Currently, Ukraine cannot yet participate in this initiative because of lacking transmission capacities. Once the synchronisation is realised, Ukraine will naturally seek for full integration into these platforms.

Large imbalances point to either large profits in selling balancing services or insufficient balancing on the generators' side.

Since market opening, mandatory balancing measures have been regularly carried out to compensate for large imbalances of up to 4GW. This indicates either missing incentives to keep the balance or excessive profits in selling balancing services. This anomaly should disappear when the EU rules on balancing are fully implemented. Then the market players do not have incentives to create large imbalances on the balancing market as this would be more expensive than trading on the day-ahead and intraday markets.

V. Recommendations

Making retail supply competitive – a look into DSOs, PSOs, the need for long-term contracts and competition

- The Ukrainian government should establish a plan and a timetable to gradually remove PSO. This plan should also include the steady decrease of the share of nuclear energy in the PSO and replace it with traded electricity. The group of consumers entitled to PSO should be limited over time to vulnerable households.
- Apply regulatory scrutiny to intra-group sales: enforce unbundling of retail suppliers from DSOs.
- A pre-requisite for the introduction of electricity contracts based on hourly spot markets is the development of generalised smart metering infrastructure with at least hourly resolution. Finally, the regulator should establish a robust price comparison portal.
- Liquidity of the long-term market (in various timeframes) needs to be urgently improved.

Making day-ahead and intraday markets competitive

- Gradually remove price caps and replace them with a robust market monitoring system, supported by tools given by the REMIT legislation (Regulation on Wholesale Energy Market Integrity and Transparency).
- Authorities should invite more market players – in particular owners of price setting plants (TPPs) – to participate in the spot market. Regulatory measures would be conceivable to reach this goal, but also targeted incentives, like e.g. offering degressive trading fees (as used in the Nordic market) to bring more volume to the market.

Developing long-term markets

- The Ukrainian government could invite big international exchanges to establish a branch in Ukraine. This would bring know-how and credibility to Ukrainian power trading. International exchanges also dominate EU markets, only a few countries continue with a national independent power exchange.
- Volumes in the long-term market should be increased by various measures. Market makers are commonly used in other markets for this purpose. They are committed to make offers for products which are less liquid, in exchange for remuneration or other benefits.
- Also, increasing amounts of electricity from renewable, hydro and nuclear should appear in the long-term market, instead of being sold via the PSO.
- Moreover, it is important to ensure, that access to auctions of power generated by state-owned power producers is not restricted to specific consumers.

Improving balancing markets and ancillary services

There are many lessons to learn from the EU on how to improve balancing markets. Effective measures include:

- Careful sizing of reserves for meeting the daily needs, increasing the number of balance service providers among smaller players.
- Allow aggregators to connect more load to the balancing market.

- Incentivise industry to monetise their demand flexibility.
- Introduce smart metering as in many EU countries to open a completely new horizon for demand-side actions.
- Electricity contracts are more often based on hourly market prices which allow end customers to be active on the market with their flexible demand.
- An increasing number of consumers have also become electricity producers, from big industry to small households.

Furthermore, we recommend to:

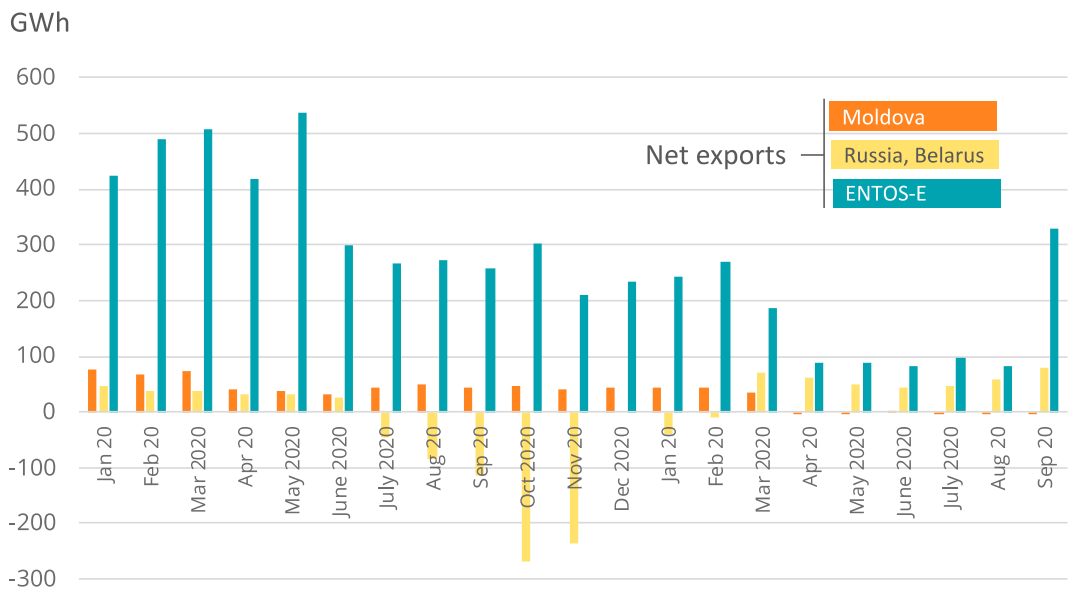
- Analyse and address any gaming opportunities the market might offer to balance-responsible parties and balance service providers;
- align the balancing markets as soon as possible with the EU rules;
- expand the group of balance service providers by removing obstacles for new players to participate, including the renewable producers and the demand side.

Re-structuring cross-border supply

Currently, flows from and to Russia only occur if necessary for system security.

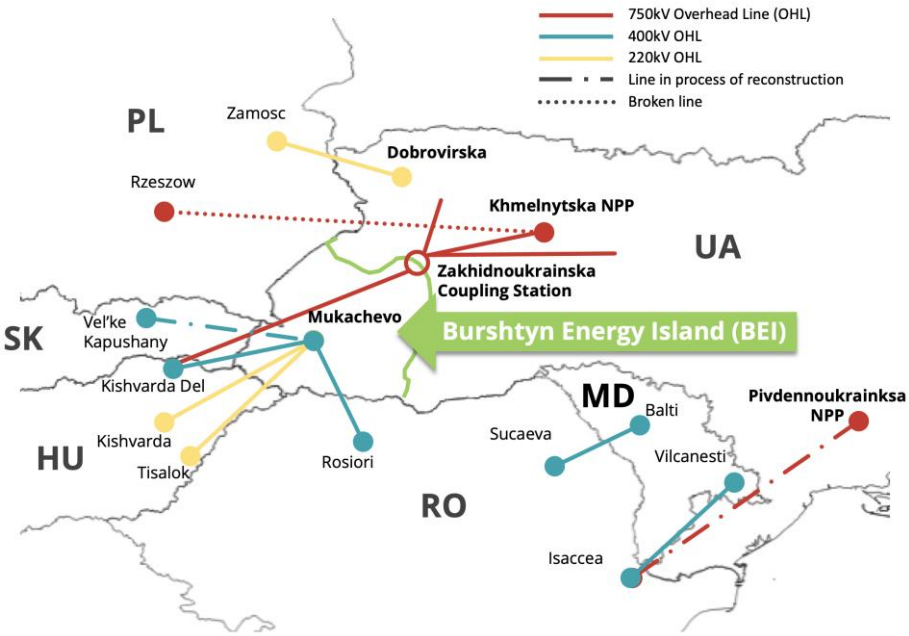
The Ukrainian power system was built as part of the electricity network of the Soviet Union. For this reason, the links to Russia are still technically strong even if for obvious reasons the trade has been reduced to a minimum. If allowed, the Russian imports will always be executed independently of the market price in Ukraine, according to a monopoly seller logic. The clear long-term objective for Ukraine is to make the power system independent from Russia. Thus, trade with Russia only takes place in a limited extent mainly for system security reasons under strict political control (see Figure 15).

Figure 15: Net exports from Ukraine to neighbouring markets in 2020



Source: Own calculation based on ENTSO-E (2020)

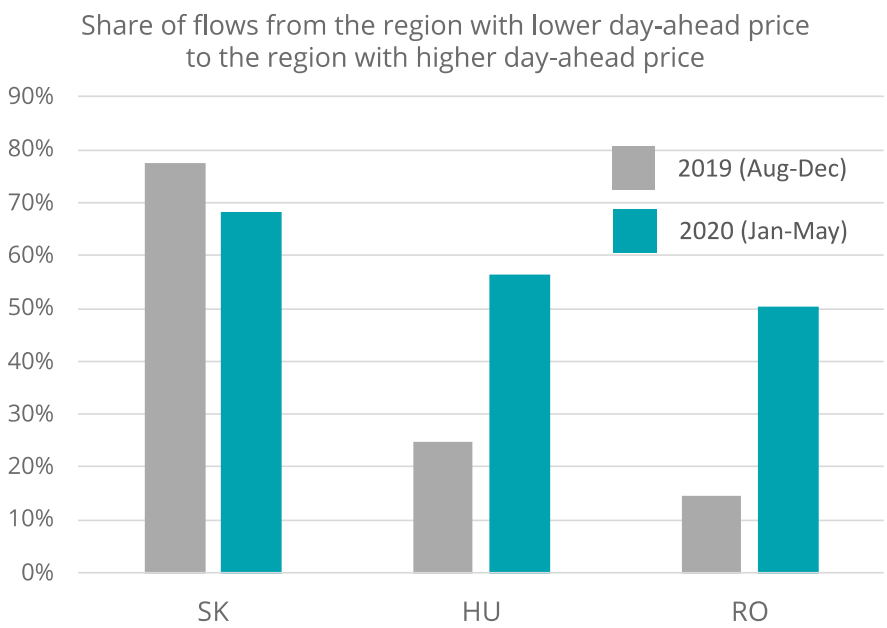
Figure 16: Electricity interconnections of Ukraine with the EU countries



Regarding Burshtyn Island, the cross-border trade with the neighbouring countries is important. Burshtyn Island was synchronised with the central European system already in 2002 and is an important node in the Central European power system (see Figure 16). As the cross-border capacity given to the market is limited, the influence on the market also remains limited. If the full technical cross-border capacity were used, trading would have a significant influence on the market price. Imports have increased considerably lately, as seen in Figure 15.

Ukraine's Burshtyn Energy Island is already synchro-nised with the European electricity system.

Figure 17: Inefficiency of cross border flows into the Burstyn island and the consequently lost welfare

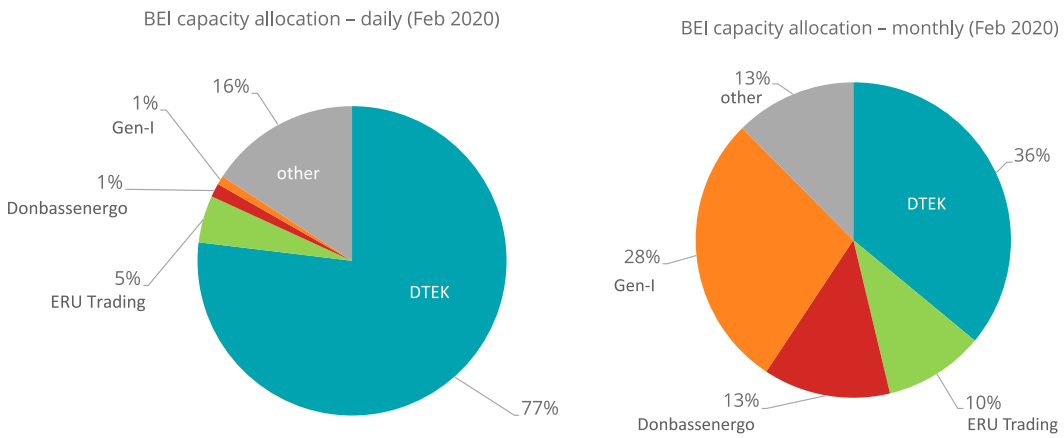


Source: Own calculation based on ENTSO-E (2020)

BEI controlled by monopoly: leading to cross-border flows flowing in opposite direction of prices.

From the observation of market prices at each side of the border and the flows, one can conclude that there is a discrepancy between the trades and prices. Roughly half of the time, electricity in the Burshtyn Electricity Island is flowing opposite to price signals, causing an estimated welfare loss of EUR70M during the first 10 months of market operation (see Figure 17). This could be explained by the monopolistic behaviour of the dominant power producer in the Burstyn Island. Figure 18 shows which companies control the capacity at the Burshtyn Electricity Island interconnectors.

Figure 18: Share of cross-border capacity allocated to different players at the Burshtyn Electricity Island interconnectors



Source: Mykhailenko, Vereshchynska, Mukha, Avetyan and Zachmann (2020)

Recommendations

Synchronisation with the central European system should be strongly pursued. This gives credibility for the future of the Ukrainian power market and for investments.

To Do's: Politicians must strongly support synchronisation with the European grid. Meanwhile, market power in the BEI and over cross-border transmission capacity must be undercut.

In the meantime, the Ukrainian government should investigate the possibility to introduce a market coupling type of capacity allocation for the trade between the Burshtyn Electricity Island and the EU. In any case, one should limit the capacity which one company or group can have at the interconnectors. This improves competition and limits the possibility to exercise market power on the cross-border trade. Also, regulatory scrutiny should be applied to capacity auctions and electricity trades in the Burshtyn Electricity Island to reveal any market manipulation attempts.

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Annex: Construction of the merit order

The construction of Ukraine's merit order is based on several assumptions. For thermal power plants, the World Bank (2007) published a report on fuel consumption on plant level, from which plant efficiencies can be calculated. These plant efficiencies can be used to calculate the short-run marginal costs (SRMC) via:

$$SRMC = \frac{Fuel\ costs\ EUR/MWh\_th}{Eff\% * MWh\_el} + \frac{1\ MWh\_th}{Eff\% * MWh\_el} * Emf \frac{tCO2}{MWh_{th}} * tax \frac{EUR}{tCO2}$$

where Eff constitutes the efficiency and Emf the emission factor of tCO_2 per MWh.

While the marginal costs of thermal power plants can be approximated on plant level due to detailed data on fuel rates, this is not the case for the remaining electricity production types. For CHPs, an efficiency of 35% for all coal-based CHPs, and 40% for all gas-based CHPs is assumed. This assumption corresponds to technology assumptions in the EU POTEnCIA Central Scenario (European Commission, 2020). For the remaining production types, marginal costs of 0 EUR/MWh are assumed for RES, 22 EUR/MWh for hydro and 12 EUR/MWh for nuclear.

As only plant efficiencies of thermal power plants are available, this is only a very rough approximation of Ukraine's merit order. Moreover, it should be noted that the plant level data for thermal power plants is already 13 years old. Consequently, retrofitting measures that could have occurred in the meantime and hereby improved efficiencies, are not taken into account.

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