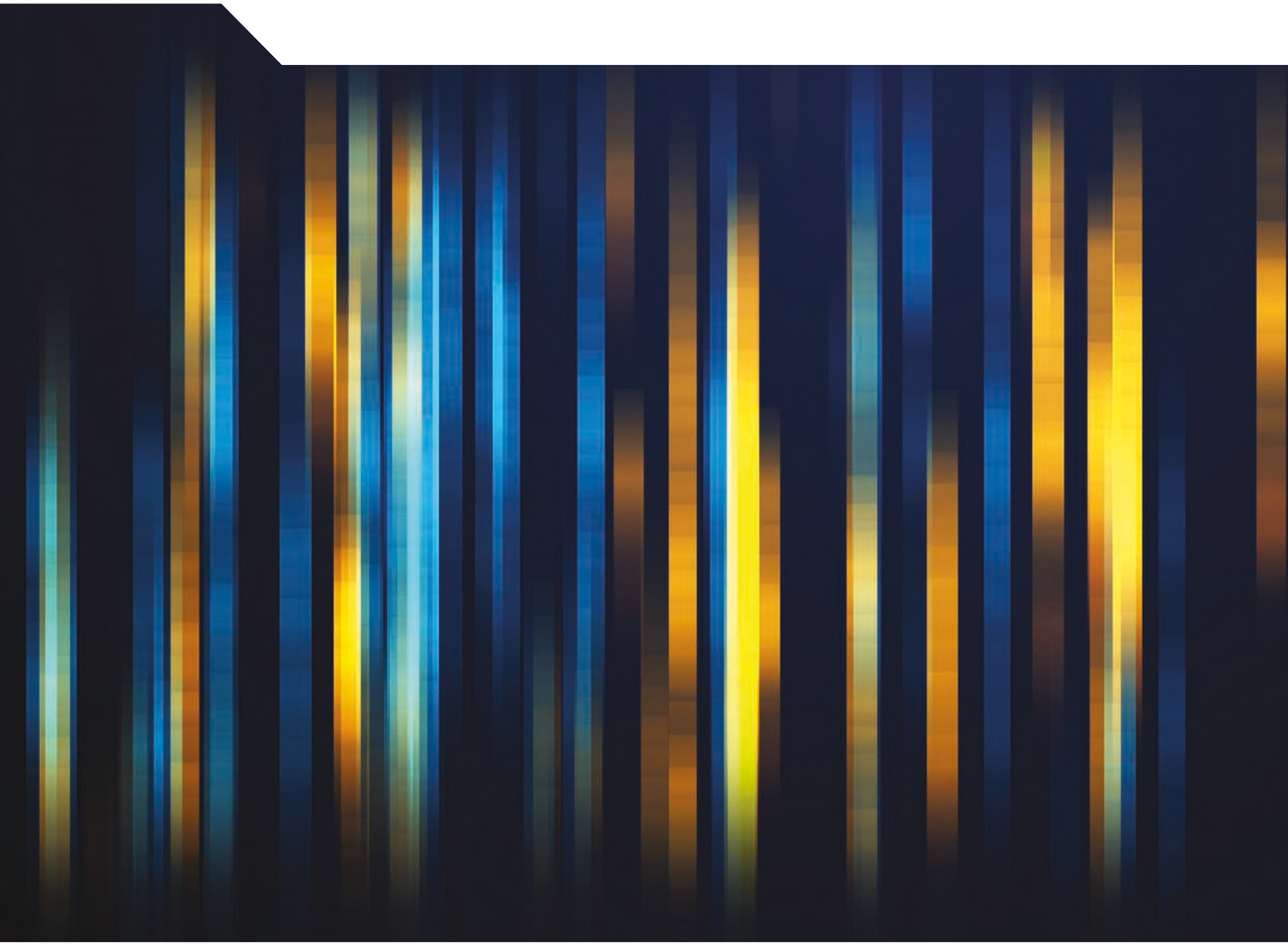
Competition Market Study of Ukraine's Electricity Sector



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Competition Market Study of Ukraine's Electricity Sector

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Preface by the EU Delegation to Ukraine

This OECD Market Study of the electricity sector in Ukraine, funded by the EU Delegation to Ukraine, presents the outcome of a fruitful co-operation between the OECD and the Ukrainian authorities.

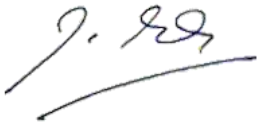
The project aimed at promoting competition in the electricity sector, which is a vital part of a modern, well-functioning economy. It contributes to a better understanding of the competitive landscape and the regulatory framework within which market participants operate.

Given the importance of the energy sector, the EU is continuing to provide both emergency and long-term support to the sector, to make it more efficient and resilient. The successful synchronisation of Ukraine's electricity system with the continental European system has been a major step towards Ukraine's integration with the EU electricity market. This study shows ways to continue with the integration process for the mutual benefit of both parties. This is particularly relevant in light of Ukraine's status of a candidate country for accession to the EU.

Russia's large-scale invasion has disrupted the lives of millions of Ukrainian citizens and severely damaged Ukraine's energy infrastructures by attacks that amount to war crimes. Despite the ongoing war, numerous Ukrainian stakeholders have contributed to this study, given its importance for the long-term functioning of the electricity sector and of the Ukrainian economy as a whole. The report is indeed vital for providing a pathway for competitive electricity market, which will be pivotal as Ukraine rebuilds after the war.

The recommendations provide clear guidance on how to complete the opening of Ukraine's electricity sector when the conditions are right, while also supporting the country's recovery and reconstruction.

I would like to express my sincere thanks to the OECD and all the experts who contributed to this project. The EU Delegation to Ukraine supported this project from its inception and stands ready to assist Ukraine in implementing its recommendations.



Matti Maasikas,

Ambassador of the European Union to Ukraine

Preface by the Antimonopoly Committee of Ukraine

The existing model of the electricity market in Ukraine has been operating for a rather short time and is still undergoing a period of formation. At the same time, it incorporates the most important principles of European legislation, including the principle of ensuring economic competition in the electricity market.

Therefore, the production, sale and purchase, and supply of electricity in Ukraine take place in a competitive environment, and the implemented model will further facilitate the opening and integration of Ukrainian markets into the European Union markets on the basis of common approaches and a single legislative framework.

The Antimonopoly Committee of Ukraine (AMCU) takes an active position on the implementation of competition policy, including in the electricity market, which consists not only of a timely response to anticompetitive actions of undertakings and authorities, but also of directing regulatory measures to create a competitive environment for the development of the electricity market, which allows achieving the goal of its liberalisation in conditions of healthy competition.

Despite the full-scale invasion of Ukraine by Russian troops, the full integration of the electricity market into the internal market of the European Union and, accordingly, the fulfillment of Ukraine's obligations remains a priority for the state.

In 2022, an important event for Ukraine was the interconnection of the national power system with the European Network of Transmission System Operators for Electricity, as provided for in the EU-Ukraine Association Agreement.

The entry of European electricity producers and suppliers into the Ukrainian market will increase competition and develop market mechanisms, as well as increase the investment attractiveness of the Ukrainian energy sector.

AMCU is grateful for the opportunity to join the study of the Ukrainian electricity market within the framework of the project "Supporting Reforms in the Energy Sector of Ukraine", especially, understanding the complexity of conducting such a global and high-quality study by the Organisation for Economic Co-operation and Development (OECD) under the conditions of martial law in Ukraine.

The OECD has conducted a detailed study of the electricity market, from the point of view of competition, from the beginning of the creation of a new model of the electricity market and during its operation in Ukraine.

As part of the study, OECD experts provided an overview of the electricity sector, analysed its regulatory framework and assessed the state of competition in it, noting that the structure of the Ukrainian market is very similar to that of the European Union, although it contains a number of shortcomings.

AMCU took an active part in working meetings and discussions during the study of the electricity market regarding the abolition of price caps, promotion of liquidity on the DAM, and participation of RES producers in the sale of electricity in competitive market segments. At the final stage, we provided proposals for the OECD's conclusions and recommendations regarding the specifics of the application of competition law instruments.

In addition, the AMCU believes that further implementation of the OECD recommendations set out in the Study will help to increase the level of integrity and transparency in the wholesale energy markets (in particular through the implementation of REMIT), improve the level of efficiency in the conduct of business for all participants in the energy markets, which in turn will contribute to the efficient functioning of the Ukrainian economy and the development of competitive relations.

AMCU expresses its sincere gratitude to the OECD experts, as well as to all parties involved in the study project, for conducting a detailed, in-depth and large-scale assessment of the electricity market and the activities of its participants.

Olha Pishchanska,

Chair of the Antimonopoly Committee of Ukraine

Foreword

This report aims to help Ukrainian policy makers and authorities with responsibilities for the electricity sector to improve the functioning of Ukraine's electricity market by identifying and recommending ways to overcome barriers to effective competition. It reviews the design, regulatory framework and functioning of wholesale and retail markets, from a competition perspective, and issues around the use of renewables and synchronisation with the European power system.

The market study was conducted by the OECD Competition Division with the financial support of the European Union, within the framework of the OECD Memorandum of Understanding for Strengthening Co-operation with the Government of Ukraine, and with the support of Ukrainian stakeholders. The recommendations of this project provide a roadmap for the Government of Ukraine to broaden and deepen pro-competitive reforms in the sector. If implemented, these recommendations will lead to improved competition at the wholesale and retail levels, the further integration of renewables into Ukraine's generation mix, and enhanced liquidity and investment in the power sector overall. It will also facilitate better integration with EU energy markets.

This report builds on the previous market studies conducted by the OECD's Competition Division. In 2016, market studies were chosen as a long-term theme for discussion by the OECD Competition Committee and between 2016 and 2018 the OECD held roundtables, hearings and workshops on various related subjects, including the characteristics of market studies, the powers available to competition authorities to collect information, procedural safeguards for stakeholders, interactions on market studies between competition authorities and other public bodies and ex-post evaluations of market studies. The Market Studies Guide for Competition Authorities summarises the work conducted by the OECD Competition Committee on this topic.

Acknowledgements

This report was prepared by the OECD, with the financial assistance of the European Union Delegation to Ukraine, in close co-operation with the Antimonopoly Committee of Ukraine, the National Energy and Utilities Regulatory Commission (NEURC), the Ministry of Energy and the Secretariat of the Cabinet of Ministers. The OECD team would like to thank them for their support to the project from its inception, for providing timely and quality information, for their availability to discuss and exchange, for reviewing the draft and providing comments, as well as for their continued engagement with the project despite the very difficult times for the country.

The OECD team is grateful for valuable input from market participants, in particular Ukrenergo, the Market Operator, the Ukrainian Energy Exchange, the DTEK Group, Ukrhydroenergo, Energoatom, Centrenergo, the Guaranteed Buyer, the CWP Group, the Ukrainian Association of Renewable Energy, the Solar Energy Association of Ukraine, the Razumkov Centre and the Public Association “Energy Union”.

The report benefited from the expertise and comments of the consultancies DiXi Group and Oxera. The Chairman of the Verkhovna Rada Committee on Energy, also reviewed the draft and provided valuable comments. International stakeholders from the Energy Community Secretariat, the International Energy Agency, the European Investment Bank, the Agency for Co-operation of Energy Regulators and the European Commission, contributed valuable insights, comments and data.

This report was prepared by Károly Nagy, Carolina Abate, Halyna Rudenko from the OECD Competition Division. Richard May contributed his expertise on market studies and reviewed the report together with Federica Maiorano, both from the Competition Division. Mariia Melnyk and Pedro Caro De Sousa formerly at the OECD Competition Division also provided inputs. Ori Schwartz, Head of the OECD Competition Division, provided overall leadership of the project. As an external electricity market expert, Oleksii Mykhailenko, prepared analytic work for the report. Gabriela Miranda, from the OECD Global Relations and Co-operation Directorate, co-ordinated the team’s interaction with Ukrainian stakeholders and provided valuable input. Padraic Convery edited the report and Erica Agostinho, from the OECD Competition Division, prepared it for publication.

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Abbreviations and acronyms

ACER	EU Agency for the Co-operation of Energy Regulators
AMCU	Antimonopoly Committee of Ukraine
BAM	Bilateral agreement market
BEI	Burshtyn Energy Island
BM	Balancing market
CHP	Combined heat and power
CMU	Cabinet of Ministers of Ukraine
DAM	Day-ahead market
DSO	Distribution system operator
EML	Electricity Market Law
ENTSO-E	European Network of Transmission System Operators for Electricity
EU	European Union
FiT	Feed-in tariff (also referred to as “green” tariff)
GB	Guaranteed Buyer
GWh	Gigawatt-hour
HHI	Herfindahl-Hirschman Index
IDM	Intraday market
IPS	Integrated power system
MO	Market Operator
MWh	Megawatt-hour
NERC	National Energy Regulatory Commission (predecessor of NEURC)
NEURC	National Energy and Utilities Regulatory Commission
NPP	Nuclear power plant
NRA	National regulatory authorities
PSI	Pivotal Supplier Index
PSO	Public service obligation
REMIT	Regulation on Wholesale Energy Market Integrity and Transparency
RSI	Residual Supply Index
RES	Renewable energy sources
TSO	Transmission system operator
TWh	Terawatt-hour
UAH	Ukrainian Hryvnia
UEEX	Ukrainian Energy Exchange
USD	United States Dollars
USS	Universal service supplier
VoLL	Value of lost load
WACC	Weighted average cost of capital

Executive summary

This competition market study describes and analyses Ukraine's electricity sector from a competition perspective.

Russia's large-scale aggression against Ukraine has upended the lives of Ukrainian people and the country's economy and has severely impacted its electricity industry. Questions relating to the competition in electricity markets have been superseded by the urgent need to ensure electricity supply to public institutions, households and businesses. Despite this, crucial parts of the power sector continue to function as competitive markets. Therefore, competition and competition enforcement have a role to play even in a time of the war. Many economic activities can and should continue based on market principles and adherence to the principles and laws governing competition.

Recognising the drastically changed situation in Ukraine, the scope and focus of this study was adjusted, in agreement with the Ukrainian authorities and the EU Delegation. An in-depth analysis of market dynamics became no longer appropriate, or possible, due to continuing changes in the market situation and the unavailability of verifiable, up-to-date information.

The study provides a detailed description and assessment of the regulatory framework within which Ukraine's electricity markets operate. The focus is therefore on issues that will likely remain relevant when Ukraine can begin to rebuild following the war.

The overall design of Ukraine's electricity market closely resembles power markets in the European Union, which make a clear distinction between competitive and non-competitive activities. Electricity transmission and distribution fall into the latter category, which is justifiable by their natural monopoly characteristics and in line with international practice. The laws governing electricity markets recognise generation, wholesale and retail supply of electricity as competitive activities. However, specific legislation and regulatory interventions significantly reduce the scope for competition in all parts of the electricity market.

In parts of the wholesale market, prices are constrained by limits that restrict market-based price formation and distort price signals. Prices that reflect supply and demand are crucial for the competitive generation of electricity and are a major factor affecting investment decisions relating to new generation capacity. Price caps also represent a hurdle to deeper integration with the EU electricity market because they are incompatible with market coupling (of the day-ahead and intraday markets).

In the retail market, regulated prices for households prevent the emergence of competition for a significant section of consumers. A phase-out of regulated prices, combined with support for vulnerable households, would enable competition in this market segment and represent a better use of limited financial resources. It would also provide appropriate incentives to use electricity in an economically efficient way.

Electricity infrastructure in Ukraine has suffered great damage as a result of Russia's large-scale aggression. Repairing the electricity network and power plants will require significant investment. New power plants will most likely be needed to replace those damaged beyond repair, and in the longer-term to cover expected increases in consumption. Electricity generation from renewable energy sources offers a sustainable and increasingly cost-effective alternative to fossil-fuel plants. While the objective should be

to mobilise market-based investments, support by the state and the international community will be necessary – at least during the initial stages of reconstruction.

Finally, integration with EU energy markets has been a political priority for Ukraine. Synchronisation with the Continental European Power System represents a major step in this direction. Increasing import and export capacity benefits security of supply and has the potential to greatly enhance electricity market competition. To reap the full benefits of synchronisation, Ukraine needs to adopt the necessary EU market rules and work towards market coupling.

1 Context of the market study and introductory remarks

Russia's unprovoked large-scale invasion in 2022 has affected all aspects of life in Ukraine. It has had a devastating effect on the economy and society. Targeted attacks on energy infrastructure have resulted in extensive damage, but Ukraine has managed to maintain a functioning electricity system. It has also succeeded in achieving closer integration with the EU electricity system. The resilience of Ukraine's electricity sector demonstrates its potential. When the war ends, it will face challenges linked to becoming more efficient and more competitive. This report aims to facilitate the sector's success in undergoing that transition.

Since the introduction of martial law on 24 February 2022, Ukraine's electricity sector has operated under special regulatory arrangements. The pre-war market model has remained largely in place but with significant adjustments. The Ministry of Energy has been granted extensive decision-making powers over the operations of companies in the sector. As of the beginning of 2023, attacks on Ukrainian infrastructure continue. The electricity sector has been a major target of attacks and has suffered immense damage. Under these adverse conditions, it has also proven its resilience.

Emergency measures to deal with the immediate effects of the war are not the focus of this study. These are vital to keep the power system functioning under extraordinary circumstances but are of a temporary nature and of lesser relevance to the longer-term development of the electricity sector. The expectation is that Ukraine's post-war regulatory system for the electricity sector will closely resemble the pre-war system described in this study. Market studies normally rely on extensive factual input from market participants, and on their views on the state of competition. For this study, the collection of information from market participants has been severely restricted by the war. Replies to an extensive questionnaire received shortly before Russia's war of aggression could not be verified and may be outdated, reducing their utility. Market participants and public authorities have been under immense pressure, given their responsibility to keep the electricity system intact. Contact with stakeholders has been limited since the start of the war, and circumstances have not permitted in-depth discussions or the distribution of additional questionnaires.

Further, martial law has led to the imposition of restrictions on the publishing and sharing of information on sensitive parts of Ukraine's economy, including the electricity sector. Even in absence of such restrictions, the impact of the war cannot be assessed at a granular level due to the dramatic and ongoing damage it has caused. As a result, the study has had to rely largely on publicly available information, some of which is not fully up to date. Inevitably, this has some negative implications for the robustness of the analysis. Nevertheless, the study should give an adequate description of the main features of Ukraine's electricity sector and the framework within which it operates.

The aim of this competition market study is to identify potential competition issues in the electricity sector and to provide recommendations to make the sector more competitive. These recommendations will provide a basis for measures by which Ukrainian authorities can overcome obstacles to effective competition, allowing Ukraine to reap fully the rewards of a liberalised electricity sector.

Most changes in the electricity sector during the war have been driven by factors beyond competition, and are mostly of a temporary nature, but some developments are noteworthy.

As a direct consequence of the war, electricity demand in Ukraine has dropped by around one-third. Business and industrial consumption has fallen due to sharply reduced economic activity, and demand by households has declined as almost 8.2 million people have been forced to flee the country (UNHCR, 2023[1]).

Initially, lower demand led to significant price declines in short-term wholesale markets, threatening electricity producers' financial viability. This prompted the introduction of price floors. Later, prices recovered as generation capacity became increasingly constrained due to physical damage to power plants and the network.

In March 2022, the Cabinet of Ministers of Ukraine introduced a moratorium on disconnecting households from electricity supply and other utility services due to non-payment of electricity bills.[1] The moratorium also applies to non-households in militarily active areas and in occupied territories.

In addition, in the event of termination of the supply of electricity by the previous supplier, consumers whose original suppliers have been designated "default market participants" or which lose supply licences have been transferred to one of the country's universal service suppliers.[2] This ensures that consumers are not left without electricity in the event of termination of their contract by the previous supplier.

Another major development with the potential to transform Ukraine's electricity sector has been its synchronisation with the Continental European Transmission System. Synchronisation ensures that electricity networks function at the same frequency. It increases the stability of connected networks and allows deeper integration of electricity markets. Ukraine has been seeking to synchronise its electricity network with the European system since the 1990s. The Burshtyn Energy Island (BEI), a small part of Ukraine's power system that accounts for around 4% of total production and consumption, has been synchronised with the European system since 1 July 2003. Ukraine applied for synchronisation of its entire system in 2006 (Ukrenergo, 2023[2]). In an emergency procedure, the Ukrainian power system was synchronised with the Continental European Power System on 16 March 2022 (ENTSO-E, 2022[3]). At the same time, the two separate Ukrainian power trade zones, the BEI and the Integrated Power System (IPS), were merged so that Ukraine now has a single power trade zone.

Box 1.1. Damage to Ukraine's electricity infrastructure

The Kyiv School of Economics estimates that Ukraine's infrastructure had suffered USD 137.8 billion (at replacement cost) of documented damage as of December 2022, including USD 6.8 billion of damage to energy infrastructure. As information about the country's temporarily occupied territories is scarce, the actual figure is likely higher.

Ukraine's electricity infrastructure suffered considerable damage during the first weeks and months of Russia's war of aggression. During aerial bombing on 3 March 2022, seven thermal and hydro power plants sustained damage, and the Okhtyrka combined heat and power (CHP) plant was destroyed. Three more CHP plants, sited respectively in Kremenchuk, Chernihiv and Severodonetsk, were substantially damaged. Russian troops also targeted and damaged more than 50 parts of the electricity grids in regions including Kyiv, Chernihiv, Sumy, Mykolaiv, Kharkiv and Kherson. At the time of writing, the Zaporizhzhia nuclear power plant, which provides around 25% of Ukraine's electricity, remains occupied by Russian troops.

Most of Ukraine's solar and wind power plants are located in areas in which intense military action has taken place. Around 60% of installed solar power capacity and 38 of the country's 42 windfarms are in the region between Odesa and Luhansk. By May 2022, the estimated insured losses from windfarms had reached at least USD 800 million.

On 10 October 2022, Russian forces intensified targeted attacks on energy infrastructure. On that day, 30% of Ukraine's energy infrastructure was damaged, leading to emergency power outages all over the country.

The heaviest shelling of Ukraine's energy system since the beginning of the war took place on 15 November 2022, when Russian forces fired 100 missiles at critical infrastructure facilities. By that time, around 50% of Ukraine's energy infrastructure had already been destroyed.

As attacks continued, electricity outages became more widespread and prolonged. Prime Minister Denys Shmyhal stated that as of 23 November 2022, "there is not a single thermal [or] hydroelectric power plant in Ukraine that has not been fired upon by the enemy". Despite the multiple adversities, a total system failure was prevented thanks to the determined efforts of repair crews from Ukrenergo (the Transmission System Operator) and other electricity companies.

By end of December 2022, Ukraine's international partners had committed support worth almost USD 1.5 billion to the country's energy sector, including equipment for repairs, according to a statement made by the prime minister. Since Russian forces have frequently attacked high-voltage transformer substations to cut off power plants from consumers, transformers are one of the most needed types of equipment.

Despite constant repairs, significant shortages of electricity have necessitated the introduction of consumption limits in all parts of Ukraine. Planned stabilisation schedules for shutdowns are in use, but

the risk of emergency shutdowns remains high. For example, cold weather on 10 January 2023 led to significantly increased electricity consumption, which prompted an emergency power shutdown in some parts of the country.

Sources: Kyiv School of Economics (2023[4]), The total amount of damage caused to Ukraine's infrastructure due to the war has increased to almost USD 138, https://kse.ua/about-the-school/news/the-total-amount-of-damage-caused-to-ukraine-s-infrastructure-due-to-the-war-has-increased-to-almost-138-billion/; Pryshlyak (2022[5]), The occupiers have already damaged about 50% of the Ukrainian energy infrastructure – Zelenskyi, https://www.unian.ua/economics/energetics/okupanti-poshkodili-vzhe-blizko-50-ukrajinskoji-energetichnoji-infrastrukturi-zelenskiy-12050670.html; Kovalenko (2022[6]), More than 8 000 generators are brought to Ukraine every day – Shmyhal – UNIAN, https://www.unian.ua/economics/energetics/shchodnya-v-ukrajinu-zavozyat-ponad-8-tisyach-generatoriv-shmigal-12051636.html; Sayenko (2022[7]), Ukrenergo told how Ukraine's energy system survived yesterday's attack, https://www.unian.ua/economics/energetics/v-ukrenergo-rozpovili-yak-energosistema-ukrajini-perezhila-vchorashnyu-ataku-12081552.html; Albul (2023[8]), Electricity capacity shortage has increased in Ukraine, https://lb.ua/society/2023/01October 542048_ukraini_zris_defitsit_potuzhnosti.html; Global Reinsurance (Global Reinsurance, 2022[9]), Renewables face billions of dollars in Ukraine losses – PCS, https://www.globalreinsurance.com/home/renewables-face-billions-of-dollars-in-ukraine-losses-pcs/1441292.article; (Korogodskyi, 2022[10]), Almost USD 1.5 billion: Shmygal talked about international aid to Ukraine in the energy sector, https://lb.ua/economics/2022/12/25/540343_mayzhe_15_mlrd_shmigal_rozpoviv_pro.html.

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Notes

[1] CMU Resolution No. 206, "Some issues of payment of housing and communal services during martial law", 5 March 2022, https://zakon.rada.gov.ua/laws/show/206-2022-%D0%BF#Text.

[2] Order of Ministry of Energy No.148, "On the settlement of issues related to the supply of electricity to consumers and settlements between participants of the retail electricity market during the period of martial law in Ukraine", 13 April 2022, https://zakon.rada.gov.ua/laws/show/z0441-22#Text.

2 Main market features

This chapter provides an overview of the main features of Ukraine's electricity sector. It begins with a short review of the sector's history. This is followed by a description of the electricity supply chain from generation to consumption, which includes a survey of the main market participants, an examination of the country's changing electricity generation capacity and energy mix, a summary of market support measures for generation using renewable energy sources and an outline of plans for developing the network, including the integration of Ukraine's electricity market with EU markets.

Electricity is one of the most widely used forms of energy and an essential part of modern life. In developed economies, households and businesses rely on the uninterrupted supply of electricity. The production of almost all goods requires the use of electricity in some form or another.

A key feature of electricity is that it cannot currently be stored economically on a large scale.[1] This means that its production and consumption must be balanced at all times. Any imbalance can result in power losses or blackouts, with serious economic and social consequences. Keeping power systems in balance is made difficult by constant variations in both generation and consumption.

In most countries, the electricity sector is generally highly regulated for safety reasons and to minimise the risk of supply interruptions to consumers. Regulation is also used to protect consumers from high prices, especially from parts of the system operated by natural monopolies. The scope of price regulation varies between countries, often going well beyond limiting the pricing power of natural monopolies.

The main actors in the electricity market are producers/generators, suppliers/retailers, traders, consumers and network operators. They interact with one another in different marketplaces, mostly the wholesale and retail markets.

Producers or generators are typically large entities operating multiple power plants and selling their output on the wholesale market. Small-scale generation by individuals, small businesses and communities is growing worldwide, but in most countries it accounts for a tiny proportion of overall production. Producers can be differentiated in terms of flexibility; power plants that use different fuels have substantially different capabilities to adjust output rapidly. Nuclear power plants (NPPs), for instance, are generally unable to substantially adjust output at short notice, while gas-fired and hydro power plants are far more flexible. Flexible output is essential for balancing power systems in real time.

Suppliers or retailers buy electricity from producers on the wholesale market and sell it on the retail market to end users. Suppliers procure fixed amounts of electricity on the wholesale market but provide fully flexible supply (subject to the technical limits of connections) to their customers.

Electricity consumers range from large industrial consumers to other businesses and public entities to individual households. In the retail market, consumers and suppliers conclude supply agreements. Industrial consumers with sufficiently large demand for electricity can and often do purchase directly on the wholesale market, but this requires a certain level of market expertise.

Network operators ensure the transport of electricity from the point of generation to the point of consumption. Two types of electricity networks exist: transmission and distribution. Transmission networks carry electricity over long distances at high voltages. Distribution networks run at lower voltages and take electricity from the transmission system into homes and businesses. The electricity network is generally considered a natural monopoly and is operated by a single company over a certain area. As such, transmission and distribution tariffs are typically regulated.

Understanding the current state of competition in Ukraine's electricity market requires some knowledge of the historical context. This chapter provides a brief historical overview of electricity sector reforms in Ukraine since the country's independence in 1991, followed by an overview of the sector's main elements: consumption, generation, transmission, distribution, supply activities and cross-border flows.

2.1. Electricity sector reforms

Ukraine started to build an independent energy sector in 1991 amid the dissolution of the Soviet Union, of which it had been part. At the time, the Ministry of Power and Electrification proposed reforming the sector by introducing the British power market model, aiming to restructure and create a wholesale market for electricity.

Following this proposal, in May 1994, then-President Leonid Kuchma issued a decree to unbundle the vertically integrated state monopoly, which controlled the entire supply chain, and introduce competition in electricity generation by establishing a national wholesale market (Lovei, 1998[1]). In 1994, independent energy regulator the National Energy Regulatory Commission (NERC)[2] was established. It was given responsibility for issuing and monitoring licences for electricity generation, high- and low-voltage transmission, wholesale market operations, and setting retail prices and network tariffs (Lovei, 1998[1]). Following the establishment of the wholesale market in 1996, power production, transmission, distribution and regulated supply were operationally separated.

Under the new market model, Ukraine established Energorynok, a state-owned company acting as a single buyer in the wholesale market. It purchased electricity from generators at regulated prices and sold it to unregulated suppliers and to regional electricity supply and distribution companies known as *oblenergos* (OECD, 2019[2]) (OECD, 2019[2]). *Oblenergos* sold electricity to consumers at regulated retail prices based on the costs of generation, transmission, distribution and other factors.

The reform laid the foundations for competition in electricity generation and supply in three ways. First, several generators and suppliers were licensed to produce and sell electricity. Second, the wholesale market proved its ability to evaluate hourly bids, dispatch power accordingly, determine financial claims and obligations, and carry out financial transactions to settle claims among market participants. And third, the NERC set the tariff for access to high- and low-voltage networks. Yet despite the new structure, the main promises of the reform – attracting investment and the depoliticisation of electricity price setting – were not fulfilled (Lovei, 1998[1]). A key factor in this is likely to have been the economic instability the country experienced following the dissolution of the Soviet Union.

The electricity sector liberalisation of the 1990s was expected to be coupled with privatisation, but that did not proceed as expected. The government launched its first privatisation of coal mines in 1996, followed by that of *oblenergos* in 1998 (IEA, 2006[3]). However, only six of the country's 27 *oblenergos* were fully privatised by 2001, while the remaining 21 were only partly privatised. Difficulties occurred due to a lack of agreement within government on the privatisation process, concerning issues such as the size of ownership stakes to be retained by the state (Lovei, 1998[1]).

A second attempt to reform the sector took place in 2002. The Cabinet of Ministers of Ukraine (CMU) issued a decree outlining a new market design based on three types of transactions: bilateral contracts, standard agreements through an exchange, and a balancing market.[3] However, implementation of this market design was delayed due to the need for legislative changes. Attempts were made to pass the required legislation but were ultimately unfruitful until Ukraine joined the Energy Community in 2011 and reforms started to be implemented.

In 2004, the government decided to increase state control over the energy sector, with the aim of improving the management of power sector enterprises. It reconsolidated the electricity and coal industries into large, vertically integrated companies. Two new entities were created: the Energy Company of Ukraine, which re-acquired operational control over electricity retail companies with stakes varying from 25% to 100%, and Coal of Ukraine, which consolidated state-owned coal mines (IEA, 2006[3]). The latter was soon abolished and its assets were transferred to the Ministry of Coal Industry.

In 2011, a new government formed under President Viktor Yanukovych made a second attempt to privatise *oblenergos*. The CMU adopted a decree permitting the sale of 13 *oblenergos*, with a further ten added in 2012 (Baker McKenzie, 2021[4]). A large-scale sale of *oblenergos*' shares was planned for November 2014. However, only 25% of the shares of *oblenergos* Zakarpattiaoblenergo, Vinnytsiaoblenergo and Chernivtsioblenergo were sold. In August and September 2017, the State Property Fund of Ukraine sold further minority stakes (25%) in *oblenergos* Dniproenergo, Dniprooblenergo, Kyivenergo (which also had distribution activities), Zakhidenergo and Donetskoblenergo (Baker McKenzie, 2021[4]). Overall, the sale of *oblenergos* proved difficult as the state was often unable to sell their shares, and even when shares were sold, *oblenergos* typically remained under majority government control.

This second attempt to privatise *oblenergos* occurred in tandem with a further reform of Ukraine's energy sector. In February 2011, Ukraine officially joined the Energy Community (European Commission, 2010[5]), with the aim of reshaping its energy sector in line with the European model. Following Ukraine's accession to the body, the wholesale market reform proposal previously initiated by the Cabinet of Ministers was enacted in a new market law. In 2013, Ukraine's government took the first step towards liberalising the electricity market and adopted a new law on the functioning of the electricity market[4] outlining the main features of the future market. The following year, Ukraine signed an association agreement with the EU[5] that entailed complying with the Third Energy Package and integrating its electricity system with the European Network of Transmission System Operators for Electricity (ENTSO-E). To this end, in 2017 the government introduced the Electricity Market Law (EML),[6] which envisaged the replacement of the single-buyer market model with competitive market elements. After the entry into force of the EML, the main institutions responsible for its implementation (the Cabinet of Ministers, the NERC, the Ministry of Energy, the Transmission System Operator [TSO] and the Market Operator [MO]) started preparing secondary legislation for the new market model. Several documents to regulate the new market were developed, including the Market Rules,[7] the Day-Ahead and the Intraday Market Rules (DAM/IDM Rules), the Retail Market Rules, the Transmission Network Code, the Distribution Network Code, the Commercial Metering Code and the Licence Terms and Conditions.

The new framework entered into force in two phases in 2019. The first was the opening of the retail market to competition on 1 January. The second was the establishment of the wholesale market on 1 July. In practice, it meant switching from a single-buyer model to a competitive market structure with bilateral contracts and day-ahead, intraday and balancing markets. Energorynok, the market operator under the previous model, was assigned liability for debts accumulated during the operation of the single-buyer model. In its place, two new companies were created: the Guaranteed Buyer (GB) and the MO. The GB was tasked with taking over and paying for electricity from renewable energy producers under the feed-in-tariff (FiT, also referred to as the "green" tariff) mechanism, and the MO became responsible for the operation of the DAM and the IDM. Transmission system operator Ukrenergo received new tasks, including operating the balancing and ancillary services markets, registering bilateral agreements, and serving as a settlements and commercial metering administrator. The energy regulator became responsible for adopting the Market Rules, the DAM/IDM Rules and the Retail Market Rules, developing transmission, distribution and commercial metering codes, and drafting licensing terms (OECD, 2019[2]). The structure of Ukraine's electricity sector is described in detail in Chapter 3.

2.2. Overview of the electricity sector

As detailed in the previous section, Ukraine's electricity sector has undergone considerable structural reforms since its creation. This section provides an overview of main elements of the sector: consumption, generation, transmission, distribution, supply activities and cross-border flows.

Box 2.1. Main electricity market participants

Ukrhydroenergo is a state-owned hydro power company managed by the Cabinet of Ministers of Ukraine. It operates ten plants located across the Dniester and Dnipro rivers, generating around 6.7% of Ukraine's total electricity production.

Energoatom is a state-owned company under the management of the Cabinet of Ministers of Ukraine that operates four NPPs that generate about half of the country's electricity.

DTEK Group, founded in 2005, is the largest vertically integrated private holding company in Ukraine. It is involved in the production, supply and distribution of natural gas and electricity, and coal mining.

Centrenergo is one of the largest thermal generating companies in Ukraine, operating three thermal power plants. Centrenergo is state-owned and managed by the State Property Fund.

Ukrenergo is the only TSO in Ukraine. It is responsible for transmitting and dispatching electricity through high-voltage networks. Under the new market model, Ukrenergo also operates the balancing and ancillary service markets, registers bilateral agreements, and serves as a commercial metering and settlements administrator. Ukrenergo was certified by the National Energy and Utilities Regulatory Commission (NEURC) under the independent system operator (ISO) unbundling model.

Distribution system operators (DSOs) are responsible for distributing and dispatching electricity to end users. There are 32 DSOs in Ukraine, eight of which are controlled by the State Property Fund.

Suppliers (under free prices) are economic entities purchasing electricity on the market and selling it to consumers at free (unregulated) prices.

Universal service suppliers (USSs) are electricity suppliers with a legal obligation to supply residential and small, non-residential consumers at regulated prices. There are 25 regional USSs, six of which are state-owned.

Ukrinternenergo (supplier of last resort) is a state-owned supplier that provides services to consumers in exceptional circumstances, such as the cancellation of their supplier services or a failure to select a supplier. It may supply electricity for no more than 90 days at regulated prices.

The GB is a state-owned company responsible for ensuring public interest in increasing the share of electricity generation from renewable energy sources by buying electricity from producers eligible for green tariffs and selling it on the market.

The MO is shareholding company whose shares are 100% owned by state and which operates the DAM and the IDM.

Traders are economic entities purchasing electricity for resale on the wholesale market.

Energy storage operators were introduced in Ukrainian legislation in 2022 to sell electricity released from energy storage facilities to provide ancillary and balancing services. As of March 2023, no energy storage operator licences had been granted.

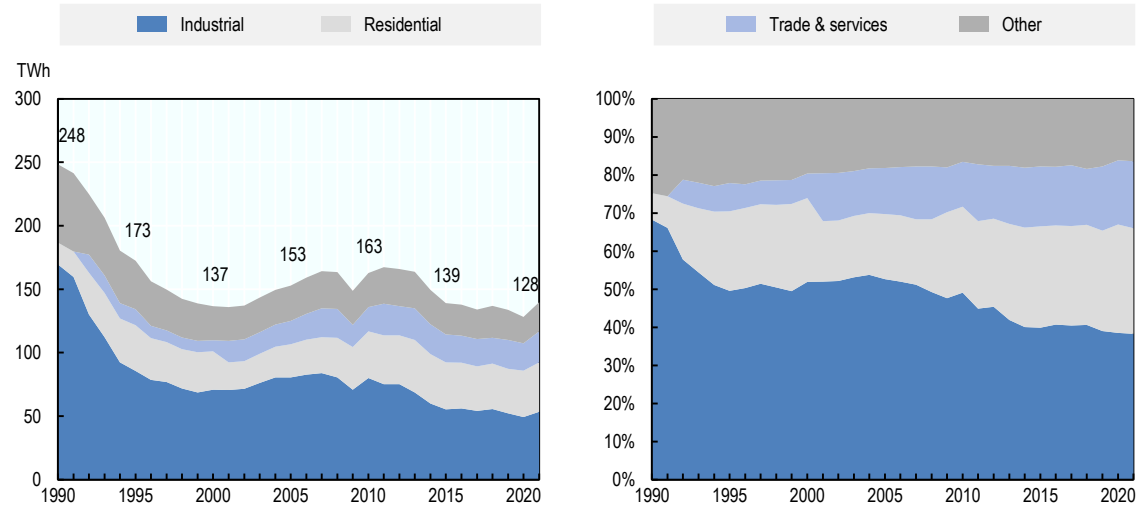
Sources: NEURC (2021[6]), The regulator publishes the results of monitoring the functioning of the retail electricity market in the first quarter of 2021, https://www.nerc.gov.ua/?news=11683; NEURC (2021[7]), The regulator publishes the results of monitoring the functioning of the wholesale electricity market in the second quarter of 2021, https://www.nerc.gov.ua/?news=12053; OECD (2019[2]) Snapshot of Ukraine's Energy Sector: Institutions, Governance and Policy Framework, https://www.oecd.org/eurasia/competitiveness-programme/eastern-partners/Snapshot-of-Ukraines-Energy-Sector-EN.pdf; Verkhovna Rada (2017[8]), Law of Ukraine about the Electricity Market, No. 2019-VIII, https://zakon.rada.gov.ua/laws/show/2019-19.

2.2.1. Electricity consumption

Ukraine's electricity system was built largely to power energy-intensive industries during the Soviet era. After the country's independence in 1991, electricity consumption decreased significantly following a sharp decline in industrial production. Consumption stabilised in the early 2000s when Ukraine entered a period of economic growth. The global economic crisis of 2008-09 led to another, albeit shorter-term, drop in consumption. Economic growth was disrupted again in 2014 following Russia's occupation of Crimea, the Donetsk and Luhansk regions.

In 2020, amid the COVID-19 pandemic, electricity demand reached a historic low of 128 TWh, around half of its 1990 level. Consumption rebounded in 2021 but fell sharply following Russia's large-scale invasion of Ukraine in 2022.

Figure 2.1. Gross electricity consumption by sector, 1990-2021

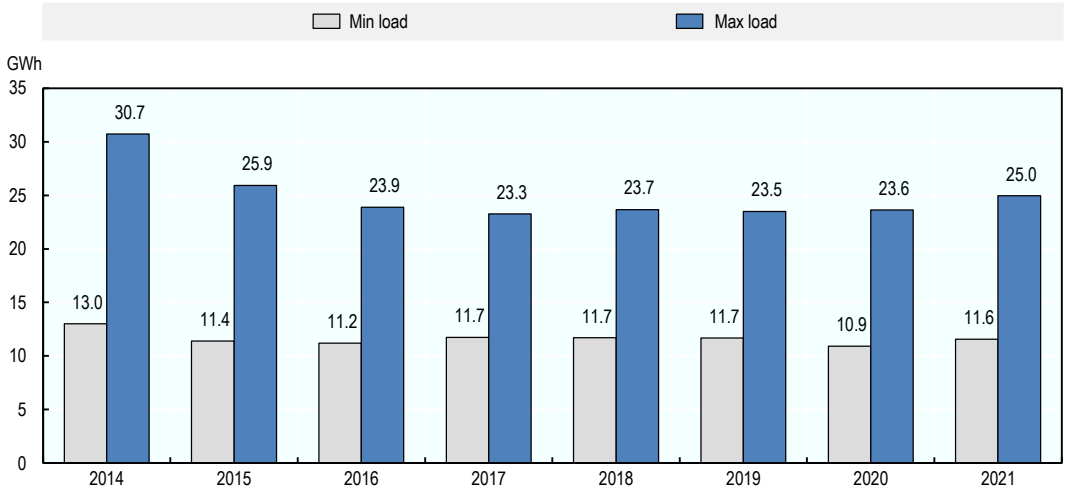


Note: Other includes transport, agriculture and power plants' own use.
Source: Ukrenergo (2022[9]), Electricity consumption by consumer groups, https://map.ua-energy.org/en/resources/742384e9-83c7-44f4-8c0b-0cd74b56561b/.

The structure of consumption has also changed dramatically since the 1990s. For example, the share of consumption accounted for by industrial use dropped from 68% in 1990 to 38% in 2021, while the share of residential consumption increased from 7% to 28% over the same period. Further, consumption by the trade and services sector grew strongly, accounting for 18% of total use in 2021, whereas consumption by the agricultural sector dropped from 11% to 3%.

In addition to overall consumption, it is worth considering the minimum and maximum levels of hourly consumption (often referred to as load). The larger the difference, the more economically challenging it is to ensure an adequate level of installed capacity and generation. Figure 2.2 shows that the difference between minimum and maximum load has decreased from 17.7 GWh in 2014 to 13.4 GWh in 2021. This is due to significant decrease in maximum load over the years.

Figure 2.2. Minimum and maximum and hourly load (IPS), 2014-21



Source: Ukrenergo (2023[10]), Hourly electricity balance of the IPS of Ukraine, https://map.ua-energy.org/en/resources/8998f2ed-379f-4fa9-9076-88782b32ee4f/.

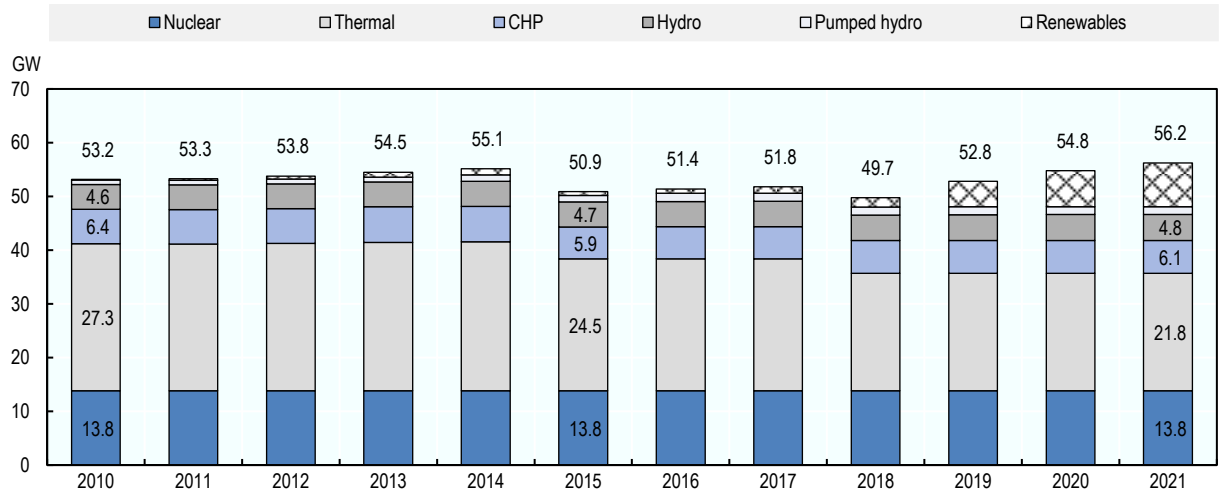
2.2.2. Generation capacity

As noted above, it is difficult to assess and verify the current state of Ukraine's generation fleet due to ongoing attacks on energy infrastructure. Before Russia's large-scale invasion in 2022, Ukraine's generation fleet was largely comprised of power stations built during the Soviet era, having not changed drastically since Ukraine's independence apart from an increase in generation capacity from renewable energy sources (RES).

NPPs (with installed capacity of 13.8 GW) serve as baseload power plants, operating continuously to meet minimum demand. Demand above this baseload is supplied largely by thermal power plants (21.8 GW). Run-of-river hydro power plants (4.8 GW) and pumped-storage hydro power plants (1.5 GW) typically serve demand increases associated with peak periods. Electricity production by combined heat and power (CHP) plants (6.1 GW) is, by design, driven mostly by demand for heating. Renewable capacity (excluding large hydro power) comprises mainly solar and wind power plants.

The development of installed capacity over the 12 years between 2010 and 2021 is shown in Figure 2.3. It has been largely stable except for a marked drop in thermal capacity that has been more than offset by an increase in renewables capacity.

Figure 2.3. Installed generation capacity by technology, 2010-21



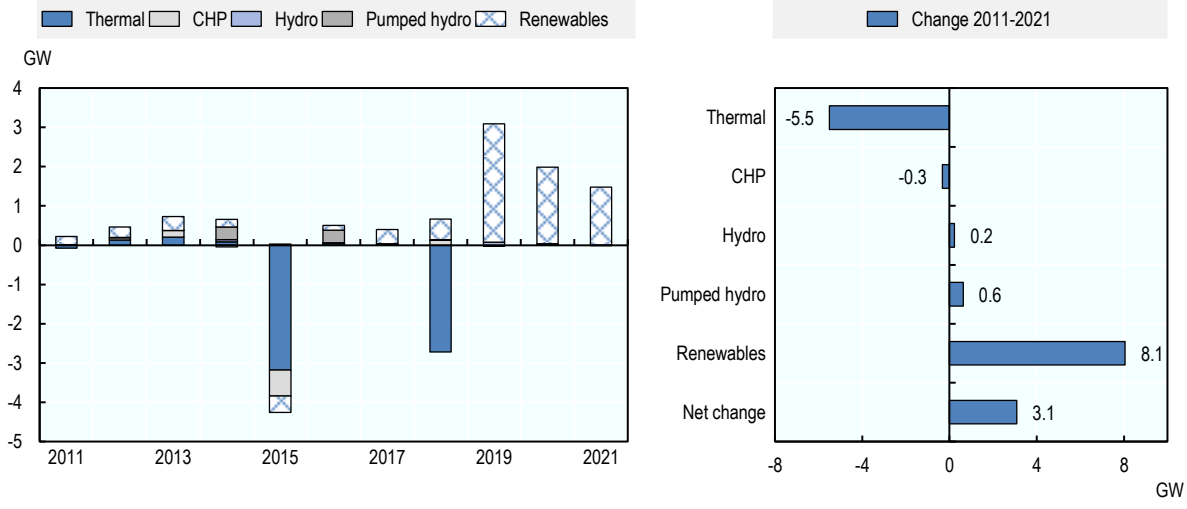
Source: Ukrenergo (2022[11]), Installed electricity production capacity by power plant types (Ukrenergo) – Energy Map, https://map.ua-energy.org/en/resources/c51a16bc-e990-40db-b790-63624d823daa/.

The first drop in thermal capacity was due to Russia's attacks in 2014 and the subsequent occupation of Ukrainian territory. Ukraine lost around 4.2 GW of generation capacity, mostly coal-fired thermal plants but also CHPs, solar and wind power plants. The second drop, in 2018, was due to the classification of some thermal generation units as "not available".

Most of the new capacity added during the past decade is based on RES. The main driver has been solar (photovoltaic) power, followed by wind. RES investments have been driven by a FiT support scheme introduced in 2009-10 that is generous by international standards. Falling capital costs of solar and wind installation have made the FiT even more attractive to investors in subsequent years.

The yearly changes in installed capacity are shown below.

Figure 2.4. Change in installed capacity, 2010-21



Note: Nuclear capacity is not shown as it remained constant over the period.
Source: Ukrenergo (2022[11]), Installed electricity production capacity by power plant types (Ukrenergo) – Energy Map, https://map.ua-energy.org/en/resources/c51a16bc-e990-40db-b790-63624d823daa/.

Nuclear power

Ukraine is one of the world's most reliant countries on nuclear energy. In 2021, 55% of its electricity production came from NPPs (Economichna Pravda, 2022[12]). Ukraine's nuclear generation serves as the baseload supply, generating a relatively stable amount of electricity throughout the year. This is also due to NPPs' limited technical flexibility to change output and their high efficiency at full load.

Box 2.2. Uranium

Ukraine is rich in uranium deposits, and in recent years domestic production has met close to 40% of its uranium ore needs. At the end of 2021, Ukraine's government approved a programme to make the country self-sufficient in uranium by 2027.

Ukraine's uranium is produced by state-owned enterprise Eastern Mining & Processing Plant (EMPP), one of Europe's biggest uranium ore extraction and processing enterprises. EMPP extracts uranium ore and produces natural uranium concentrate. It has encountered considerable financial problems in the past due to non-payment by Energoatom. In December 2020, it stopped production due to strikes related to wage arrears (LigaNews, 2020[13]). In response, the government proposed a merger between EMPP and Energoatom to facilitate debt settlement (Government Portal, 2021[14]). The idea was strongly supported by the Ministry of Energy but reportedly opposed by Energoatom's management because of EMPP's financial problems (OilPoint, 2021[15]).

Ukraine relies on other countries for nuclear fuel enrichment as it has no enrichment capacity. All nuclear fuel cells are produced abroad and imported. Ukraine had previously fully relied on TVEL, a division of Russia's Rosatom, for nuclear fuel supply. In 2005 Ukraine began implementing a strategy to diversify its supply of fuel for NPPs, licensing nuclear fuel produced by Westinghouse Electric.

Until 2021, Ukraine also relied on the Russian Federation for storage of nuclear waste. Following construction of a long-term storage facility, the Centralised Spent Nuclear Fuel Storage Facility, spent nuclear fuel from the Khmelnytskyi, Rivne and South-Ukrainian NPPs is stored in Ukraine. (Zaporizhzhia NPP has its own dry storage for waste nuclear fuel.) This contributes to Ukraine's energy independence in the nuclear sector and is expected to save Energoatom USD 150-200 million annually in storage costs.

Sources: World Nuclear News (2022[16]), Ukraine pushes for domestic uranium supply, https://www.world-nuclear-news.org/Articles/Ukraine-pushes-for-domestic-uranium-supply; OECD (2019[2]), Snapshot of Ukraine's Energy Sector: Institutions, Governance and Policy Framework, https://www.oecd.org/eurasia/competitiveness-programme/eastern-partners/Snapshot-of-Ukraines-Energy-Sector-EN.pdf; Economichna Pravda (2021[17]), The first batch of nuclear fuel was taken to the Central Storage Facility, https://www.epravda.com.ua/news/2021/11/25/680135/.

In February 2022, Ukraine had four nuclear power stations with 15 reactor units, all owned and run by Energoatom. Twelve were commissioned between 1980 and 1989, one in 1995 and two in 2004. The older units have already reached their designed lifetime of 30 years. With major investments and upgrading, Energoatom managed to extend the operating lifetime of 11 units by 10-20 years (Ukrenergo, 2019[18]). In 2020, Energoatom adopted a development strategy to modernise its facilities and further extend the lifetime of its power plants (Energoatom, 2020[19]).

The Khmelnytskyi NPP is home to two unfinished reactors on which work stopped in 1990, when construction was 75% and 28% complete, respectively. In September 2021, Energoatom and US nuclear power company Westinghouse agreed on joint completion of one of these reactors and on construction of four new AP1000 reactors at established sites in the country (World Nuclear Association, 2023[20]). In June 2022, the scope of the agreement was extended, increasing the number of planned reactors to nine (World Nuclear Association, 2023[20]).

Thermal power

Thermal power plants in Ukraine produce electricity from coal, oil and gas. Biomass and biogas are classified as renewables sources rather than thermal.

In February 2022, there were 12 thermal power plants (excluding CHP plants) in Ukraine with unit capacities ranging from 150 MW to 800 MW (The Accounting Chamber, 2021[21]).[8] The plants are of Soviet design and were commissioned between 1958 and 1977. Most of the units were modernised after 2000. Some plants are designed to be able to run on both coal and natural gas, with coal being the primary fuel. Power plants using only natural gas (with capacity of 4.6 GW) have rarely been used during the past decade. Some 2.5 GW of installed capacity is in preservation, which means it is not readily available for production. In total, out of 21.8 GW installed capacity, 15.4 GW was in active use as of 2021.

Ukraine also has three large CHP plants with four units of 100-120 MW and five of 250-300 MW.

Box 2.3. Coal

Historically, Ukraine relied on domestic coal production for its metallurgy industry, as well as for electricity and heat production. The metallurgy industry and power plants use different types of coal that are not interchangeable.

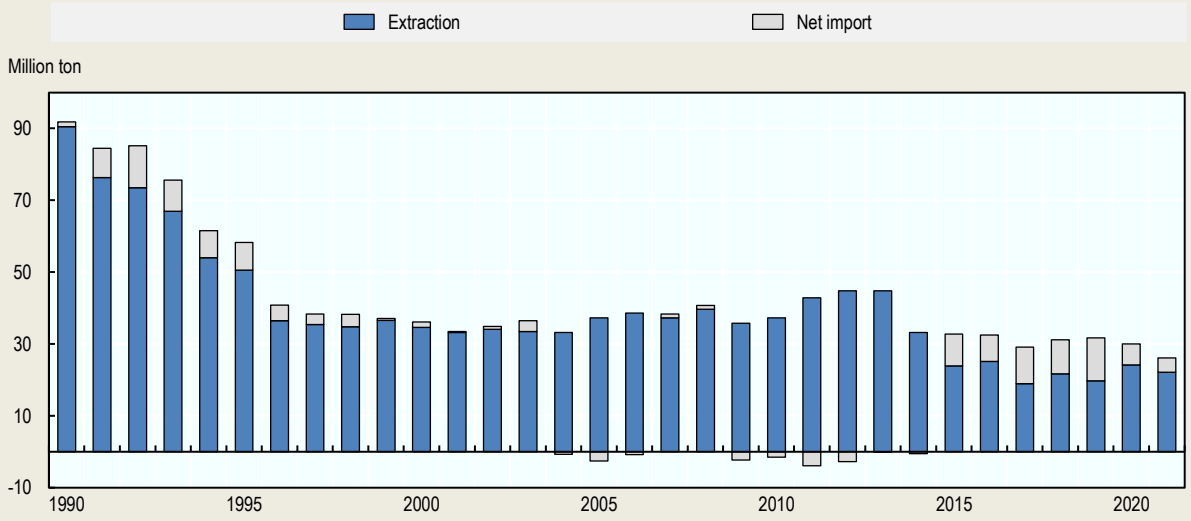
Ukraine's coal-fired power plants use two types of coal: A-grade (anthracite) and G-grade (gaseous). The share of installed capacity running on A-grade coal was 65% in 2021, with G-grade coal making up the remaining 35%.

In 2014, Ukraine lost control of 95 coal mines in the coal-rich Donetsk and Luhansk regions, including all its anthracite mines. The extraction of steam (energy-grade) coal fell from 45 million tonnes in 2013 to 24 million tonnes in 2015, a 46% drop, but coal demand by power plants fell by only 20-25%, requiring imports to fill the gap.

In 2020, domestic extraction covered 80% of Ukraine's demand for steam coal. At that time, most coal imports originated from the Russian Federation, including DTEK's imports from its mines there. In November 2021, the Russian Federation stopped exporting coal to Ukraine.

Domestic production of gaseous energy coal is split between DTEK (75%) and state-owned mines (25%). The price of DTEK's domestically extracted coal is lower than the cost of imports. DTEK's costs are also considerably lower than those of state-owned mines, which have historically relied on state subsidies to remain operational.

Figure 2.5. Coal extraction and net imports for energy production, 1990-2020



Sources: AMCU (2016[22]), Report on the results of a comprehensive study of the electric energy and thermal coal markets, http://reform.energy/media/120/81404676e3df44fcb1d2c0c437906798.pdf; Slovo i Dilo (2021[23]), Russia suspends supplies of thermal coal to Ukraine, https://www.slovoidilo.ua/2021/10/29/novyna/ekonomika/rf-prypynyaye-postavky-enerhetychnoho-vuhillya-ukrayiny-nardep; State Statistics Service of Ukraine, 2021 data, https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_en.xls.

Renewables

Ukraine's renewables generation capacity consists mainly of hydro, solar and wind power plants.

Most of the country's large hydro power plants are concentrated along the Dnieper and Driester rivers. All major hydro power stations are owned and managed by Ukrhydroenergo (Ukrenergo, 2019[18]). As of February 2022, seven large run-of-river (4.6 GW) plants and two pumped hydro plants (1.2 GW) were operating in Ukraine. Most were built during the Soviet era but were extensively modernised in the 2000s.

Ukraine has more than 160 small hydro plants with total installed capacity exceeding 150 MW. Many are refurbished Soviet era facilities.

Most of Ukraine's solar and wind power plants were commissioned in 2019-21 and are located in the south of the country. More than 1 100 solar installations are in place, ranging from small rooftop installations with capacities of around 25 kW to large plants with capacities of up to 240 MW. Total installed solar capacity is 6.4 GW. DTEK Renewables, one of the largest producers, operates three solar parks: Tryfoniv (10 MW), Nikopol (200 MW) and Pokrovsk (240 MW).

Wind power has developed at a slower pace than solar power. In 2021, total installed capacity was approximately 1.5 GW. DTEK Renewables is also a leader in the wind segment, owning and operating the Botievska (200 MW), Prymorskaya (200 MW) and Orlivska wind farms (100 MW). Several foreign investors also operate wind power plants of various sizes, including Ukraine Power Resources, Güriş, EuroCape New Energy, Elementum Energy and SyvashEnergoProm.

Electricity produced from biofuels plays a minor role in Ukraine, with total capacity amounting to only around 0.3 GW.

Support for renewables

Since 2009, electricity generation from RES has been supported through a FiT system. It has been available for solar, wind, alongside small, mini and micro hydro, geothermal, biomass and biogas power plants. Large hydro power plants with generating capacity of at least 10 MW have not been eligible for this support.

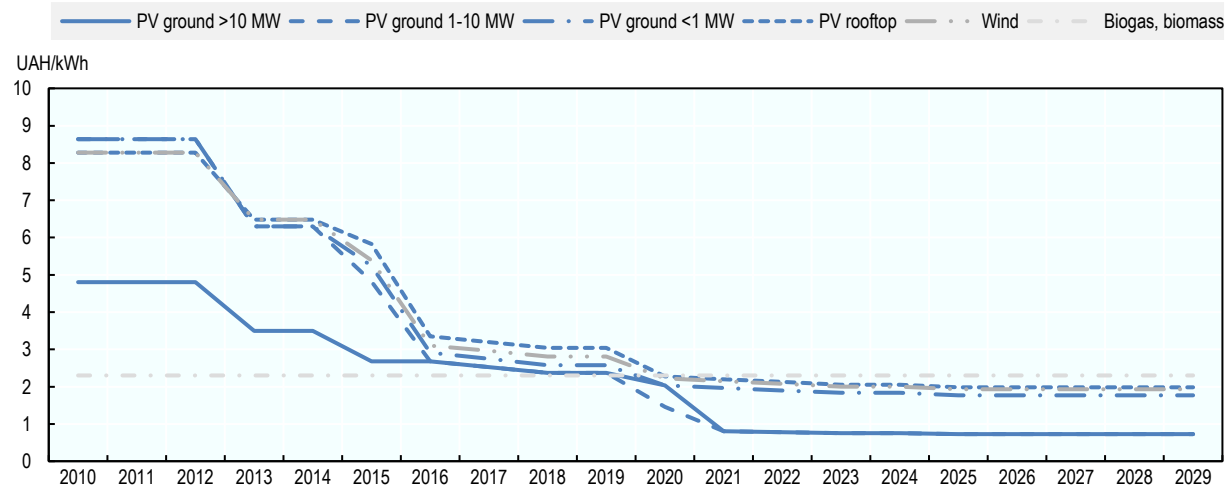
The FiT is paid by the GB, which buys the output of eligible RES producers and sells it on the wholesale market. Surplus electricity from residential photovoltaic installations is bought by USSs.

The initial FiT for RES was among the most generous in Europe. For instance, ground-based solar panels with up to 12 MW capacity received 0.0612 EUR/kWh in France (PV Magazine, n.d.[24]), while a similar solar panel in Ukraine received between 0.14 EUR/kWh (if commissioned in 2015) and 0.04 EUR/kWh (if commissioned between 2024 and 2029) (Baker McKenzie, 2021[4]).

The FiT was set until 2029 but not as fixed value but had a built-in decrease and a currency adjustment.[9] In 2020, the government adopted a new law, effective from 1 August 2020, reducing the FiT by between 2.5% and 60%, depending on the type of renewable energy generated, the size of plants and the date of their commissioning.[10] The 60% reduction was applied to ground-based solar power plants commissioned between 2021 and 2029 with capacities above 1 MW. For small solar and wind plants with capacities of up to 1 MW commissioned in the same period, the tariff reduction was 2.5% (Baker McKenzie, 2021[4]).

The FiT, including the adjustment introduced in 2020 are presented below.

Figure 2.6. Feed-in-tariffs for renewables



Source: Verkohvna Rada of Ukraine (2023), https://zakon.rada.gov.ua/laws/show/555-15#Text.

Further changes were proposed in August 2021, when the Ministry of Energy published a draft law introducing a new feed-in-premium (FiP) instead of the FiT. According to the draft law, eligible RES producers would sell their electricity on the market and the state budget would directly cover the difference between the market price and the FiP in a move aimed at solving the GB and TSO's debt problems (CMC, 2021[25]). The market price would be defined by NEURC and based on either the hourly price on the DAM, the average monthly or the average annual price on the DAM. Existing RES producers with "green" tariffs would be able to switch to the new FiP or remain under the old FiT scheme until 2029. RES auctions and the FiP scheme have not yet been put into practical use.

Ukraine intends to further increase the share of RES in its generation mix. According to the draft National Action Plan for the Development of Renewable Energy until 2030[11] and the National Energy Strategy of Ukraine until 2035,[12] the share of electricity production from RES should reach 25% by 2035, twice the level of 2021. In addition to the question of how to achieve the target, this raises questions about the technical ability of the power system to accommodate a higher share of RES production (USAID, 2021[26]) and the need to analyse scenarios for the cost-effective integration of intermittent or fluctuating RES (wind and solar) into the existing generation mix. For the period until 2025, it found that proactive RES curtailment would be the least costly and most feasible flexibility option.

2.2.3. Transmission and distribution

The transportation of electricity is provided by the transmission and distribution systems. The transmission system consists of high-voltage power lines connecting power plants and stations to various substations, from which the distribution network connects to consumers. The length of Ukraine's transmission system is more than 24 000 km (Ukenergo, 2020[27]), while that of its distribution networks is 818 000 km (NEURC, 2022[28]).

The electricity transmission system is operated by Ukrenergo, the state-owned TSO. Ukrenergo's functions include operational and technological control of the power system, and the transmission of electricity from points of generation to the distribution networks.

Box 2.4. The Third Energy Package

The Third Energy Package came into force in September 2009, aiming to complete the European Union's transition towards a single European energy market. The legislation covers five areas: unbundling, independent regulators, the creation of the Agency for the Co-operation of Energy Regulators, cross-border co-operation, and open and fair retail markets.

Ukraine committed to implementation of the *acquis communautaire* on 1 February 2011 following the adoption of the Energy Community Treaty and, consequently, becoming a member of the Energy Community. The Energy Community aims to create an integrated, pan-European energy market that includes the European Union and its neighbours. Contracting parties agree to adopt the Third Energy Package within a defined timeline.

Since the adoption of the treaty, Ukraine has made significant efforts towards its implementation. According to the Energy Community Secretariat, as of 2022, it had transposed 64% of relevant EU legislation into national law and implemented 68% of required electricity sector legislation. As outstanding issues, the Energy Community Secretariat identified implementation of the Regulation on Wholesale Energy Market Integrity and Transparency and a compliant cross-border capacity allocation. It also recommended continued efforts towards market integration with neighbouring EU member states and Moldova.

Sources: European Commission (2009[30]), Third energy package, https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/third-energy-package_en; Energy Community Secretariat (2022[31]), Ukraine Annual Implementation Report, https://www.energy-community.org/dam/jcr:1731cc05-e414-47a8-95f8-4fb793fe0abd/IR2021_Ukraine.pdf.

The electricity transmission network used to be separated into two zones – the Integrated Power System (IPS) and the smaller Burshtyn Energy Island (BEI). On 24 February 2022, the two trade zones were merged.[13] This was intended as a temporary measure to prepare for the synchronisation of Ukraine's network with the ENTSO-E system but was made permanent with the implementation of emergency synchronisation that took place on 16 March 2022 (ENTSO-E, 2022[29]).

On 17 December 2021, Ukrenergo was certified as a TSO under the Independent System Operator model by NEURC.[14] Hereby, NEURC took into account the Energy Community's assessment of Ukrenergo's

compliance with European regulations.[15] The certification asserts that Ukrenergo is fully independent from supply and production interests.

Ukrenergo is responsible for investing in new infrastructure capacity, such as substations and transmission lines, to enhance the efficiency and reliability of power grids, ensuring RES integration with the power system, and overseeing technical compliance with ENTSO-E standards and requirements. Annual investment in such infrastructure in Ukraine is worth up to EUR 163 million (Ukrenergo, 2021[32])

Following market liberalisation in July 2019, Ukrenergo also became responsible for operating the balancing and ancillary markets, registering bilateral agreements, and serving as the settlements and commercial metering administrator.

Ukrenergo co-ordinates electricity import/export activity with neighbouring countries, it determines the net transfer capacity available for cross-border trading and – with neighbouring TSOs – the mechanism to allocate it. Integration of Ukraine's power system with the ENTSO-E system is one of the key strategic goals of Ukrenergo; the aim is to increase the reliability and sustainability of the Ukrainian system, expanding electricity trading possibilities, increase competition in the domestic market, and create opportunities for operation within the European energy market (Ukrenergo, 2023[33]).

Box 2.5. Network Development Plan 2021-30

Ukraine has a relatively high network density and an electrification rate of nearly 100%. But most of the network was built during the 1960s and 1970s, and is in need of modernisation. According to a 2018 study, 64% of power equipment was more than 40 years old and 22% was between 30 and 40 years old. As a result, transmission and distribution networks suffer losses estimated at more than 14% of injected electricity.

To address the issue of ageing equipment, in January 2021 NEURC approved an ambitious network development plan for 2022-31. It envisages EUR 2.5 billion of investment[1] to increase the reliability and security of the transmission network and to move towards full integration with the ENTSO-E system. According to the plan, Ukrenergo will increase substation capacity by renovating existing substations and building new ones, reconstruct more than 1 500 km of 220-330 kV transmission lines, and build more than 3 200 km of 220-750 kV lines. In addition, it plans to facilitate the integration of renewables by building 750 km of new 330-750 kV lines, a new 750 kV substation, and a 220 MW energy storage system.

1. In addition to the 10-year network development plan, the regulator has also approved Ukrenergo's annual investment programme. For 2020, approved investment amounted to more than UAH 3.2 billion (excluding VAT). It is financed largely through loans (60%) and only to a lesser extent through general tariff revenues (33%) and revenue from capacity allocation (4%).

Source: Ukrenergo (2021[34]) Grid, https://ua.energy/transmission-and-dispatching/networks/; Flanders (2018[35]), Ukrainian energy market: Overview of the sector and future projects, https://www.flandersinvestmentandtrade.com/export/sites/trade/files/market_studies/Ukrainian%20Energy%20Market_0.pdf; Ukrenergo (Ukrenergo, 2021[36]), Transmission system development plan for 2021-30, https://ua.energy/peredacha-i-dyspetcheryzatsiya/plan-rozvytku-oes-ukrayiny/; NEURC (2020[37]), Annual Report, https://www.nerc.gov.ua/pro-nkrekp/richni-zviti.

The EML introduced a regulatory framework closely resembling the system used in the EU. One important element of the transition to the European market model was the unbundling of electricity supply and generation from distribution, which took effect on 1 January 2019. As a result, each *oblenergo* was split into two separate entities – an electricity supplier (retailer) and a distribution system operator (DSO) (OECD, 2019[2]). The state continues to hold shares eight of the country's 32 DSOs through the Ministry of Energy.[16]

DSOs are responsible for delivering electricity to end users, while suppliers buy from producers, traders or other suppliers and sell it to end users. In line with international practice, DSOs in Ukraine are considered natural monopolies, thus their tariffs are regulated by NEURC. The distribution of electricity to consumers and its supply are both subject to the issuance of an appropriate licence by NEURC.

2.2.4. Electricity suppliers

In Ukraine, there are three types of suppliers: commercial suppliers, USSs, and a supplier of last resort (SoLR). The latter two types serve approximately 44% of all consumers (OECD, 2019[2]).

Commercial suppliers buy electricity on the wholesale market and sell it to industrial and business consumers at freely negotiated prices. At the end of 2021, there were 955 licensed electricity suppliers, of which only 30% (287) were active suppliers to consumers (NEURC, 2022[38]). The biggest by customer base are DTEK Kyiv Energy Services, Lvivenergozbut, DTEK Dnipro Energy Services, Enera group[17] and Kharkivenergozbut.

USSs supply in their assigned region households at fixed prices set by the CMU and small businesses at prices approved by NEURC. There is one USS per region, 25 in total. In addition, USSs may also act as commercial suppliers and supply non-household consumers at freely negotiated prices throughout the whole territory of Ukraine. Some of the largest commercial suppliers are in fact also USSs.

The state-owned Ukrinterenergo is assigned SoLR, it supplies electricity to consumers in special situations such as the cancellation of their supplier services or their failure to select a supplier, and can do so for no more than 90 days at a regulated price (OECD, 2020[39]).

2.2.5. Cross-border trade

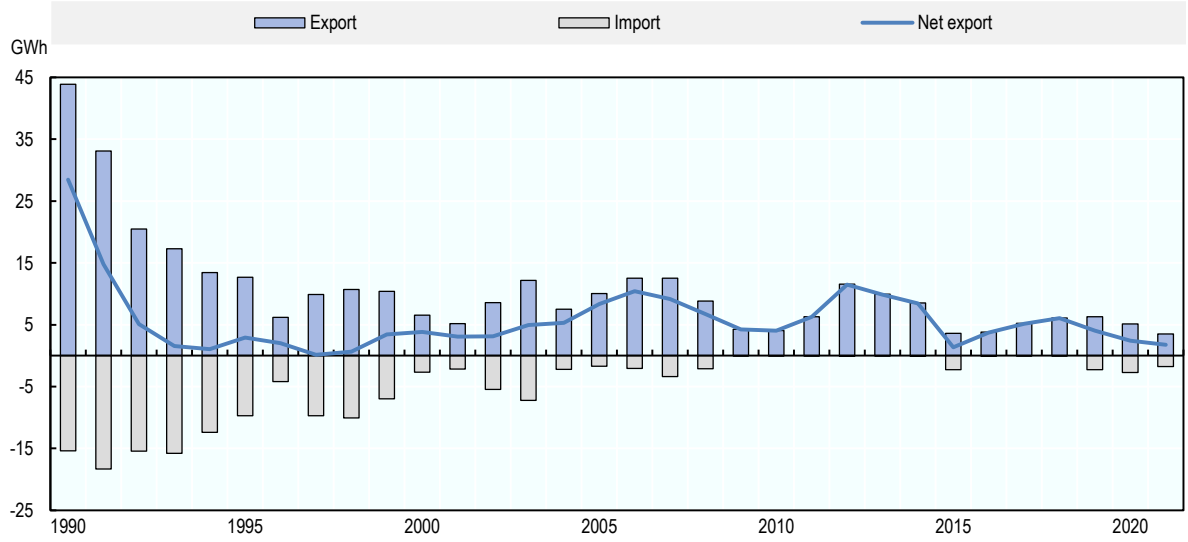
Ukraine has been traditionally a net exporter of electricity. In 2021, it exported more than double the amount of electricity it imported, selling 3 495 GWh and buying 1 694 GWh (Ukrenergo, 2022[40]). Most exports originated from the BEI and went towards Poland, Romania, the Slovak Republic and Hungary, at 3 334GWh, compared with 415 GWh of imports from the Slovak Republic, Hungary and Romania. In the IPS, imports (from the Russian Federation and Belarus) were higher than exports, at 1 278 GWh vs. 981 GWh (Ukrenergo, 2022[40]). Since May 2021, electricity imports from the Russian Federation and Belarus have been banned for national security reasons.

Ukrenergo conducts auctions for cross-border capacity allocation unilaterally but is in the process of negotiating with EU TSOs to start joint capacity allocation in accordance with EU rules.

On 24 February 2022, the IPS was disconnected from the energy systems of Russia and Belarus. On 27 February 2022, Ukrenergo and Moldelectrica – Moldova's TSO – sent a request to continental European TSOs for emergency synchronisation with the ENTSO-E system. With the support of the European Commission, EU member states, their regulatory authorities, European TSOs and ENTSO-E, emergency synchronisation was implemented on 16 March 2022. At the initial stage, the interconnection was of a technical nature and did not allow for cross-border trade On 7 June 2022, after fulfilment of the key conditions, continental TSOs agreed to Ukrenergo's request for the gradual opening of commercial flows on the interconnections with Ukraine (ENTSO-E, 2022[43]).

The first commercial flows started in midsummer 2022 across Ukraine's borders with the Slovak Republic and Romania. As of February 2023, the trade capacity from the Ukraine-Moldova power system to the Continental Europe power system had reached 400 MW and 700 MW in the other direction (ENTSO-E, 2023[44]).

Figure 2.7. Ukraine's electricity exports and imports, 2021



Sources: Ukrenergo (2022[41]), Volume of electricity exported/imported from/to the IPS of Ukraine, https://map.ua-energy.org/en/resources/8462ca14-63b1-4686-b613-b5f056d32d69/; Ukrenergo and NEURC (2022[42]), Hourly electricity imports and exports, https://map.ua-energy.org/en/resources/56df70b0-6bc1-4c7d-a82f-284cf723438d/.

Ukraine began the project to synchronise with ENTSO-E in 2017, signing the Agreements on the Conditions of the Future Interconnection of the Power System of Ukraine and Moldova with the Power System of Continental Europe. Since then, synchronisation has been one of the main priorities of Ukrainian energy policy for a number of reasons.

Technical synchronisation allows Ukraine's power grid to end its dependence on the Russian grid operator for frequency maintenance, improving energy security in the country. Full synchronisation would create increased commercial opportunities for imports and exports and enhance competition. The direction of trade might change seasonally, and in the long term will depend heavily on available surplus capacity and the cost structure of generation in Ukraine. In a reference scenario analysed by (Zachmann and Feldhaus, 2021[45]), cross-border transmission would increase the consumer surplus by EUR 0.9 billion annually and boost the TSO's congestion rent by EUR 300 million. However, achieving these benefits will require a functioning domestic market. In addition to technical complexities and practical challenges, such as establishing new transmission lines and maintaining grid stability, successful full synchronisation will also require extensive electricity sector reforms (see also Feldhaus, Westphal and Zachmann (2021[46]) and Zachmann and Feldhaus (2021[45]).

Emergency synchronisation led to an important change in the structure of Ukraine's electricity market, unifying the IPS and BEI as a single trade zone. This has the potential to enhance competition by reducing market concentration and market power. This is particularly true for the former BEI trade zone, where there was only a single electricity producer and very few suppliers of significant size.

The potential benefits of synchronisation are wide-ranging, from enhanced energy security, market integration and energy efficiency to decarbonisation and increased competition. However, only a functioning and competitive electricity market can be effectively integrated and provide the full benefits of synchronisation. Competition can thus not only be fostered by successful synchronisation, but it is also a precondition for it, making competition a key element of any market assessment under the current circumstances.

These issues are discussed later in this report, including synchronisation's possible effects on competition and on the broader functioning of the market.

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Notes

[1] Pump-storage power plants can store electricity indirectly, but can be built only in places with a specific topography. There also several emerging technologies for large-scale storage, but they are currently expensive and/or not yet fully proven in commercial applications.

[2] The NERC was replaced by NEURC in August 2014 by Decree of the President of Ukraine No. 694/2014.

[3] CMU Order No. 1 789 "On approval of the Concept of functioning and development of the wholesale electricity market of Ukraine", 16 November 2002, https://zakon.rada.gov.ua/laws/show/1789-2002-%D0%BF#Text.

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[7] NEURC Decision No. 307 "On the approval of the Market Rules", 14 March 2018, https://zakon.rada.gov.ua/laws/show/v0307874-18#Text.

[8] Excluding assets in territories not controlled by Ukraine (including the Donetsk and Luhansk regions, and the Autonomous Republic of Crimea).

[9] To reduce currency exchange rate risks for investors, the FiT is linked to the EUR/UAH rate and is updated every quarter.

[10] Law of Ukraine No. 810-IX "On Amendments to Certain Laws of Ukraine related to Improvements of the Terms of Support for Production of Electricity from Renewable Energy Sources", 21 July 2020, https://zakon.rada.gov.ua/laws/show/810-IX#Text.

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[14] NEURC Decision No. 2 589 “On making the final decision on the certification of the transmission system operator”, 17 December 2021, https://zakon.rada.gov.ua/rada/show/v2589874-21#Text.

[15] Energy Community Secretariat Opinion 4/21, 25 November 2021, https://www.energy-community.org/dam/jcr:8329300c-f30a-41f9-9a63-e8b07ff4b94c/ECS_Opinion_421_Ukrenergo.pdf.

[16] These are Zaporizhiaoblenergo (60%), Odesaoblenergo (25%), Kharkivoblenergo (65%), Cherkasyoblenergo (46%), Mykolayivoblenergo (70%), Khmelnitskoblenergo (70%), Sumyoblenergo Public JSC (25%) and Ternopiloblenergo JSC (51%). See CMU Order No. 1 222-r, 15 September 2021, https://zakon.rada.gov.ua/laws/show/1222-2021-%D1%80#Text.

[17] Enera Group unites four regional electricity supplier companies: Enera Sumy, Enera Chernigiv, Enera Vinnitsa and Enera Skhid.

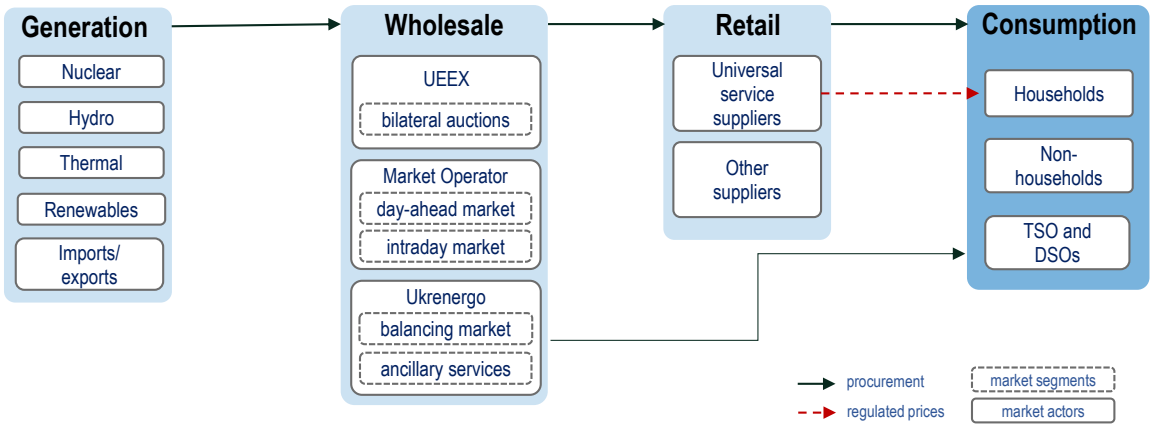
3 Market functioning and regulatory framework

This chapter describes Ukraine's wholesale electricity market, identifies different wholesale submarkets, and describes their functioning. It then describes the Ukrainian retail electricity market, which can be demarcated into several segments. It presents two important public service obligations, one protecting households from high electricity prices and the other supporting generation from renewable energy sources. These public service obligations have a profound impact on Ukraine's electricity market.

Liberalised electricity markets, in the simplest description, allow producers to sell electricity wholesale to suppliers that agree supply contracts with consumers in the retail market. In practice, they involve multiple parties and varying degrees of complexity. Imports and exports complement domestic production, traders buy and sell electricity, and large consumers may buy directly on the wholesale market. Wholesale markets consist of several submarkets and retail markets are often segmented.

Ukraine's overall electricity market design is shown in Figure 3.1.

Figure 3.1. Electricity market design in Ukraine



Several variations of overall electricity market design are possible. Ukraine's market design closely resembles those of EU countries. This is significant, given Ukraine's and the EU's ambitions to increase the integration of their electricity markets. The main platform driving these efforts is the Energy Community. With Ukraine's status as a candidate for EU membership, close alignment with EU rules has become even more vital.[1]

3.1. Wholesale market

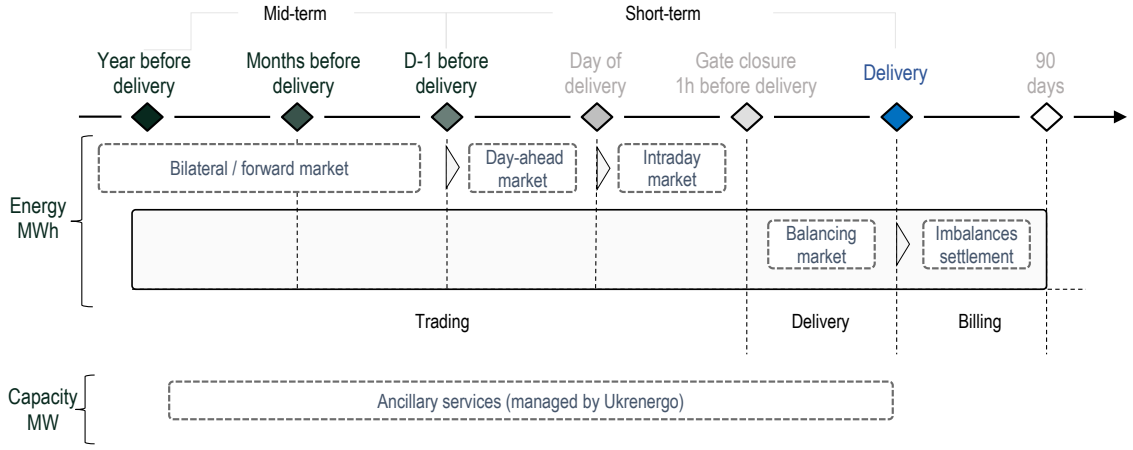
Wholesale markets are where large volumes of electricity are traded before being delivered to consumers such as households, businesses and public institutions via the transmission and distribution network. Wholesale electricity markets play a central role in the operation of any competitive power system, serving as the basis for retail prices.

In general, wholesale electricity markets comprise different market segments that fulfil distinct but related roles. The main differentiating characteristic is the timing of market exchanges in relation to the delivery and consumption of electricity. Key short-term markets are the day-ahead market (DAM), the intraday market (IDM) and the balancing market (BM). On these markets, trading takes place between one day to near real-time to delivery. Longer-term markets, called forward markets, are for electricity delivery further in advance. In Ukraine, the bilateral agreement market (BAM) offers forward trading.

In addition to timing, there is also a distinction between energy markets and capacity markets. An energy market matches demand and supply for electricity at a given time (for the next day, in the case of the DAM). A capacity market, conversely, does not cover the actual delivery of electricity but matches demand and supply for the readiness, or capacity, to produce electricity if needed. In essence, capacity markets procure a promise to produce. Capacity markets are often described as ancillary services.

Figure 3.2 presents the sequence of Ukraine's wholesale electricity market and the different market segments.

Figure 3.2. The sequence of Ukraine's wholesale electricity market



3.1.1. Bilateral agreement market

Electricity can be traded through bilateral agreements between two parties. Sellers are typically producers and buyers are typically suppliers, but other types of market participants are also common, such as traders and large industrial electricity consumers. Bilateral contracts may specify any delivery time and duration in the future. They can be concluded on a purely bilateral basis or facilitated by brokers. Due to the fact that they are fulfilled in the future, they are forward contracts.

In many countries, forward contracts are the dominant mode of electricity trading. In France, for example, around seven times more electricity is sold on the forward market than on the DAM (CRE, 2021[1]). The main reason is that forward contracts allow sellers and buyers to reduce their exposure to short-term price fluctuations. This is crucial for financial planning by both producers and suppliers. Bilateral contracts also offer privacy to the parties if they wish not to disclose the conditions of their agreements.

In Ukraine, the Electricity Market Law (EML) stipulates that market participants have the right to conclude bilateral agreements at freely negotiated terms, but with certain exceptions.[2] There is an indirect limit on bilateral sales as producers and importers must sell certain volumes on the DAM. State-owned producers may sell bilateral contracts only in electronic auctions. Further, there is a maximum limit of 50% bilateral sales between vertically integrated entities.[3]

Most bilateral agreements are concluded on the platform operated by the Ukrainian Energy Exchange (UEEX). Bilateral agreements outside the UEEX play a minor role. The bilateral market on the UEEX is Ukraine's largest wholesale electricity market by volume, accounting for 78% of total sales in 2021, up from 75% in 2020.[4]

The requirements for organising and conducting electronic auctions via the UEEX are set out in the "Procedure for conducting electronic auctions for the sale of electric energy under bilateral contracts" (Auction Procedure) and its subsequent amendments.[5] Detailed trading rules govern interactions between the UEEX and market participants.

The UEEX offers two types of auctions: one-way auctions and two-way continuous auctions. In one-way auctions, there is single initiator (seller or buyer) and an unlimited number of counterparties can participate, provided they comply with auction regulations. In two-way continuous auctions, there is no single initiator and an unlimited number of sellers and buyers can participate simultaneously, also subject to auction regulations. The two-way continuous auction platform was set up by the UEEX in August 2022, but at the time of writing had not been used.

One-way auctions are further divided into special, commercial and export sections that have their own rules and purposes. The special section is reserved for sales under specific public service obligations (PSOs). The commercial section is open to all market participants. Participation in it was previously voluntary, but EML amendments in July 2021 made it mandatory for all producers. The export section was created in July 2022 and is meant to be temporary. There have been no auctions yet in the export section.

The EML empowers the National Energy and Utilities Regulatory Commission (NEURC) to limit the maximum duration of bilateral contracts to a period of six months. NEURC has not set a general term limit for contracts, but Cabinet of Ministers of Ukraine (CMU) Resolution No. 499 limits the duration of bilateral contracts in the special section to 12 months,[6] and to 36 months for contracts of a certain size.[7] The commercial section has no duration limit.

Table 3.1 provides a breakdown of sales on the UEEX in the fourth quarter of 2021. Most auctions took place in the special section, accounting for 83% of total volume. In terms of sellers, the special section consists of a small number of companies.

Table 3.1. Bilateral auctions by section, Q4 2021

Description	Special section	Commercial section	Total
Number of auctions	274	107	381
Number of initiators/sellers	19	52	71
Sales volume (GWh)	26 658	5 570	32 228

Source: UEEX (2022[2]) UEEX report Q4 2021,https://www.ueex.com.ua/files/ueex_electricity_q4_2021.pdf.

The shares of market participants across the sections varies substantially. For instance, the commercial section is dominated by thermal producers (including combined heat and power [CHP]), with DTEK holding a significant share as a seller, while in the special section, Energoatom is the biggest seller.

Special section

The special section serves market participants with special duties to ensure the public interest in the functioning of the electricity market, as defined in the Auction Procedure. The sellers are exclusively electricity producers entrusted with special responsibilities and the Guaranteed Buyer (GB). [8]

The trading rules for the special sections are set out in the "Regulations on organisation and holding of an electronic auction on the sale of electricity on the commodity exchange".[9] This governs interactions between the UEEX and market participants.

Under the latest version of the PSO for households, Energoatom must sell part of its output to universal service suppliers (USSs) through electronic auctions on the UEEX. (Until 1 October 2021, Ukrhydroenergo also had to do so.) In these auctions, the maximum price may not exceed the price determined in accordance with the PSO Act.

The GB must sell part of the electricity it acquires under the feed-in tariff (FiT) support scheme (see Section 3.3.2) in the special section of the UEEX.[10] Any market participants may participate as buyers in sales initiated by the GB on a voluntary basis. To initiate an auction, the GB must indicate the starting price and amount of electricity offered, as well as the period of supply. For a short time in 2020, the starting price could not exceed the price determined by a specific formula.[11] The formula was based mainly on the GB's sale prices on the DAM and the IDM. In October 2020, the minimum price requirement was removed.[12] Since then, the GB has been free to set the starting price, but the maximum duration of supply contracts remains limited to 12 months.[13]

Commercial section

In the commercial section, electricity market participants can conclude bilateral contracts under freely negotiated conditions. Prices, volumes, delivery times and other conditions (such as settlement) are agreed between producers and buyers. Any market participant not excluded by legislation can participate. The TSO, DSOs and the GB are excluded from selling in the commercial section.

Participation was previously voluntary, but in July 2021, Law No. 1 639-IX introduced a temporary requirement for all producers (except RES producers on the FiT) to conclude bilateral sales exclusively via the UEEX.[14] The stated aim of this amendment was to ensure transparent and equal terms for all producers regardless of their ownership structure (state-controlled producers already had such an obligation). With the latest amendment of Article 66 of the EML, this requirement was made permanent.[15]

The trading rules for the commercial section are set out in the "Regulations for the organisation and conduct of electronic auctions for the purchase and sale of electricity under bilateral contracts in commercial sections on the commodity exchange".[16]

Products sold in the commercial section are not standardised, although the initiator of each auction sets several key parameters for transactions. These include the starting price, the lot size (MWh to be delivered), the number of lots, a guarantee fee and the period of supply.

The UEEX publishes monthly and quarterly price indices for baseload supply. This information contributes to price transparency on the wholesale market and is the only source of regular price reporting outside the short-term market (DAM or IDM). Table 3.2 shows the quarterly price index for the fourth quarter of 2021 and the first quarter of 2022.

Table 3.2. UEEX quarterly baseload price index (IPS trade zone), 2021-22

Delivery period	Price (UAH/MWh)	Volume (MWh)	Value (million UAH)
Q4 2021	2 038.8	3 359 889	6 850
Q1 2022	2 330.2	811 784	1 892
Q4 2022	2 705.6	1 435 850	3 885
Q1 2023	2 993.8	485 775	1 454

Source: UEEX (2022[3]) Quarterly BCM Indices, https://www.ueex.com.ua/eng/exchange-quotations/electric-power/indexes/.

The monthly and quarterly price indices indicate the weighted average price for baseload energy in the IPS trade zone. It is calculated by dividing the total value of sales within the month/quarter (excluding VAT) by the total amount of baseload electricity. Only contracts in the commercial section are included in the calculation. It should be noted that commercial contracts with a weighted average price of more than 10% above the weighted average price are excluded from the calculation (UEEX, 2023[4]).

Two-way continuous auctions

The trading platform for two-way continuous auctions has existed since 10 August 2022. The UEEX developed it following a proposal by the Ministry of Energy and market participants.

It offers trading of standardised products. As such, the sales schedules (base, peak, off-peak), the delivery period (month) and other conditions (payment terms, warranty contribution) are all pre-defined.

Market participants reportedly had an overall positive view of this new trading model but trading never took place due to a lack of applications from producers. The UEEX attributed this to:

- inconsistent and unpredictable policy by the regulator in setting maximum price limits (market participants expect a revision of the maximum prices, which does not motivate to conclude contracts for longer periods)
- a large share of regulated volume (not available to the competitive segment)
- the availability of alternative segments (specialised and commercial sections) for the sale of electricity by producers
- a lack of support for product standardisation by the regulator.[17]

NEURC disagrees with UEEX's assessment and stresses that it has proposed improvements for the rules and functionalities of the new auction platform.

Auction rules

Auction participants are required to transfer a guarantee fee to the UEEX. This provides a degree of financial security for the effective conclusion of bilateral agreements. The fee is established by the auction initiator but cannot exceed 25% of the value of the electricity offered, calculated using the starting price. Bidders can submit their offers and counter-offers only within the limits of the guarantee.

Within the auction, a position can be initiated by a seller or a buyer. If the initiator is a seller, interested buyers submit offers to buy a lot (or package of lots) on the seller's terms. If the initiator is a buyer, interested sellers submit offers to sell a lot. Depending on the type of initiator (seller or buyer), the bidding is for price increases or decreases.

During the auction, initiators are allowed to adjust certain parameters of their positions, as long as they are not traded at the time of the adjustment. In particular, they can adjust prices, combine lots[18] into packages, adjust the number of lots in packages,[19] and withdraw all or part of the lots. Initiators can also exclude any counterparty from bidding for their positions.[20] This must be done before the auction and must be notified to the auction administrator.

During the bidding period, auction participants can submit proposals for the offered lot (or package of lots). If a proposal is not accepted, an improved bid can be made (the minimum increase/decrease is 1 UAH/MWh). Software automatically ranks the counter-offers according to their prices.[21] The initiator can either accept or reject the best counter-offer selected by the software. If a counter-offer is accepted, other buyers have a window of opportunity during which they can increase their price offer.

At the end of the auction, the UEEX draws up auction certificates for each transaction that stipulate the agreed conditions. This concludes the bilateral contract between the seller and the buyer and makes the conditions final.

There are certain rules and restrictions that aim at ensuring fair competition in accordance with the Law of Ukraine on the protection of economic competition.[22] In particular, the number of lots that can be combined into a single package is limited, as is the amount of electricity in each auction item.

In June 2019 the Ministry of Energy established an auction committee to monitor compliance with the auction rules.[23] The committee has the power to set requirements for organising and conducting auctions, and to change the auction rules. It approves the auction regulations and their amendment. It monitors auction regulation compliance by both auction participants and the auction organiser, develops and provides auction organisers with recommendations on measures aimed at supporting fair competition, establishes procedural requirements for the organisation and conduct of bilateral continuous auctions and to orders of settlement (if necessary), approves exemplary forms of bilateral contracts for the purchase and sale of electricity, and oversees the annual schedule of auctions. The committee is comprised mainly of public authority representatives, including a representative from the Antimonopoly Committee of Ukraine who has only an advisory vote. Each seller has one representative with an advisory vote on the committee.

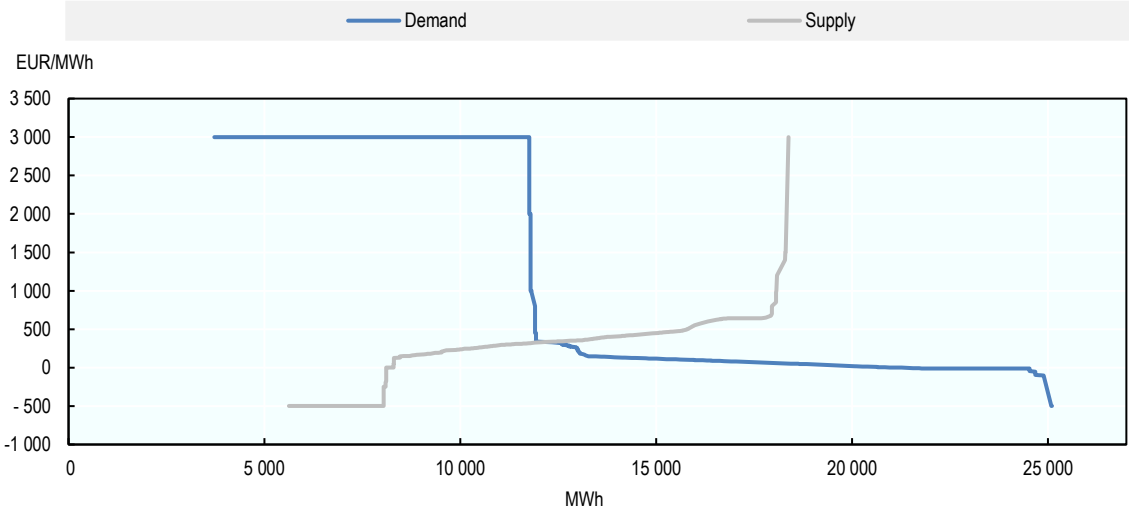
3.1.2. Day-ahead and intraday markets

Electricity spot markets are used to buy and sell electricity in a short timeframe ahead of delivery. Spot markets consist of the DAM and the IDM, both of which are indispensable parts of the wholesale electricity market.

On the DAM, electricity is traded for delivery on the next day through an online blind auction. Once a day, market participants submit their orders, indicating their willingness to buy and/or sell electricity for the following day. Each purchase/sale order specifies a volume, price and delivery hour(s).

Based on the orders received, the operator of the DAM establishes a demand and a supply curve for each hour of the following day. The intersection of the two curves determines the price and volume. The equilibrium price is referred to as the clearing price. Figure 3.3 shows a real-world example of matching supply and demand for a single hour (6-7 p.m.) on the French day-ahead market.

Figure 3.3. Example of supply and demand on the day-ahead market, 3 March 2022



Source: OECD based on data provided by EPEX.

All sell orders equal to or below the clearing price, and all buy orders equal to or above it, are accepted. All accepted orders receive/pay the same clearing price. This pricing formation method is referred to as marginal pricing, uniform pricing or pay-as-cleared. The hourly clearing prices constitute a reference point for the bilateral market, making the DAM an essential segment for the functioning of the entire wholesale electricity market.

The DAM allows electricity to be traded close to delivery and offers some protection against real-time price volatility. DAM prices can signal the need for flexibility during specific time periods, incentivising long-term investments (Schittekatte, Reif and Meeus, 2019[5]).

The IDM allows producers and consumers to adjust their positions after closure of the DAM. IDMs are normally organised as continuous markets, meaning that electricity is traded around the clock. In some countries, continuous trading is complemented or sometimes replaced by individual auctions.

Although the design of DAMs is similar across OECD countries and largely harmonised in the EU, the same cannot be said about IDMs. In some countries, such as Belgium, France and the Netherlands, shortly after a DAM auction, continuous trading with hourly products is possible. In other countries, such as Spain,

multiple intraday auctions are held. In Germany, a combination of continuous trading and auctions is used (Schittekatte, Reif and Meeus, 2019[5]).

In continuous trading, market participants can submit buy and sell orders for electricity for delivery on the same day. Trades are completed when a buy order and a sell order are matched. To facilitate matching, the delivery period, also called settlement period, is standardised, typically in one hour, half-hour or 15-minute units. Prices are determined separately for each settlement period and each trade. This price setting mechanism is referred to as pay-as-bid.

The IDM offers market participants a high level of flexibility, as they can adjust their positions at very short notice and in close to real time. It enables the optimisation of electricity production and supply, and reduces costly imbalances in the system.

The DAM and the IDM in Ukraine were created as part of the new wholesale market model in July 2019, following the liberalisation of the electricity sector.

The main legal provisions for the DAM and the IDM are set out in Article 67 of the EML, which [24] specifies that DAM and IDM prices are formed according to market principles. The pricing principle for the DAM is marginal pricing based on the balance of total demand and supply. For the IDM, the pricing principle is pay-as-bid.

The EML designated the state-owned company Market Operator (MO) to operate the DAM and IDM.

Based on the EML, NEURC issued detailed rules on the functioning of the DAM and the IDM in 2018. [25] In 2020, amid the COVID-19 pandemic, NEURC created new versions of certain provisions through a special COVID-19 resolution.[26] Due to the exceptional circumstances, this happened without market consultation or a public hearing. The changes were limited to the quarantine period plus one month after.

As a guiding principle, the EML establishes that the rules covering the DAM and the IDM "should create conditions for providing objective price signals for producers and consumers of electricity" to maintain a balance between electricity demand and supply.[27]

In the event of a substantial price fluctuation, NEURC is empowered to set price caps (temporary minimum and/or maximum price limits) on the DAM, the IDM and the BM.[28] Prior to setting price caps, NEURC must consult the Antimonopoly Committee of Ukraine. When setting price caps, NEURC should ensure that they do not unduly influence price formation, and should review them at least every six months.

Further, to ensure a sufficient level of liquidity on the DAM, the EML empowers NEURC to impose an obligation on producers (except RES producers under the FiT) and importers to make up to 30% of their monthly sales on the DAM. NEURC may also require the TSO, DSOs and pumped-storage hydro power plants to purchase electricity on the DAM to cover their technical losses and needs.[29]

Trading sequence

On the DAM, participants can submit orders seven days before the day of delivery and change or cancel them until noon the day preceding the delivery day (the DAM gate closure time). Half an hour before the gate closure time, the MO checks compliance of bidders with financial requirements, such as sufficient deposits in escrow accounts.

At noon, the main trading session opens, during which the DAM algorithm determines the clearing price for each hour (billing period), based on the balance of aggregate demand and supply. If there is at least one billing period for which the clearing price cannot be determined, the MO immediately announces an additional trading session. Otherwise, the MO informs participants of the detailed results by 1 p.m. Participants may submit a reasoned objection within 30 minutes of receiving the results. A full trade report including prices, volumes and participants is published within the following three hours. In addition, the MO reports relevant information on the DAM results to the TSO and NEURC.

The IDM opens for bids at 3 p.m. on the day before the delivery day and the IDM gate closure time is 60 minutes before the start of the settlement period.[30] Upon the receipt of bids on the IDM, the MO verifies them and, if they fulfil all necessary conditions, registers them as valid bids. As long a bid is not accepted by another market participant, it can be changed or cancelled. At the IDM gate closure time, all unaccepted bids are automatically cancelled. Market participants can not only accept registered bids but can also submit counter-offers, for instance by offering lower volumes.

The MO notifies the TSO of the volumes and prices of IDM trades 30 minutes before start of the settlement period. Further, it provides a full trade report to market participants until 1 p.m. on the day following delivery. As on the DAM, participants can object in writing within 30 minutes. Finally, the MO reports detailed IDM trading data to NEURC by 3 p.m. on the day following delivery.

Price and volume limits

Upon the market opening on 1 July 2019, NEURC set temporary price limits for the DAM and the IDM until March 2020.[31] The initial price limits were calculated based on the average wholesale prices prior to the market opening (March-May 2019). Bids outside the specified range are dismissed by the MO. There have been different price limits for the two trade zones and for periods of minimum load (off-peak hours) and maximum load (peak hours). Minimum load is defined as the hours from midnight to 7 a.m. and from 11 p.m. to midnight. The other hours are maximum load periods.

In February 2020, the application of the price limits was extended for an undetermined period.[32] Since then, NEURC has changed the price limits several times, as shown in Table 3.3.

Table 3.3. Price limits on the DAM per trade zone (UAH/MWh, excl. VAT), 2019-22

Trade zone	Load	Type of limit	1 July 2019	29 July 2020	16 June 2021	5 July 2021	13 July 2021	1 August 2021	7 October 2021	2 January 2022
IPS	maximum	maximum	2 048.23	2 048.23	2 655.99	2 048.23	2 048.23	4 000.00	2 048.23	2 048.23
		minimum	10.00	10.00	10.00	734.85	10.00	10.00	10.00	10.00
	minimum	maximum	959.12	1 228.94	1 243.70	1 243.70	1 243.70	2 000.00	1 243.70	1 243.70
		minimum	10.00	10.00	10.00	734.85	10.00	10.00	10.00	10.00
BEI	maximum	maximum	2 048.23	2 048.23	2 048.23	2 048.23	2 048.23	2 048.23	2 500.00	3 000.00
		minimum	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
	minimum	maximum	959.12	959.12	959.12	959.12	959.12	959.12	1 500.00	1 650.00
		minimum	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

Note: For the IDM, the minimum limit is set as a percentage of displayed values.
Source: OECD based on data provided by NEURC.

Following the merger of the two trade zones, NEURC set minimum price limits for the DAM from 28 February 2022 as follows:

- 2 646.25 UAH/MWh during hours of maximum load
- 1 378.97 UAH/MWh during hours of minimum load.[33]

In 2022, the minimum limit for the IDM was set in a new way, namely with reference to the DAM price. From 6 February 2022, the minimum limit for the IDM was set at 105% of the DAM price.[34] Within a short period, it was increased to 115% and then to 150%[35] before being cut to 110%, and then to 102% from 1 June 2022.[36]

In addition to the general price limits, NEURC imposed a specific limit for sales of renewable electricity by the GB. Notably, on 4 April 2020, it introduced Resolution No. 791 requiring the GB to sell RES electricity on the DAM at a price not higher than the weighted average nuclear power price during April-May 2019.[37] Soon after, on 30 April 2020, NEURC changed this cap, setting it at 75% of the maximum price limit on the DAM during hours of maximum load.[38] This resolution was cancelled in April 2022 and the GB-specific price limit was abolished.[39]

An amendment of the EML in July 2020 set minimum mandatory monthly sales on the DAM of 10% for producers (except RES producers) and importers.[40] On a temporary basis, another amendment to the EML placed a maximum limit on sales on the DAM. From July to November 2021, monthly sales by suppliers and traders were limited to a maximum of 10% of the electricity purchased from producers, the GB and importers under bilateral agreements.[41]

Main market participants

By volume, the DAM is Ukraine's second-largest market segment. In 2021, the share of electricity traded was 12% (35.8 TWh) on the DAM and 2% (5 TWh) on the IDM (Market Operator, 2022[6]).

Table 3.4. Average monthly sales on the DAM (IPS trade zone), 2020-22

Seller	2020		2021		2022	
	MWh	%	MWh	%	MWh	%
Producers	2 007 762	72	1 819 057	70	1 196 282	84
Suppliers	743 189	27	658 976	25	206 863	14
Traders	37 191	1	133 093	5	22 753	2
Network operators	0	0	2 352	0	2 641	0
Total	**2 788 142**	**100**	**2 613 478**	**100**	**1 428 539**	**100**

Note: Sales by the GB are included in sales by producers.
Source: Market Operator (2023[7]), DAM/IDM Analysis, https://www.oree.com.ua/index.php/web_monitoring_dtorg_year/index_year_dam.

Table 3.5. Average monthly sales on the IDM (IPS trade zone), 2020-22

Seller	2020		2021		2022	
	MWh	%	MWh	%	MWh	%
Producers	416 772	85	360 274	86	204 002	91
Suppliers	62 794	13	42 541	10	17 655	8
Traders	10 933	2	14 927	4	1 651	1
Network operators	24	0	117	0	742	0
Total	**490 523**	**100**	**417 859**	**100**	**224 050**	**100**

Note: Sales by the GB are included in sales by producers.
Source: Market Operator (2023[7]), DAM/IDM Analysis, https://www.oree.com.ua/index.php/web_monitoring_dtorg_year/index_year_dam.

Participants on the DAM and IDM need to register with the MO. In 2021, registered participants consisted of 36 producers, 455 suppliers, 27 traders, five business customers, the TSO, 32 DSOs, and the GB (Market Operator, 2022[8]).

On both the DAM and IDM, producers are the biggest group of sellers by a wide margin, followed by suppliers. Sales by traders amounted to no more than 5% on the DAM and 4% on the IDM in 2020-22.

Table 3.6 shows the main (state-owned and private) participants in the DAM and their respective shares of sales and purchases.

Table 3.6. Market participants on the DAM, 2020-21

Trade zone	Market participant	Share in 2020	Market participant	Share in 2021
Sellers				
IPS	Guaranteed Buyer	27%	Energoatom	20.9%
	Energoatom	22%	Guaranteed Buyer	18.3%
	Energyx	9%	Ukrhydroenergo	9.2%
	Centrenergo	5%	Energyx	4%
	Ukrhydroenergo	4%	Centrenergo	3.4%
	Other	*33%*	*Other*	*44.2%*
BEI	DTEK Zahidenergo	32%	DTEK Zahidenergo	72.1%
	Guaranteed Buyer	12%	Guaranteed Buyer	12.1%
	Gen-I Kiev	10%	D.Trading	5.9%
	Kalush CHP- Nova	9%	Kalush CHP- Nova	5.1%
	D.Trading	8%	*Other*	*4.8%*
	ERU Trading	8%		
	Other	*21%*		
Buyers				
IPS	D.Trading	24%	D.Trading	36.5%
	United Energy	10%	United Energy	24.6%
	Ukrenergo	7%	Ukrenergo	5.1%
	Kharkivenergozbut	3%	*Other*	*33.8%*
	New Energy Company	3%		
	Other	*53%*		
BEI	Guaranteed Buyer	36%	Guaranteed Buyer	28.5%
	D.Trading	16%	Zakarpattyaenergozbut	11.5%
	Zakarpattyaoblenergo	9%	Lvivenergozbut	9.4%
	Lvivenergozbut	6%	D.Trading	9%
	New Energy Company	5%	*Other*	*41.6%*
	Other	*28%*		

Sources: OECD based on data received from AMCU and NEURC; NEURC (2020[9]), Report on the results of the National Commission, which carries out state regulation in the spheres of energy and public services.

In the IPS trade zone, the two biggest sellers on the DAM were the GB and Energoatom, with a combined share was 49% in 2020 and 39.2% in 2021. Producers Ukrhydroenergo and Centrenergo, with trader Energyx, collectively accounted for 16.6% of sales in 2021 and a similar share the previous year. The cumulative share of smaller sellers (those whose shares were individually less than 3%) was 33% in 2020 and 44.2% in 2021.

In the BEI trade zone, the three main sellers on the DAM in 2021 were DTEK Zahidenergo, the GB and D.Trading. DTEK Zahidenergo and D.Trading, which belong to DTEK Group, had a combined share of 78%. It is noteworthy that the shares changed significantly from 2020 and 2021. The share of the two DTEK companies almost doubled, while the shares of ERU Trading and smaller sellers declined steeply.

In the IPS trade zone, the two main DAM buyers were D.Trading and the United Energy, with a combined share of 61.1% in 2021, a large increase from 34% the previous year. The third-largest buyer in both years was TSO Ukrenergo. There were also significant shifts among buyers in the BEI trade zone. The GB's share fell from 36% to 28.5%, while the combined share of smaller buyers increased from 28% to almost 42%.

Table 3.7shows the main participants on the IDM and their respective shares of sales and purchases.

Table 3.7. Market participants on the IDM, 2020-21

Type	Trade zone	Market participant	Share in 2020	Market participant2	Share in 2021
Sellers	**IPS**	Ukrhydroenergo	25%	Ukrhydroenergo	43%
		Centrenergo	25%	Energoatom	21%
		Energoatom	19%	Guaranteed Buyer	5%
		Guaranteed Buyer	5%	Kharkiv CHPP-5	4%
		Kharkiv CHPP-5	4%	DTEK Zahidenergo	4%
		Other	22%	Other	24%
	BEI	DTEK Zahidenergo	50%	DTEK Zahidenergo	85%
		D.Trading	9%	Guaranteed Buyer	8%
		De Trading	8%	D.Trading	3%
		New Energy Company	5%	Zakarpattyaenergozbut	2%
		Gen-I Kiev	4%	Other	3%
		Other	24%		
Buyers	**IPS**	New Energy Company	16%	D.Trading	9%
		United Energy	9%	United Energy	8%
		Energozahid	6%	New Energy Company	7%
		Energo Zbut Trans	4%	De Trading	6%
		TEC	4%	Pivden Energo Zbut	5%
		Other	61%	Other	65%
	BEI	Guaranteed Buyer	29%	Zakarpattyaenergozbut	21%
		D.Trading	14%	Lvivenergozbut	16%
		Zakarpattyaoblenergo	11%	Guaranteed Buyer	14%
		New Energy Company	10%	United Energy	8%
		Lvivenergozbut	7%	Zakarpattyaoblenergo	8%
		Other	29%	Other	33%

Sources : OECD based on data received from AMCU and NEURC; NEURC (2020[9]), Report on the results of the National Commission, which carries out state regulation in the spheres of energy and public services.

In the IPS trade zone, Energoatom and Ukrhydroenergo were collectively responsible for around 63% of all sales on the IDM in 2021. The main change from the previous year concerned Centrenergo, whose share dropped from almost 25% to only around 2%. The situation was quite different in the BEI trade zone, where the biggest supplier was DTEK Zahidenergo, whose market share increased from 50% to 84.5% between 2020 and 2021. The next biggest seller in 2021 was the GB, with 7.6%, followed by D.Trading with 2.7%.

The largest IDM buyer in the IPS trade zone in 2020 was the New Energy Company, with a 16% share. Its share fell to 7% in 2021 as it was overtaken by D.Trading which had an 8.9% share. Smaller buyers had a very significant combined share of more than 60% in both years.

In the BEI trade zone, the largest IDM buyer in 2020 was the GB, with a share of 29%. Its share fell to 13.8% the following year. In 2021, the largest buyers were USSs Zakarpattyaenergozbut with 20.9% and Lvivenergozbut with 16.3%.

3.1.3. Balancing market and ancillary services

The BM is the last stage for electricity trading. It allows market participants to correct differences between their predicted and actual levels of supply and demand close to delivery.

The BM is operated by the TSO responsible for balancing the power system. The TSO acts as the single buyer on the BM. On the supply side, balancing service providers (BSPs) offer balancing services to the TSO. Balance-responsible parties (BRPs) are market participants with a financial responsibility for their individual imbalances. Imbalances are deviations between generation, consumption and commercial transactions by a BRP within a given imbalance settlement period.

Based on the need for balancing, the TSO procures balancing capacity from BSPs. Depending on the system imbalances, it activates capacity and receives balancing energy (Schittekatte, Reif and Meeus, 2019[5]). In cases of negative imbalances (power shortages), the TSO asks BSPs to increase production. In cases of positive imbalances (power surpluses), the TSO asks BSPs to reduce output. Large industrial consumers and smaller consumers, through aggregators, can offer the equivalent service through demand response, i.e. by adjusting consumption.

The final phase of trading on the BM is the balance settlement. BSPs are remunerated for the balancing services they provide, while the BRPs bear the costs of their imbalances (see also (Veen and Hakvoort, 2016[10])). The BM can have a single-price or dual-price imbalance system for settlements. In the single-price system, deviations are settled at a single price, regardless of the nature of their imbalances (i.e. excessive or insufficient production). As a general rule, the balancing price is higher than the day-ahead price if the system is in deficit and lower if it is in surplus. This price settlement opens up arbitrage opportunities for producers as they can be rewarded for deviations (Mazzi and Pinson, 2017[11]). There are no such arbitrage opportunities under a dual-price system, in which positive and negative deviations involve different prices.

Balancing market

The Ukrainian BM began operating on 1 July 2019, at the same time as the DAM and the IDM. It is organised by Ukrenergo and functions as a daily auction in which market participants offer balancing energy to the TSO based on their marginal costs.

In principle, the actual power generation and consumption of market participants should equal their planned generation and consumption, or schedule. In cases of deviations, market participants are financially responsible for their imbalances towards Ukrenergo. To this end, each market participant must either become a BRP or join a balancing group. In the latter case, the financial responsibility for the group's aggregated imbalance resides with the group BRP.[42] For RES producers under the FiT, the GB forms a balancing group and assumes responsibility for balancing the entire portfolio.

Generators must offer balancing energy up to the level of their remaining available capacity. For consumers, participation is voluntary.[43]

BSPs are required to offer positive and negative energy to Ukrenergo for each settlement period of the trading day, which starts at midnight Kyiv time. The settlement period, the basic time unit of the balancing market, consists of a block of 15 minutes. Offers for each settlement period can be submitted up to 45 minutes before its start (BM gate closure).

For each settlement period, Ukrenergo determines the overall positive or negative balance of the system and establishes the market price based on the offers received from BSPs. In cases of deficits in the system, the highest accepted offer (for upward balancing energy) determines the market price. In cases of surpluses, the lowest accepted offer (for downward balancing energy) determines the market price. Prices for balancing energy are set in UAH/MWh and must be greater than zero.

After determining the price for balancing energy, Ukrenergo calculates the payment due by each BRP for their imbalances. Both the price for balancing energy and the imbalance price are limited by regulation.

Initially, the price limits for balancing energy were set as a range calculated from the DAM price cap (minimum 85% and maximum 115%). A few months later, this fixed price range was replaced by a dynamic range linked to the DAM price instead of the DAM caps. On 1 March 2020, the maximum balancing energy price was again linked to the DAM cap, but the minimum price remained linked to the DAM price. At the same time, the single imbalance price was replaced by a dual imbalance price with the maximum price set at 115% of the DAM price in cases of positive imbalances and a minimum price of 70% of the DAM price in cases of negative imbalances. Table 3.8 provides an overview of the changes in the price limits for balancing energy.

Table 3.8. Price limits for the balancing energy, 2019-21

Date	Peak (max. load)		Off-peak (min. load)	
	Maximum	Minimum	Maximum	Minimum
1 July 2019	115% of DAM cap (2 355.47 UAH/MWh)	85% of DAM cap (1 741 UAH/MWh)	115% of DAM cap (1 102.99 UAH/MWh)	85% of DAM cap (815.25 MWh)
30 November 2019	115% of DAM price	70% of DAM price	115% of DAM price	70% of DAM price
1 March 2020	115% of DAM cap (2 355.47 UAH/MWh)	55% of DAM price	115% of DAM cap (1 102.99 UAH/MWh)	55% of DAM price
8 April 2020	105% of DAM cap (2 150.64 UAH/MWh)	55% of DAM price	105% of DAM cap (1 007.08 UAH/MWh)	55% of DAM price
27 May 2020	105% of DAM cap (2 150.64 UAH/MWh)	65% of DAM price	105% of DAM cap (1 007.08 UAH/MWh)	65% of DAM price
10 June 2020	105% of DAM cap (2 150.64 UAH/MWh)	80% of DAM price	105% of DAM cap (1 007.08 UAH/MWh)	80% of DAM price
29 July 2020	105% of DAM cap (2 150.64 UAH/MWh)	80% of DAM price	105% of DAM cap (1 290.39 UAH/MWh)	80% of DAM price
1 March 2021	115% of DAM cap (2 355.47 UAH/MWh)		115% of DAM cap (1 413.3 UAH/MWh)	
16 June 2021	115% of DAM cap (3 054.39 UAH/MWh)		115% of DAM cap (1 430.26 UAH/MWh)	
1 August 2021	115% of DAM cap (4 600 UAH/MWh)		115% of DAM cap (2 300 UAH/MWh)	
10 August 2021	100% of DAM cap (4 000 UAH/MWh)		100% of DAM cap (2 000 UAH/MWh)	

Source: OECD based on data received from NEURC.

The number of changes is symptomatic of problems with the functioning of the BM. There have been accusations of market manipulation linked to the interplay of the DAM and the BM (DTEK, 2020[12]).

An important provider of balancing energy also commented that linking imbalance prices to DAM prices does not encourage market participants to reduce their imbalances. Further, it claimed that the system allows market participants to manipulate different market segments.

Ancillary services

In addition to buying balancing energy, Ukrenergo also procures ancillary services for regulating the network. This is a more technical part of power system operation, which ensures the frequency remains at 50 Hertz and that the system can be restarted in cases of partial outages (brownout) or complete shutdowns (blackouts). The most important ancillary services are the operating reserves. Ukrenergo procures the following types of operating reserves:

- frequency containment reserves (FCRs): used for immediate stabilisation of system frequency
- frequency restoration reserves (FRRs): active power reserves activated to restore system frequency to the nominal frequency
- replacement reserves (RRs): used to restore/support the required level of FRR to be prepared for additional system imbalances.

Each type of reserve must fulfil specific technical requirements. For that reason, only units certified by the TSO can provide these ancillary services. Only a few companies fulfil the technical requirements and are certified by Ukrenergo. As shown in Table 3.9, only four providers of ancillary services operate in the IPS trade zone.

Table 3.9. Certified reserves (IPS trade zone, MW), 2021

Name	FCR	Automatic FRR	Manual FRR	RR
Ukrhydroenergo		1 219	3 193	3 340
DTEK Group	±224	465	868	420
Kharkiv CHP-5	±27	90	90	180
Energoatom	±140			
Total	**±391**	**1 774**	**4 151**	**3 940**

Source: OECD based on data received from Ukrenergo.

For each type of reserve, there are only three providers. The share of the largest provider by reserve type ranges from 57% (FCR) to 85% (RR). There is clearly very high concentration in the supply of ancillary services due to the special technical characteristics of the services. The demand side is represented solely by Ukrenergo.

3.2. Retail market

Following the sale of large volumes of electricity on the wholesale market, electricity is sold to end consumers on the retail market. The retail market serves households, businesses and public entities such as hospitals and schools. In the retail market, consumers are connected mainly to the distribution network. Only a small number of large industrial consumers are directly connected to the high-voltage networks of the TSO.

To conclude an electricity supply contract, customers must first enter into a contract with a DSO. The contract with the DSO determines certain technical conditions of electricity supply, such as metering, termination procedures, reliability and continuity. A supply contract determines the commercial terms, in particular the price (or pricing method) and payment conditions. As of 31 December 2020, there were 17 602 832[44] electricity connection contracts with DSOs, most concluded by household consumers (97.1%) (NEURC, 2020[9]). In terms of consumption, households' share was much lower, at 31%.

The retail market is regulated by the EML, the Retail Market Rules,[45] the Transmission Network Code, the Distribution Network Code and the Commercial Metering Code. The EML provides the general legal framework, while the Retail Market Rules and the codes provide detailed rules on the rights of participants and their interactions with one another. The market rules and codes are developed and administered by the TSO and approved by NEURC.

The EML stipulates that from 1 January 2019, the supply of electricity to consumers is carried out at freely negotiated prices, except for in cases established by the law. Thus, in principle, Ukraine's retail electricity

market is fully liberalised and all consumers have the right to choose suppliers at unregulated prices. In practice, the retail market is split into different segments. Although some differences exist in the supply of different types of consumers in terms of volume and supply flexibility, the main reason for the segmentation is retail price regulation. Price regulation has two layers: universal service supply prices and fixed, regulated prices under a PSO.

3.2.1. Regulated price segment

According to the EML, household consumers and small non-household consumers (with capacities of up to 50 kW) have the right to be supplied by a USS "at economically reasonable, transparent and non-discriminatory prices, calculated according to the methodology approved by the regulator". On a transitional basis, for the years 2019 and 2020, budgetary institutions and non-household consumers with contracted capacities of up to 150 kW were also eligible to receive universal services.

The EML allows NEURC to introduce regulated prices for universal services, but it must justify doing so and they must reflect costs. When NEURC sets regulated prices, it should review them annually and provide a timetable for phasing them out.

In 2018, NEURC developed a pricing methodology for supplies under the universal service obligation, which is based on the (baseload) DAM price.

For households, the government introduced an additional price regulation in the PSO Act. It stipulates that households (individual and collective) should be eligible for supply at fixed prices by a USS. The fixed prices set by PSO Act (see Section 3.3.1) have been significantly lower than prices based on the USS methodology by NEURC and below market prices. Households therefore have no incentive to seek supply at either USS prices or unregulated prices. In fact, commercial suppliers do not offer supply contracts to household consumers because there is no demand for them. Household consumption accounts for 35% to 40% of total electricity supply in Ukraine.[46]

The only other supplier operating in the regulated retail segment is the supplier of last resort (SoLR), which has a special and very limited role.[47] It provides electricity for up to 90 days to consumers without suppliers, for instance in circumstances in which a previous supplier has ceased to operate.

It is important to note that USS or SoLR status does not preclude the possibility of supplying electricity at freely negotiated prices in the unregulated segment. USSs' supply volumes depend mainly on the number of households within their licensed territory. Since Ukraine's population is concentrated near industrial centres in the country's eastern and central regions, USSs operating in these areas have the biggest share.

Six of the 25 USSs are state-controlled and collectively supply 21% of households (3.5 million out of 16.5 million) (Vinnichuk, 2021[13]) The other USSs are privately owned. Private energy group DTEK controls three USSs, which supply close to 24% of all household consumers, and the Enera Group (foreign entity) controls four USSs, supplying a further 13% of household consumers (Vinnichuk, 2021[13]).

Table 3.10. Shares of electricity supply in the regulated segment (10 largest USSs by volume), 2021

Company	Share
Dnipro Energy Services (DTEK Group)	9.9%
Kyiv Energy Services (DTEK Group)	9.5%
Kyiv Regional Energy Supply Company	8.5%
Odessa Regional Energy Supply Company	8.2%
Kharkivenergozbut	6.7%
Lvivenergozbut	5.6%
Zhaporizhyaelectropostachannya	4.6%
Donetsk Energy Services (DTEK Group)	4.2%
Enera Vinnitsa	3.3%
Zakarpattyaenergozbut	3.2%
Total	**63.7%**

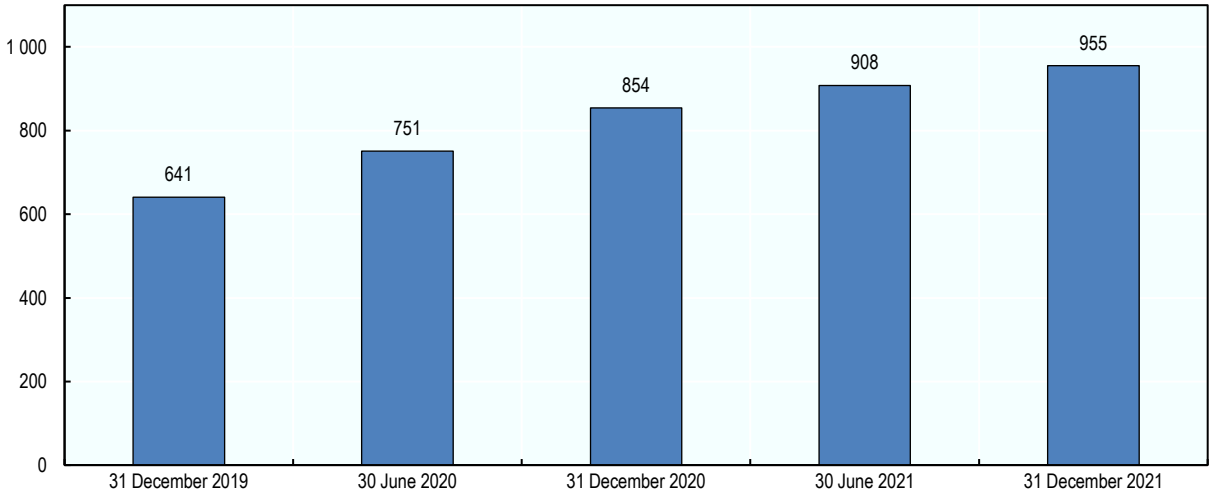
Source: OECD based on data provided by NEURC.

3.2.2. Unregulated price segment

Non-household consumers with capacities above 50 kW are not entitled to universal service supply and must purchase electricity at freely negotiated prices in the competitive segment. According to the latest available data from NEURC, supplies in this segment made up 69% of total supply in 2021 (NEURC, 2022[14]).

The supply of electricity at freely negotiated prices is arranged through contracts drawn up by suppliers based on a model contract set out in the Retail Market Rules. Several aspects of such contracts can be freely agreed between suppliers and customers, notably prices, payment methods and termination procedures.

Figure 3.4. Number of licensed electricity suppliers, December 2019-December 2021



Source: NEURC (2021[15]), Monitoring the functioning of the retail electricity market in the 3rd quarter of 2021, https://gas.ua/Content/Entities/LegalBasis/239/document.

Electricity suppliers need a licence that allows trading and supply to consumers. According to market participants, obtaining a licence does not represent a significant administrative burden. The large number of suppliers and its continued increase also indicate that the licensing does not constitute an entry barrier.

The majority of companies with supply licences are not active in the retail market and many active ones have few customers. In 2020, 81.2% of the 38 291 supply contracts at unregulated prices were concluded with one of the USSs and the ten largest suppliers supplied close to 60% of all electricity in this segment (NEURC, 2020[16]).

Table 3.11. Shares of supply in the competitive segment (10 largest suppliers by volume), 2020

Company	Share
D.Trading (DTEK Group)	26.7%
Energo Zbut Trans	6.4%
Kyiv Energy Services (DTEK Group)	5.2%
Dnipro Energy Services (DTEK Group)	4.0%
Kyiv Regional Energy Supply Company	3.1%
Odessa Regional Energy Supply Company	3.0%
Trading Electric Company	2.8%
Lvivenergozbut	2.6%
Kharkivenergozbut	2.5%
Poltavaenergozbut	2.1%
Total	**58.4%**

Source: OECD based on data provided by NEURC.

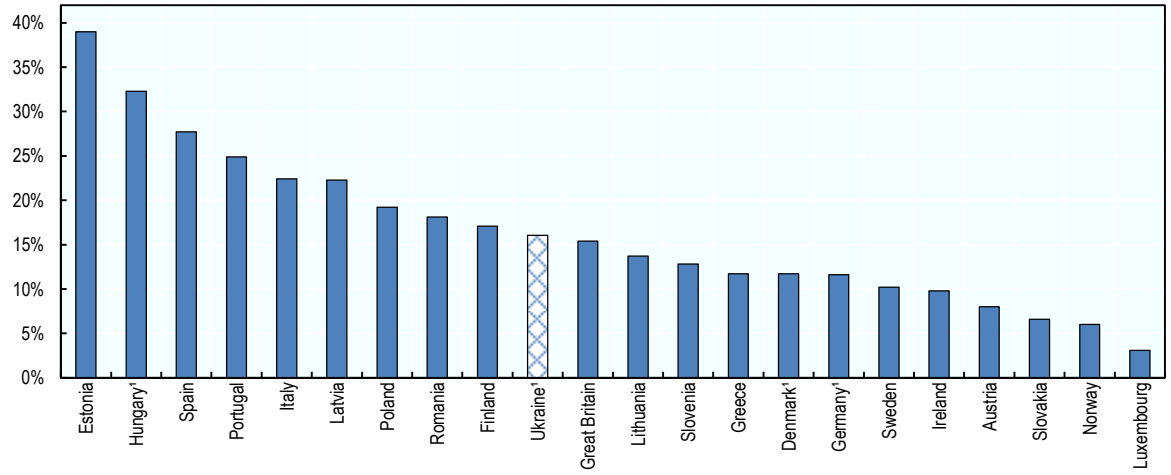
Based on Table 3.11, DTEK Group had a 36% share of the competitive segment in 2020. The top five suppliers in the segment have remained the same since the liberalisation of the retail electricity market in 2019.

One indicator of the intensity of competition in the retail market is customers' switching rate. This is a measure of the percentage of consumers who have changed electricity suppliers within a certain period (typically in a year). Changing electricity suppliers is the most direct way for consumers to benefit from competition in energy markets. By switching, consumers seek to obtain lower prices and/or better service. If many consumers switch or are ready to switch, suppliers must offer competitive prices and quality services to prevent losing them. In theory, readiness to switch is sufficient to subject suppliers to competitive pressure, but one can assume a significant correlation between actual switching rates and consumers' readiness to switch. Low switching rates may indicate limited choice for consumers, high switching costs or a lack of consumer engagement. The latter is relevant mostly for smaller consumers, especially households, rather than businesses with larger consumption. Finally, it should be noted that switching may also be a sign of consumers' dissatisfaction with suppliers.

In 2020, 9.27% of Ukraine's non-household consumers (by metering point) changed suppliers, representing 16.05% of electricity volume supplied to this customer group in the retail market (ECRB, 2021[17]). The difference between the two values reveals that consumers with above average consumption switch more frequently than consumers with below average consumption. This indicates that the main driver for switching is probably lower price rather than better quality; potential savings increase with consumption volume, whereas quality improvement does not depend on consumption levels.

Compared to switching rates in other European countries, Ukraine is within the middle range.

Figure 3.5. Non-household consumer switching rates (by volume), 2021



Note: Latest available data is for 2020.
Source: ACER/CEER (2021[18]), Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2020 – Energy Retail Markets and Consumer Protection Volume, https://documents.acer.europa.eu/en/Electricity/Market%20monitoring/Documents/MMR%202020%20Summary%20-%20Final.pdf; ECRB (2021[17]), ECRB Market Monitoring Report Gas and Electricity Retail Markets in the Energy Community, https://www.energy-community.org/dam/jcr:5bd1fa33-679b-4bfa-8cfe-566d22413cf8/ECRB_MM_retail_2020.pdf.

3.3. Public service obligations

PSOs are regulatory measures or requirements to guarantee minimum levels of quality, service standards and consumer rights to achieve sector-specific objectives in the name of general economic interest. In the energy sector, PSOs are justified by the fact that electricity and gas are essential goods, the supply of which must be continuous and non-discriminatory.

In Ukraine, the EML lists the following general public interest considerations that may be invoked for PSOs to be adopted in the electricity market:

- national security and security of supply
- stability, quality and availability of energy, including for vulnerable consumers
- protection of the environment, including energy efficiency, increases of the share of energy from alternative sources and reductions of greenhouse gas emissions
- protection of life, health and the property of the general public.

According to Article 62 of the EML, in pursuit of these broad public interests, the regulator should set up implementation mechanisms for the following special obligations for market participants:

- purchases of electricity at FiT
- provision of universal services
- performance of functions of the supplier of last resort
- provision of services to ensure the development of generating capacity
- increases in the efficiency of the combined production of electricity and thermal energy.

Further, the EML empowers the CMU to impose additional special obligations on market participants (except consumers) to pursue public interest objectives. Proposals for additional special obligations are prepared by NEURC and consulted on with the Energy Community Secretariat before being submitted to the CMU.

On 5 June 2019, CMU Resolution No. 483 (the PSO Act) laid down detailed rules for PSOs. [48] Originally, PSOs were conceived as a temporary measure valid until 31 December 2020. Since then, the PSO Act has been amended 16 times and its validity has been extended. The latest version of the act was adopted on 23 April 2023 and is valid until 31 May 2023.[49]

It is worth noting that PSOs are not particular to Ukraine but are widely used to ensure public economic interests. In the EU, Directive 2019/944[50] explicitly recognises that member states may impose PSOs on undertakings operating in the electricity sector in the general economic interest but requires that "such obligations shall be clearly defined, transparent, non-discriminatory and verifiable".[51] Similarly, the EML requires PSOs imposed by the CMU to be transparent, temporary and non-discriminatory. However, as will be outlined further, these requirements have not been followed in practice.

This section examines two PSOs that have had significant impacts on the functioning of Ukraine's electricity markets. The first is the PSO designed to ensure the supply of electricity at affordable prices to household consumers.[52] The second aims to support generation from renewable energy sources.

3.3.1. PSO for households

In order to protect household consumers from high electricity prices in the newly liberalised market, the government introduced an obligation for USSs to supply electricity to household consumers at regulated prices. It is important to note that all households have been entitled to electricity at regulated prices, not only vulnerable consumers, as is often the case in other jurisdictions.

Regulated prices vary according to household consumption, with an initial amount priced at low rates and additional volumes at higher rates.

Table 3.12. Regulated electricity prices for households, 1 July 2019

Consumption bracket	Price (UAH/kWh, incl. VAT)
Up to 100 kWh per month	0.366
From 100 kWh to 600 kWh per month	0.63
Over 600 kWh per month	1.407

Source: OECD based on data provided by NEURC.

Upon the introduction of the new market model in 2019, regulated prices applied only to electricity consumption by private households. In 2021, collective households, an additional category of consumers, became entitled to receive electricity at regulated prices. Collective households include the following categories of consumers:

- apartment buildings (e.g. electricity for elevators, lighting of common areas)
- dormitories
- religious organisations
- co-owner associations such as *dacha*-building co-operatives and gardeners' partnerships.

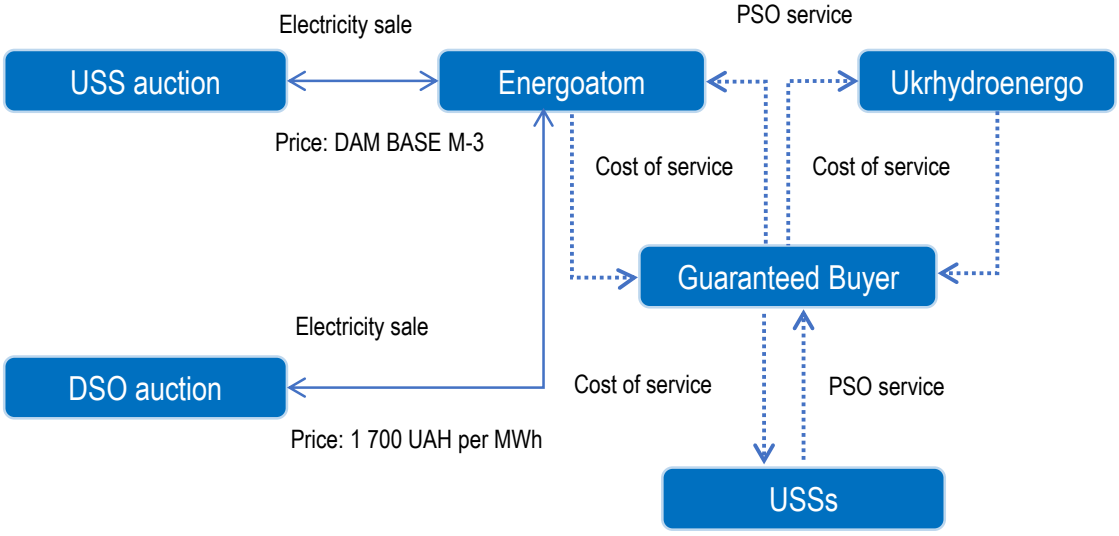
Since regulated prices for households had been significantly below wholesale market prices, the PSO for households offered a mechanism to provide lower-cost electricity to USSs to supply households at regulated prices. To this end, the PSO Act obliged Energoatom and Ukrhydroenergo to sell up to 60% and 20% of their output, respectively, to the GB.[53] The GB resold this electricity to USSs in electronic bilateral auctions at the weighted average price of electricity sold by the respective generator during the last three calendar months before the date the new electricity market became operational (April-May 2019).[54] On

20 August 2020, the weighted average price method was replaced with a fixed price of 10 UAH/MWh.[55] In December 2020, the price for Energoatom was increased to 150 UAH/MWh, but the price for Ukrhydroenergo remained unchanged.

Prices set by the PSO Act for Energoatom and Ukrhydroenergo appear not to have fully covered their costs, leading to significant financial difficulties.[56] As of September 2021, the accumulated debt for households under the PSO amounted to EUR 153 million (NEURC, 2021[19]). In response, on 1 October 2021, a new PSO model for households became operational, aiming to replace transfers of electricity with a financial compensation mechanism.[57] In principle, a financial PSO model is a more market-friendly approach than a physical PSO, as it allows producers to sell and USSs to buy electricity on the free market rather than on a special, regulated market. This shifts supply and demand to the free market, which makes markets more liquid and prices more meaningful.

The new PSO model was not a fully financial PSO but a hybrid model with both physical and financial elements. Under the new arrangements, Energoatom remains obliged to sell electricity to USSs through electronic auctions in the special section of the UEEX. The volume corresponds to the minimum hourly electricity consumption by households in the same month of the previous year. In addition, Energoatom and Ukrhydroenergo must pay a financial contribution to the GB, which in turn compensates USSs for the difference between the DAM baseload price and the regulated price for households. Energoatom's and Ukrhydroenergo's payments to the GB are determined by a specific formula. Somewhat simplified, Energoatom pays 95% of its revenues above a certain threshold derived from the average price of electricity in the first half of 2019 and Ukrhydroenergo pays 60%.

Figure 3.6. Financial PSO as of 1 October 2021



With the introduction of the new PSO model, regulated prices for households were also changed. The new prices, shown in Table 3.13, were set for the period 1 October 2021 to 31 October 2022 and later extended until 31 March 2023. [58]

For comparison, the higher price of 1.68 UAH/kWh (approximately EUR 0.054[59]) was less than one-quarter of the average household electricity price in the EU (EUR 0.237) and roughly half the lowest price in the EU, that of Hungary, in the second half of 2021 (Eurostat, 2022[20]).

The introduction of the new PSO model did not remedy the financial problems associated with the previous physical PSO model. In fact, the cost of the new model turned out to be much higher than estimated. The initial pre-VAT forecast for the fourth quarter of 2021 was UAH 621 million, but the actual cost turned out

to be UAH 3.04 billion. Ukrhydroenergo estimates that its share of the financial compensation mechanism amounts to 30% of its revenues.[60]

Table 3.13. Regulated electricity prices for households, 1 October 2021

Type of consumer	Price (UAH/kWh, incl. VAT)
Individual households	
Up to 250 kWh per month	1.44
Over 250 kWh per month (all consumption)	1.68
Collective households	1.68

Source: OECD based on data provided by NEURC.

3.3.2. PSO for renewables

The PSO for renewables was designed to increase generation from RES to reduce greenhouse gas emissions. Under the PSO for renewables, most RES producers – with the notable exception of large hydropower plants – benefit from "green" or feed-in FiT. They sell their output to the GB at the applicable FiT and the GB resells it on the wholesale market (through electronic auction on the DAM or the IDM). Since wholesale market prices are on average lower than those under the FiT, this results in a loss for the GB. To cover this loss, Ukrenergo is obliged to compensate the GB from its transmission tariff revenues.

When the market was liberalised, NEURC increased the transmission tariff more than eightfold, from 42.24 UAH/MWh to 347.43 UAH/MWh.[61] After several complaints and a series of lawsuits, NEURC was forced to reduce the tariff sharply, producing insufficient revenues for Ukrenergo to compensate the GB fully for its losses. To remedy this problem, NEURC increased the transmission tariff slightly for 2020 (to 155.40 UAH/MWh),[62] but this proved insufficient and it made a much larger tariff increase effective from 1 August 2020 (to 240.23 UAH/MWh),[63] and another from 1 December 2020 (to 312.76 UAH/MWh).[64]

As a reaction to the problem of RES financing, an amendment to the Law of Ukraine on alternative energy sources[65] on 21 July 2020 stipulated that the state budget should pay the GB for at least 20% of RES producers' forecast output.[66] In anticipation of this direct state support and a corresponding easing of Ukrenergo's financial contribution to the GB, NEURC reduced the transmission tariff to 293.93 UAH/MWh from the beginning of 2021. However, the 2021 state budget did not allocate any funds to supporting the GB, leaving Ukrenergo with the full financial cost of the renewable PSO but without adequate tariff revenues.

Overall, the design of the PSO for renewables caused significant fluctuations in the transmission tariff and undermined the financial stability of Ukrenergo, which accumulated a debt of around UAH 12 billion to the GB during 2020. By October 2021, the debt had increased to around UAH 21 billion (Litvinchuk, 2022[21]). To repay this, Ukrenergo issued five-year, state-guaranteed corporate bonds to raise USD 825 million in November 2021. The funds enabled Ukrenergo to pay most of its debt to the GB, leaving it owing UAH 8 billion as of February 2022. By 16 May 2022, however, Ukrenergo's debt to the GB had risen to around UAH 10 billion (Guaranteed Buyer, 2022[22]) suggesting that the financing of the PSO for renewables remains unsustainable.

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Notes

[1] Ukraine applied for EU membership on 28 February 2022 and received candidate status on 23 June 2022.

[2] Article 67 of the EML.

[3] Article 66 of the EML.

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[10] More precisely, the GB must sell electricity on the short-term markets and/or on the BAM. The part of electricity it does not sell on the short-term markets must be auctioned in the special section of the UEEX.

[11] See para 42 of CMU Resolution No. 887 “On amendments the Procedure for holding electronic auctions for the sale of electric energy under bilateral contracts”, 28 September 2020, https://zakon.rada.gov.ua/laws/show/887-2020-%D0%BF#n8.

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[13] This limit is set in the “Procedure for holding a special session on the sale of electricity produced from alternative sources”.

[14] Law of Ukraine No. 1 639-IX “On measures aimed at overcoming the crisis and ensuring financial stability in the natural gas market”, 14 July 2021, https://zakon.rada.gov.ua/laws/show/1639-20#n267.

[15] Law of Ukraine No. 2 371-IX “On amendments to the Law of Ukraine on the electric energy market regarding the regulation of relations on the sale of electric energy by energy producers under bilateral contracts”, 8 July 2022, https://zakon.rada.gov.ua/laws/show/2371-20#n5

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[18] A lot is an indivisible volume of electricity, it equals capacity of 1 MW during the specified sale period. If the period is five hours for 10 days, then the lot equals 50 MWh.

[19] According to the regulation, the number of lots sold in a package may not exceed 20% of the total number of lots offered by the seller, and it cannot be more than 50 lots.

[20] Point 10.10 of the rules for the commercial section.

[21] The software ranks counter-offers made at the same price according to the time they are received.

[22] Law of Ukraine No. 2 210-III "On the protection of economic competition", 11 January 2001, https://zakon.rada.gov.ua/laws/show/2210-14#Text.

[23] Order of the Ministry of Energy No. 272 "On the establishment of the auction committee for the sale of electricity under bilateral agreements", 21 June 2019, http://mpe.kmu.gov.ua/minugol/doccatalog/document?id=245398571

[24] Law of Ukraine No. 2019-VIII "On the electricity market", 13 April 2017, https://zakon.rada.gov.ua/laws/show/2019-19#Text.

[25] NEURC Decision No. 308 "On approval of the Rules of the day-ahead market and the intraday market", 14 March 2018, https://zakon.rada.gov.ua/laws/show/v0308874-18#Text.

[26] NEURC Decision No. 766 "On the actions of electricity market participants during the quarantine period and restrictive measures related to the spread of coronavirus disease (COVID-19)", 8 April 2020, https://zakon.rada.gov.ua/rada/show/v0766874-20#Text.

[27] Art. 19 of the EML.

[28] Law of Ukraine No. 1 639-IX "About measures aimed at overcoming crisis events and ensuring financial stability in the natural gas market", 14 July 2021, https://zakon.rada.gov.ua/laws/show/1639-20#Text

[29] Article 67 of the EML.

[30] In certain cases, the MO may postpone the start time for bidding until 5 p.m. See para 3.1.10. NEURC Decree No. 308 "On the approval of the Rules of the day-ahead market and the intraday market", 14 March 2018, https://zakon.rada.gov.ua/laws/show/v0308874-18#Text.

[31] NEURC Decision No. 308 "On approval of the Rules of the day-ahead market and the intraday market" (with amendments), 14 March 2018, paragraph 5.1, https://zakon.rada.gov.ua/laws/show/v0308874-18#Text.

[32] NEURC Decision No. 517 "On amendments to the Rules of the day-ahead market and the intraday market", No. 517, 28 February 2020, https://zakon.rada.gov.ua/rada/show/v0517874-20#n2.

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[34] NEURC Decision No. 2 969 “On NEURC amendments decision No. 766 of 8 April 2020”, 24 December 2021, https://zakon.rada.gov.ua/rada/show/v2969874-21#Text.

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[40] The mandatory sales target is also reflected in Clause 9 of chapter X of the Market Rules.

[41] section XVII “Final and Transitional Provisions” of Law of Ukraine No. 1 639-IX “On Measures to Overcome the Crisis and Ensure Financial Stability in the Natural Gas Market”,14 July 2021, https://zakon.rada.gov.ua/laws/show/1639-20#n339).

[42] Participants in a balancing group are not responsible for their individual imbalances towards the TSO, but they remain financially responsible towards the BRP of their group.

[43] Unless the dispatched load is selected to provide reserves. In such cases, the provider of balancing services is obliged to submit offers corresponding to the volumes of the selected reserve to the balancing market.

[44] The number does not include Crimea, Donetsk and Luhansk regional data.

[45] NEURC Decision No. 312 “On approval of the Retail Market Rules”, 14 March 2018, https://zakon.rada.gov.ua/laws/show/v0312874-18#Text.

[46] In the third quarter of 2021, the share was 32%, according to NEURC’s Retail Monitoring Report (NEURC, 2021[24]).

[47] As of 1 July 2021, only 65 consumers were supplied under a SoLR agreement.

[48] CMU Resolution No. 483 “On approval of the provision on the assignment of special duties for electricity market participants to ensure public interest in the process of electricity market functioning” (PSO Act), 5 June 2019, https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text.

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[50] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0944.

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[52] See points 11 to 14 of paragraph 13 of section XVII "Final and Transitional Provisions" of the EML.

[53] It should be noted that Energoatom had an additional obligation to sell 15% of its output to the TSO and DSO to cover their network losses.

[54] CMU Resolution No. 483 "On approval of the provision on the assignment of special duties for electricity market participants to ensure public interest in the process of electricity market functioning" (PSO Act), 5 June 2019, https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF/ed20190605#n9.

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[56] See (Economic Truth, 2020[23]) on Energoatom's financial problems.

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[59] Based on the EUR/UAH exchange rate of 30.9226 on 31 December 2021. https://bank.gov.ua/en/markets/exchangerate-chart?cn%5B%5D=EUR&startDate=2021-12-31&endDate=2022-01-31.

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[61] NEURC Decision No. 954 "On setting the tariff for electricity transmission services of NEC Ukrenergo for the second half of 2019", 7 June 2019, https://zakon.rada.gov.ua/laws/show/v0954874-19#Text.

[62] NEURC Decision No. 1998 "On NEURC amendments decision No. 2 668 of 10 December 2019", 11 November 2020, https://zakon.rada.gov.ua/rada/show/v1998874-20#n2.

[63] NEURC Decision No. 1 329 "On NEURC amendments decision No. 2 668 of 10 December 2019", 11 July 2020, https://zakon.rada.gov.ua/laws/show/v1329874-20#n2.

[64] NEURC Decision No. 2 668 "On setting the tariff for electricity transmission services of NEC Ukrenergo for 2020", 10 December 2019, https://zakon.rada.gov.ua/laws/show/v2668874-19#Text.

[65] Law of Ukraine No. 555-IV “On alternative energy sources”, 20 February 2003 (as amended), https://zakon.rada.gov.ua/laws/show/555-15#Text.

[66] Law of Ukraine No. 810-IX “On amendments to some laws of Ukraine regarding the improvement of the conditions for supporting the production of electricity from alternative energy sources”, 21 July 2020, https://zakon.rada.gov.ua/laws/show/810-20#n13

4 Assessment of the wholesale market

This chapter provides an assessment of electricity market concentration, market power and liquidity in Ukraine. It also includes a theoretical discussion of the specificities of market power in electricity markets. This is followed by an analysis of regulatory interventions with a significant impact on competition in Ukraine's wholesale market. Finally, the chapter identifies market entry barriers that can limit the emergence of more competition in the long term.

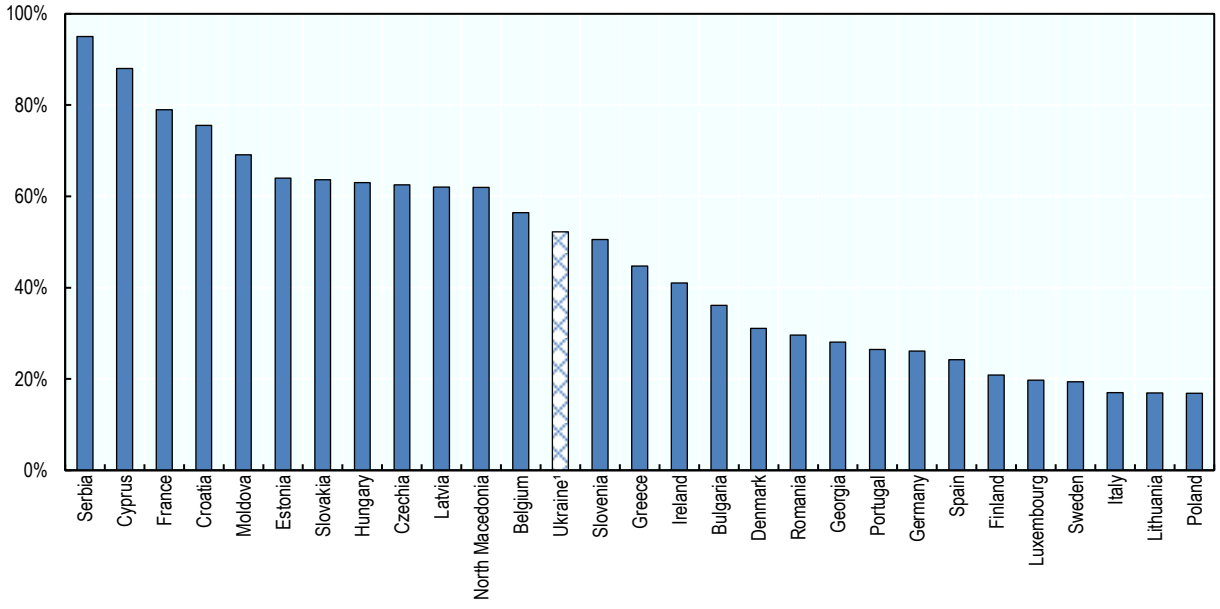
A key element of any competition assessment is the investigation of market structure and market power. Market power refers to the ability of a firm (or group of firms) to raise and maintain prices above the level that would prevail under competition. In newly liberalised electricity markets, the exercise of market power can hinder or even derail the transition towards competitive and efficient wholesale and retail markets.

Traditionally, measures of market concentration such as numbers of firms, market shares and the Herfindahl-Hirschman Index (HHI) have been used as a proxy for the intensity of competition and the assessment of market power. Although they can reveal some useful information about market structure, they do not capture several electricity market-specific aspects of market power.

4.1. Concentration and market segmentation

Due to historical reasons, high capital requirements, economies of scale and regulation, high levels of concentration in generation are a common feature of many electricity markets worldwide. Figure 4.1 shows the share of the largest generator in Ukraine (namely Energoatom) and other European countries. Ukraine with 52%, is within the mid-range. However, many of the countries with higher shares are relatively small and not fully comparable to Ukraine.

Figure 4.1. Market share of the biggest generator by European country, 2021

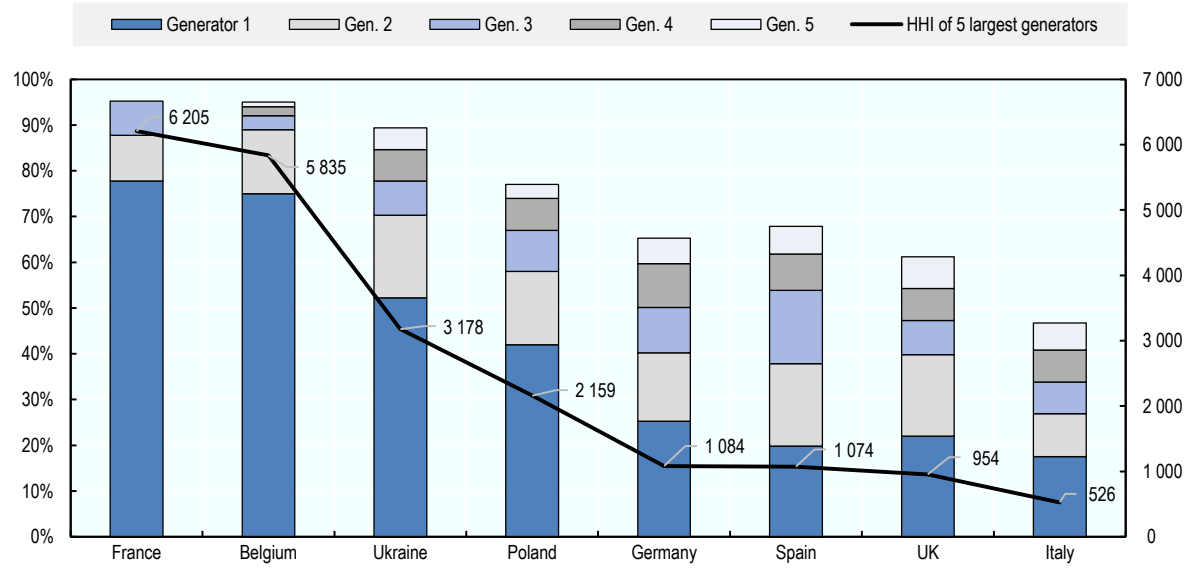


1. 2020 value.
Source: Eurostat (2023[1]), Market share of the largest generator in the electricity market, https://ec.europa.eu/eurostat/databrowser/view/TEN00119/default/table?lang=en&category=nrg.nrg_market; Ukrenergo.

Figure 4.2 compares the shares of the biggest five generators in selected European markets with different characteristics. The French and Belgian generation mixes feature a large share of nuclear, similar to Ukraine. The German and UK electricity markets are Europe's most liquid, while Spain's and Italy's are somewhat isolated due to cross-border constraints. Poland is most similar to Ukraine in terms of population and domestic consumption. For this comparison, the Guaranteed Buyer (GB) is considered a de-facto generator as it markets all renewables under the feed-in tariff (FiT) support scheme. Ukraine's five biggest

power producers dominate generation, with a combined market share of 89%, translating into the third-highest concentration among the selected – mostly larger – European countries.

Figure 4.2. Shares of the five biggest generators, 2021



Sources: Eurostat, Ofgem, URE, ARERA, Bundeskartellamt, CNMS, Ukrenergo.

In addition to the shares of the largest power producers, the figure above also shows the HHI index of market concentration. Even though Poland and Ukraine appear similar in terms of the combined market share of the five biggest producers, with 77% and 89%, respectively, the HHI is one-third lower in Poland, reflecting a higher number and larger combined share of smaller players.

Table 4.1 provides an overview of key attributes of Ukraine‘s biggest electricity generators. It shows that state-ownership is the norm and that suppliers focus on different generation technologies. A significant technology overlap exists only between DTEK and Centerenergo, which both operate fossil fuel power plants.

Table 4.1. Overview of the five largest generators in Ukraine, 2020

Company	Technology portfolio	Ownership	Share of generation
Energoatom	Nuclear, one pumped hydro	State	52%
DTEK	Coal- and gas-fired	Private	18%
Guaranteed Buyer	solar, wind, small hydro, biofuel	State[1]	8%
Centerenergo	Coal- and gas-fired	State	7%
Ukrhydroenergo	Large hydro	State	5%
Total			**90%**

1. The Guaranteed Buyer markets the output of private generators.
Source: Ukrenergo (2021[2]), Production and sale of electric energy by generating companies, http://web.archive.org/web/20211022135312/https://ua.energy/uchasnikam_rinku/administrator-komertsijnogo-obliku/statystychni-dani/vyrobnytstvo-ta-vidpusk-elektrychnoyi-energiyi-generuyuchymy-kompaniyamy/.

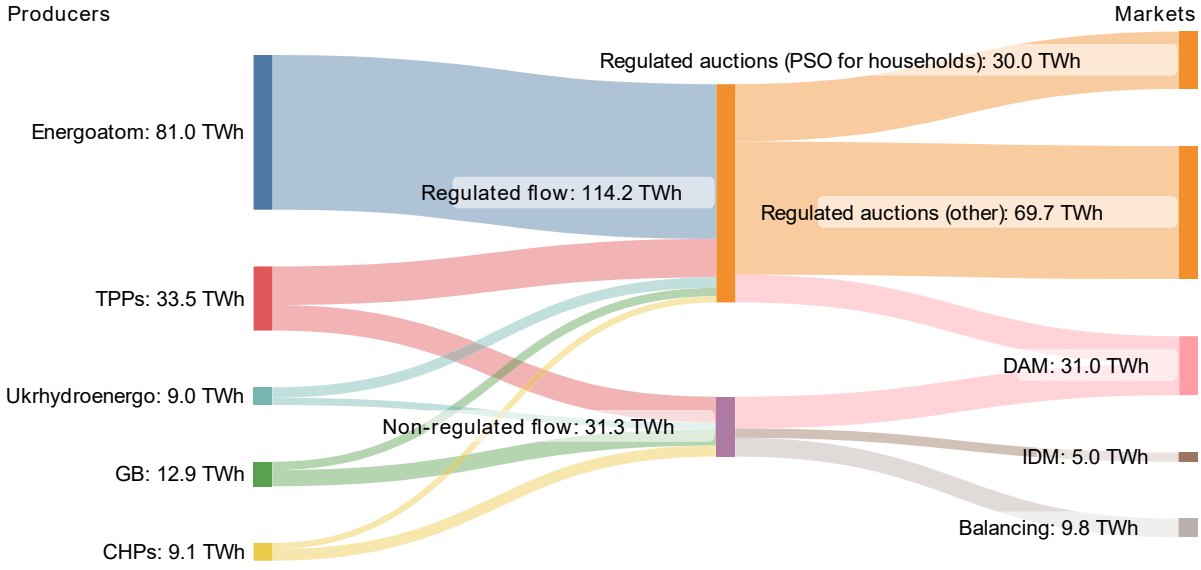
Ukraine's energy regulator has introduced several measures aiming to reduce the risks associated with high levels of market concentration. These include: 1) an obligation for producers to sell a minimum share of output on the day-ahead market; 2) an obligation for producers to sell power bilaterally on the power exchange under the regulated auction rules; and 3) self-supply restrictions for vertically integrated holdings. Additionally, considering the significant share in generation of Energoatom, and its unique position as a state-owned nuclear power producer, the government imposed a fourth measure, a public service obligation (PSO) for households, further limiting Energoatom's freedom to market its output.

These measures redistribute primary volumes of electricity and thereby change the size and the supply-demand structure of all market segments. Most obviously, regulated sales through bilateral auctions (i.e. sales in the special section of the UEEX), reduce the volumes available in other market segments, such as the day-ahead market (DAM).

Figure 4.3 shows the extent and effect of regulatory interventions on electricity volumes. The regulated flow (the vertical orange bar in the middle of the chart) represents volumes directed to specific market segments by regulatory obligations. The unregulated flow (the vertical purple bar) represents volumes unaffected by regulatory obligations.

The obligations limit producers' freedom to sell their output, but they are not equally restrictive and do not necessarily change the behaviour of market participants. For example, the obligation to sell at least 10% on the DAM may very well be in line with what (at least) some producers would do in the absence of such an obligation. Conversely, sales in the special section of the UEEX occur only because they are prescribed; otherwise, this segment would not even exist.

Figure 4.3. Effects of regulatory obligations on primary sales (TWh)



Note: This diagram shows sales by electricity producers, with supplies on the left, and markets where sales takes place are on the right. Intermediate nodes group sales into two categories "regulated" and "non-regulated". The amounts are not representative of total trading volumes across all market segments as only primary sales are shown.
Source: OECD calculations based on Ukrenergo 2021 generation data and current regulations.

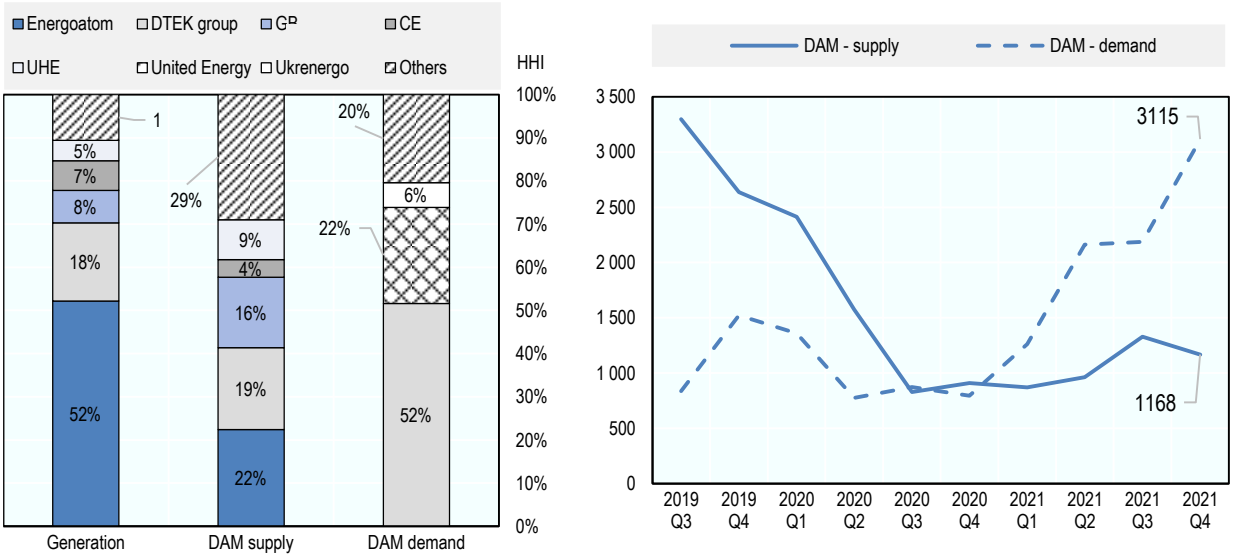
The OECD estimates that the regulated flow includes around 80% of total electricity production in Ukraine. This means that a large majority of electricity produced is sold on a market segment determined by regulation rather than by producers' choice. Most of the regulated flow originates from Energoatom and thermal power plants, but all producers contribute. Only around 20% of total electricity production is sold

on market segments freely chosen by producers. This unregulated flow originates from all types of producers.

By directing specific volumes of electricity to specific market segments, the regulatory obligations partly pre-determine producers' shares of the different market segments.

Figure 4.4 shows how regulatory obligations change suppliers' shares on the DAM. The share of the five largest suppliers on the DAM decreases from 89% to 70% because of regulatory obligations. Energoatom's share declines the most, from 52% to 22%. The shares of the GB and Ukrhydroenergo double, while Centrenergo's drops from 7% to 4%. The supply share of DTEK group is not substantially affected, increasing only slightly from 18% to 19%. The share of other companies rises from 11% to 29%. This includes increased activity by traders that trade electricity on the DAM previously procured in bilateral auctions. Overall, regulatory obligations significantly reduce the shares of large suppliers and supply side concentration on the DAM. This may contribute to reducing market power on the DAM, but whether this is actually the case and to what extent requires an in-depth investigation of DAM bids.

Figure 4.4. DAM supply shares and HHI after regulations



Sources: NEURC 2021 data from operative monitoring, OECD calculations.

The evolution of HHI since market liberalisation shows a strong decrease in supply side concentration and an increase in demand side concentration on the DAM. Two factors explain the increased demand side concentration: first, the growing share of bilateral agreements reduced volumes on the DAM; and second, DTEK's share of demand increased significantly because of self-supply restrictions introduced in November 2021. Previously, part of DTEK's demand was covered through intragroup sales.

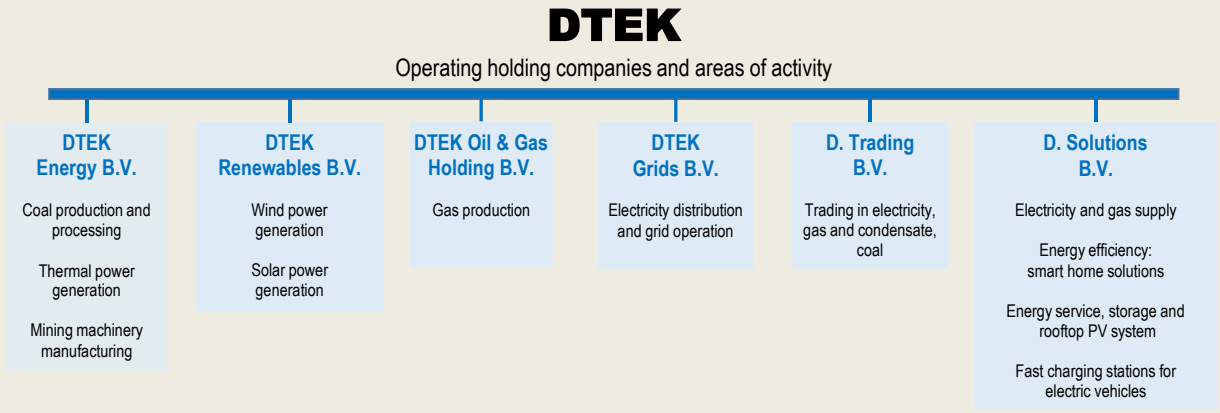
DTEK Group has a unique position on the DAM as it has a significant presence both as a producer (seller) and a retail supplier (buyer). More broadly, DTEK Group has other business activities (see Box 4.1), which make it a very large consumer of electricity.

Box 4.1. DTEK Group

DTEK Group is owned by SCM Holdings Ltd. SCM also owns Metinvest, an international group of steel and mining companies. Metinvest is one of the biggest electricity consumers in Ukraine. SCM is present in all parts of the energy value chain:

- electricity consumption: 8% of total consumption in Ukraine
- energy coal (G-grade): 76% of domestic production, 75% of consumption
- power generation: 20% by a mix of coal- and gas-fired thermal, solar and wind power plants
- electricity distribution: 48% of final consumption delivered by four distribution system operators (DSOs)
- electricity trading: 55% of demand on spot markets
- supply: around 33% of supply to final consumers
- export: de-facto control over 200 MW power line to Poland.

Figure 4.5. Structure of DTEK group



Source: Based on DTEK, https://dtek.com/en/.

4.2. Market power

Factors beyond concentration impact the degree of competition within an industry, including producers' incentives, elasticity of demand, short-run potential for market entry and output expansion (Borenstein et al., 1999[3]). These factors are not captured by concentration measures but are critical for the electricity market because, with some exceptions, electricity cannot be stored, short-term demand is inelastic, and supply and demand must be always in balance. (Borenstein et al., 1999[3]) show that because of these factors, market concentration measures are insufficient to assess market power in wholesale electricity markets and sometimes yield misleading results (i.e. increased price-cost margin when concentration declines) when compared to an oligopoly equilibrium approach.

Specific structural indices are better suited to assessing market power in the electricity sector, such as the pivotal supplier index, the residual supply index and residual demand analysis. Moreover, behavioural

analyses that examine, for instance, bid-cost margins, net revenue benchmarks or physical and economic withholding can be used to find direct evidence of exercises of market power.

In wholesale electricity markets, market power often arises if particular producers play a pivotal role in satisfying demand. If a supplier controls a crucial part of generation capacity, it can gain significant market power and commensurate influence over market prices. Such power can be concentrated in the hands of one producer or spread among a few. The extent to which pivotal suppliers can influence market prices depends on the concentration of their pivotal power and the market-specific merit order curve (Perekhodtsev, Lester and Blumsack, 2022[4]). The merit order curve ranks available generation capacity based on an ascending order of short-run marginal cost. It is used on the DAM to determine which power plants (or units) should be dispatched.

The market power of electricity producers often varies between times of high demand and low demand. Generally, market power is more easily exercised during peak hours, when there is little unused capacity. As more capacity is dispatched, the number of suppliers able to provide additional volumes decreases. In addition, the likelihood that the remaining suppliers with free capacity become pivotal increases.

4.2.1. Exercise of market power

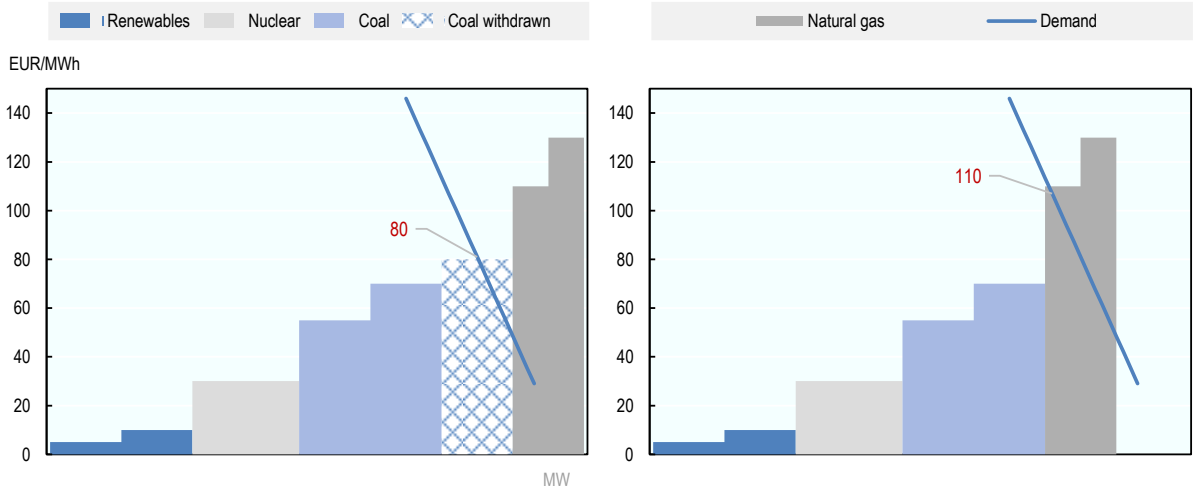
The main way of exercising market power in wholesale electricity markets is through withholding available capacity from the market. This can be done through:

- physical withholding – not offering available capacity to the market that could be profitably produced at the market price
- economic withholding – offering available capacity at a price that does not reflect its marginal cost (including opportunity cost), resulting in non-supply (ACER, 2021[5]).

Both, physical and economic withholding lead to the same result, raising prices above their competitive level and making customers worse off while benefitting producers. In addition, overall welfare is reduced as the consumer loss is larger than the producers' extra profit.

Figure 4.6 shows the effect of physical capacity withholding for a stylised merit order curve. Part of the coal capacity is removed from the merit order curve and as a result the intersection of the merit order curve with the demand curve moves up, meaning the market price increases from 80 to 110 EUR/MWh.

Figure 4.6. The merit order curve and the effect of capacity withdrawal



Source: OECD based on Chauve et al. (2009[6]), The E.ON electricity cases: an antitrust decision with structural remedies, http://ec.europa.eu/

Withholding capacity makes the merit order curve steeper and shifts its intersection with the demand curve, resulting in a higher price. Any supplier pursuing this strategy forgoes the profits from the capacity withdrawn, but the loss can be outweighed by increased profit on its remaining sales due to the higher market price. It is therefore easier for firms with large generation portfolios to profitably withhold capacity.

It is important to note that although the market-clearing price is normally set by the marginal supplier, the supplier exercising market power with a bid that raises the clearing price can be a different supplier. Thus, focusing only on the marginal supplier can result in non-detection of capacity withholding.[1]

Box 4.2. The E.ON antitrust cases

At the end of 2006, in the wake of an electricity sector inquiry, the European Commission opened two cases relating to E.ON's strategies in Germany.

In the first case, the commission investigated E.ON over suspected abuses of dominance in the wholesale electricity market in the form of capacity withholding and deterring investment in electricity generation by third parties.

The commission's analysis established that E.ON may have profitably withheld certain amounts of capacity thanks to the breadth of its generation portfolio. Moreover, third parties might have been deterred from making generation capacity investments by E.ON's offers of shares in its generation projects and long-term contracts.

The second case concerned the balancing market, in which E.ON was suspected of abuses of dominance through its vertically integrated transmission system operator (TSO). E.ON's TSO may have favoured its generation branch over other market participants by purchasing secondary balancing power, provided mainly by E.ON, instead of tertiary balancing power, which was subject to more competition. The commission found that this had likely led to higher balancing costs and significant consumer harm.

Both cases were settled in 2008 with asset divestiture remedies: E.ON had to divest 20% of its German generation portfolio and its high-voltage transmission grid, including its system operation business in Germany.

Source: Chauve et al. (2009[6]), The E.ON electricity cases: an antitrust decision with structural remedies, http://ec.europa.eu/.

4.2.2. Market integrity and transparency

Given the potential for market distorting conduct in electricity markets, both regulation and antitrust enforcement are needed. As underlined by (Moss and Vaheesan, 2014[7]), "this complementarity is essential because (1) regulation can overcome some of the limitations of antitrust law in reaching certain types of withholding, and (2) antitrust is better suited to prosecuting some of the conduct that spawns withholding, and can often obtain more effective remedies".

The design and enforcement of effective regulation is vital. On the one hand, poorly formulated laws and regulations can distort the market, create constraints that hinder competition, and even facilitate concentrations of market power in the hands of specific market participants. On the other, sector regulation, accompanied by competition law enforcement, has a fundamental role to play in addressing market failures and protecting consumers by ensuring competitive, efficient, sustainable markets.

In the EU, the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT)[2] gives regulators the instruments to address market manipulations and abuses of market power. REMIT is without

prejudice to the application of EU competition law but due to some overlaps, certain behaviour can be investigated and sanctioned under either framework.

REMIT came into force in 2011, providing a regulatory framework for the EU's wholesale energy markets and capable of supporting the effective functioning of the market based on open, fair competition. REMIT explicitly prohibits market abuses, defined to include market manipulation, attempted market manipulation and insider trading. In relation to market manipulation, Article 2(2) defines four categories of practices: 1) false/misleading transactions; 2) price positioning; 3) transactions involving fictitious devices/deception; and 4) dissemination of false and misleading information.

REMIT also sets out rules promoting integrity and transparency in the trading of wholesale energy products. It requires market participants to disclose inside information in an effective and timely manner.

Finally, REMIT incorporates two other key principles: monitoring and co-operation. It establishes a sector-specific, comprehensive monitoring framework for wholesale energy markets, implemented in close co-operation and co-ordination between the European Union Agency for the Co-operation of Energy Regulators (ACER), in charge of EU-wide monitoring, and national regulatory authorities (NRAs), in charge of national monitoring, investigations and enforcement.[3]

According to ACER, 109 potential REMIT breach cases were opened in 2021, either notified to ACER by external entities such as NRAs or identified by ACER through its own monitoring (ACER, 2021[8]). Most of the cases related to violations of REMIT's Article 3, concerning the prohibition of insider trading, and Article 5, concerning the prohibition of market manipulation.[4] Box 4.3 illustrates a recent enforcement decision following a breach of Article 5.

Box 4.3. The Energi Danmark/Optimax Energy case

In May 2021, the German Federal Network Agency (Bundesnetzagentur) imposed fines of EUR 200 000 on Energi Danmark A/S and EUR 175 000 on Optimax Energy GmbH for manipulation of the wholesale electricity market. The penalties were the results of investigations opened in September 2020 after significant imbalances were observed in the system in June 2019.

The Bundesnetzagentur's analysis of trading activities indicated market manipulation involving sales of electricity that was not available. The companies placed offers to sell electricity on the intraday market shortly before the electricity was due to be supplied, without intending to supply it. They had an incentive to do so due to the difference between the unusually high intraday price and the lower expected imbalance price on the balancing market. The practice distorted market signals at a time when TSOs had to make full use of balancing energy and take other measures to ensure the stability of the German system. The practice not only allowed the companies to realise unjustified profits but also threatened system stability.

Source : Bundesnetzagentur (2021[9]), Fines for manipulation of wholesale energy market, https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/EN/2021/20211005_BussgeldMarktmanipulation.html.

4.2.3. Market power in Ukraine

In Ukraine, the most crucial wholesale market in terms of price formation is the DAM. Therefore, market power on the DAM has the most potential to distort wholesale market prices.

As previously mentioned, static indicators such as market shares and the HHI do not capture the presence of market power that may arise at specific times. In the electricity sector, market power may shift over a short period of time. The ability to influence electricity prices on the DAM depends on hourly

supply-demand conditions, which can vary significantly within a single day. For instance, certain producers may not be able to influence prices during off-peak hours but may be able to do so during times of peak demand. The non-availability of certain power plants or their individual units due to regular maintenance or technical problems may also affect generators' market power. Overall, HHI values are of limited value for assessing market power on the DAM.

Eventually, the presence and distribution of market power largely depends on the specific structure of the generation fleet and its ownership. In Ukraine, all main generating companies hold technology-specific portfolios. Energoatom, Ukrhydroenergo and the GB hold portfolios with a low marginal cost of production. The GB and Ukrhydroenergo's marginal cost is close to zero, so they never set the price on the DAM. The marginal cost of Energoatom's nuclear power plants is estimated by the NEURC to be 600-750 UAH/MWh, below the day-ahead price most of the time, meaning that Energoatom is rarely in a position to set the price. Additionally, nuclear plants in Ukraine are designed as baseload facilities, maximising their utilisation rate rather than adjusting their output according to the level of demand. This means that Energoatom is normally not competing with thermal and hydro generation to supply peak demand.

Aware of the limitations of static indicators, NEURC has adopted a pivotal supplier test in its monitoring reports, based on two indices, the Pivotal Supplier Index (PSI) and the Residual Supply Index (RSI). The PSI is a binary variable that indicates whether a supplier is pivotal in the market, given hourly supply and demand. In other words, it identifies whether supply can meet demand without the supplier, showing the indispensability of a supplier, which is one form of market power. The RSI has been developed as an extension of the PSI and has been adopted in many countries as a standard method in the monitoring of electricity markets. It provides additional information on the ratio of residual supply relative to demand by revealing the extent to which competitors of a given generator can meet demand using their generation capacities.

NEURC reports the RSI and PSI for Ukraine's two biggest suppliers, Energoatom and DTEK Group, in its quarterly monitoring reports. It uses two approaches for its calculation: one based on total volumes and another excluding volumes regulated by the PSO. The latest available calculation shows the following results for the Integrated Power System (IPS) trade zone during the third quarter of 2021:

- Based on total volumes
  - Energoatom had market power according to both the RSI and the PSI
  - DTEK group had no market power according to both indices.
- Based on volumes excluding the PSO
  - Energoatom had no market power according to both indices
  - DTEK Group had market power in 47.7% of hours, according to the RSI, and no market power according to the PSI.

For the Burshtyn Energy Island trade zone, the RSI indicates that DTEK Group had market power, while according to the PSI, it had market power only in 28.4% of the hours during the third quarter of 2021.

The RSI and PSI show that the PSO significantly reduces Energoatom's market power. In absence of the PSO or under a fully financial PSO, Energoatom would have significant market power, according to these indices. This may not be surprising, given Energoatom's share of generation, but it is unusual for a baseload operator to be able to influence prices in a significant number of hours.

Contrary to NEURC's above conclusions, (Supponen, 2021[10]) states that "DTEK's dominant position in the power market is obvious and well-known". He finds that prices on the DAM are set mostly by thermal generation and that 61% of price-setting capacity is owned by DTEK Group.

From a legal perspective, Article 12 of the Law of Ukraine on the protection of economic competition[5] stipulates the following: "2. The position of a business entity whose share in the product market exceeds

35% is considered monopolistic (dominant), unless it proves that it is subject to significant competition. 3. The position of a business entity can also be recognised as monopolistic (dominant) if its share in the product market is 35% or less, but it is not subject to significant competition, in particular due to the relatively small size of market shares belonging to competitors."

Thus, there is a rebuttable presumption of dominance above a market share of 35%, meaning the obligation to prove the absence of dominance rests with the business entity. Below this threshold, findings of dominance are possible, but the obligation to prove it rests with the Antimonopoly Committee of Ukraine (AMCU).

Compared to the EU, where the European Court of Justice established a presumption of dominance above a market share of 50%[6] and the European Commission considers that "dominance is not likely if the undertaking's market share is below 40%",[7] the threshold in Ukraine is relatively low. However, as pointed out by the AMCU, the national legislation of several EU member states sets a market share threshold of 40% and in Austria it is 30% (AMCU, 2023[11]).

In the context of electricity markets, the most important issue is not so much the presumption threshold but the recognition that market shares do not necessarily correspond with market power. Especially on the DAM, market power depends mostly on the generators' position on the merit order curve rather than on their market share. Marginal generators can influence prices and thus exercise market power even with a relatively low market share, while non-marginal generators are price takers and have limited or no ability to influence prices even if their market share is significant, i.e. above the 35% threshold.

Based on generators' positions on the merit order curve, perhaps the most likely candidate to hold market power is DTEK as it controls most marginal coal-fired plants. Even though its share of electricity generation is well below 35% and the PSI and RSI calculated by NEURC are ambiguous regarding its market power, close monitoring of its behaviour would be warranted, both by the energy regulator and the competition authority.

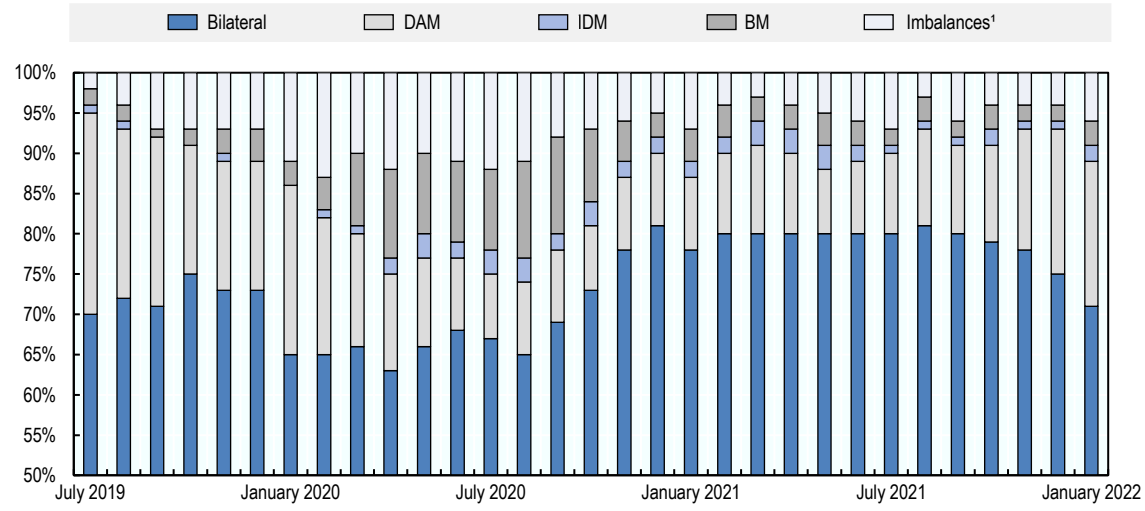
4.3. Liquidity

Liquidity is an important feature of a well-functioning electricity market. Liquid wholesale markets allow market participants to buy and sell electricity in a timely way at reliable market prices. The more liquid markets are, the easier it is for non-vertically integrated firms to compete with vertically integrated firms and for new entrants to compete with incumbent firms. Weak competition and the presence of market power increase uncertainty about short-term and forward prices, and tend to reduce liquidity in all timeframes.

Liquidity in the wholesale market is affected by regulations that either directly control flows of electricity to particular market segments or influence prices through price caps for the DAM, the Intraday Market (IDM) and the Balancing Market.

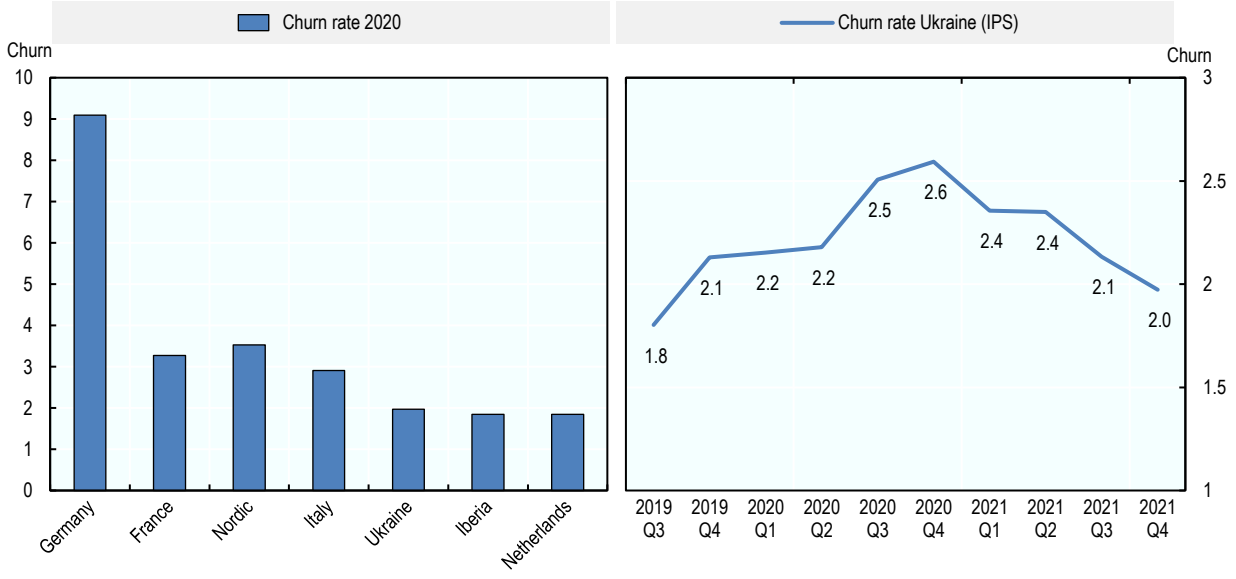
As shown in Figure 4.7, the distribution of trade volumes in Ukraine's wholesale electricity market leans heavily towards bilateral trading. The proportion of volume traded on organised spot markets (the DAM and IDM) has been generally modest and was particularly low from April 2020 to August 2021. The share of spot trading increased after price caps were raised in August 2021 and self-supply restrictions for vertically integrated holdings were introduced in December 2021. This demonstrates the influence of regulatory measures on the distribution of trade volumes and market liquidity.

Figure 4.7. Distribution of trading across segments in Ukraine's electricity market, July 2019-January 2022



1. Imbalances represent the electricity settled after gate closure of the BM. This volume is not traded.
Source: NEURC (2022[12]), Share of trade in different market segments, https://public.tableau.com/app/profile/neurc/viz/2__16324695298060/sheet0_1.

Figure 4.8. Total churn rate in selected European electricity markets



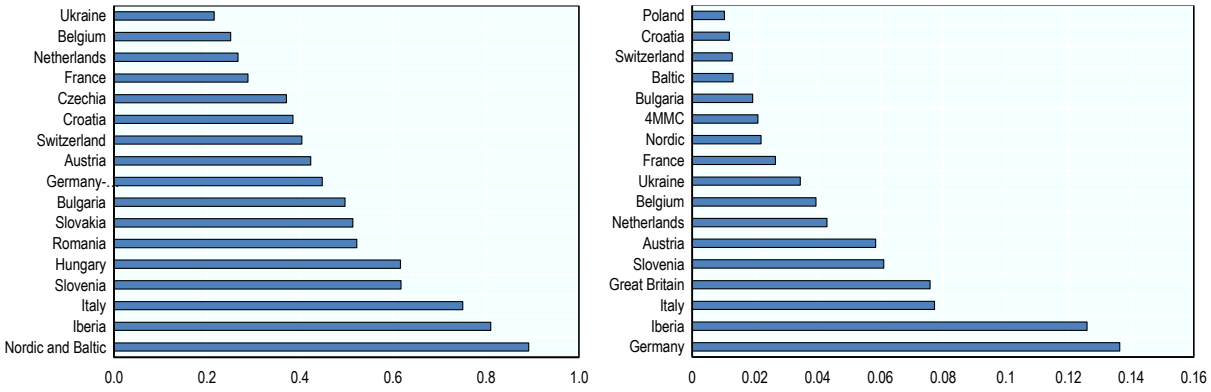
Sources: NEURC (2022[13]), Churn rate in the IPS trade zone of Ukraine, https://public.tableau.com/app/profile/neurc/viz/1__16324693131810/1_; ACER/CEER (2021[14]), Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2020, https://acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Market%20Monitoring%20Report%202020%20%E2%80%93%20Electricity%20Wholesale%20Market%20Volume.pdf.

One widely used indicator to assess market liquidity is the churn rate. It is calculated as the ratio of the overall volume traded to total physical consumption. There is no consensus on a level of churn that indicates sufficient market liquidity, but a churn rate of three is considered the minimum value (ACER/CEER, 2021[15]). Ukraine's average churn rate of two (see Figure 4.8) means that electricity

"changes hands" twice before reaching end consumers. The churn rate decreased throughout 2021, indicating a lower level of trading activity.

Considering the DAM specifically, Ukraine has a relatively low churn rate compared to other European countries, despite its regulatory obligation for the sale of a certain share of generation on the DAM. The intraday churn rate in Ukraine is more in line with the average in other countries (see Figure 4.9). This is likely because the price cap on the IDM is above the DAM cap, encouraging generators to shift volume from the DAM to the IDM.

Figure 4.9. Churn rates on the day-ahead and intraday markets



Sources: Market Operator (2023[16]), DAM/IDM Analysis, https://www.oree.com.ua/index.php/web_monitoring_dtorg_year/index_year_dam; ACER/CEER (2021[14]), Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2020, https://acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Market%20Monitoring%20Report%202020%20%E2%80%93%20Electricity%20Wholesale%20Market%20Volume.pdf.

4.4. Regulatory intervention affecting competition

Competition in wholesale electricity markets is often strongly affected by regulatory interventions. They can safeguard, induce but also hinder competition. They may seek directly to ensure the competitive functioning of electricity markets or, as is often the case, serve other public policy objectives.

In Ukraine, the most important regulatory interventions affecting competition are wholesale price caps and the PSOs for households and renewables. Price caps aim to prevent abuses of market power in the form of excessive prices. The PSOs serve public policy objectives and do not aim to improve competition.

4.4.1. Wholesale price caps

Wholesale price limits were introduced at the initial stage of market liberalisation as a temporary measure to safeguard against potential price increases and spikes. Although they are still treated as temporary, they have become a permanent feature of Ukraine's electricity market.

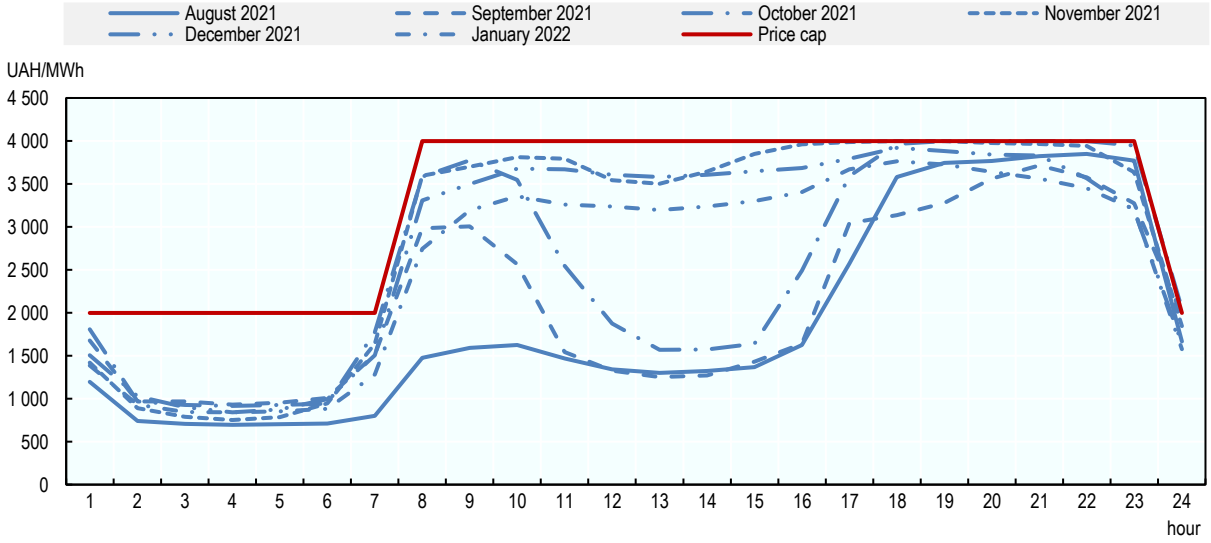
There are minimum and maximum price limits, but the minimum limits have had no significant impact on price formation. The maximum limits, or caps, however, have materially limited price formation in the wholesale market.

Frequent changes in the caps illustrate the difficulty of reconciling them with the efficient functioning of the market.

Price distortions

Figure 4.10 shows the DAM price caps and average hourly prices for the IPS trade zone. In October and November 2021, average prices reached the price cap between 6 p.m. and 10 p.m., suggesting that price formation was affected by the price cap during this period. In the other months depicted and during other hours, the cap was not reached.

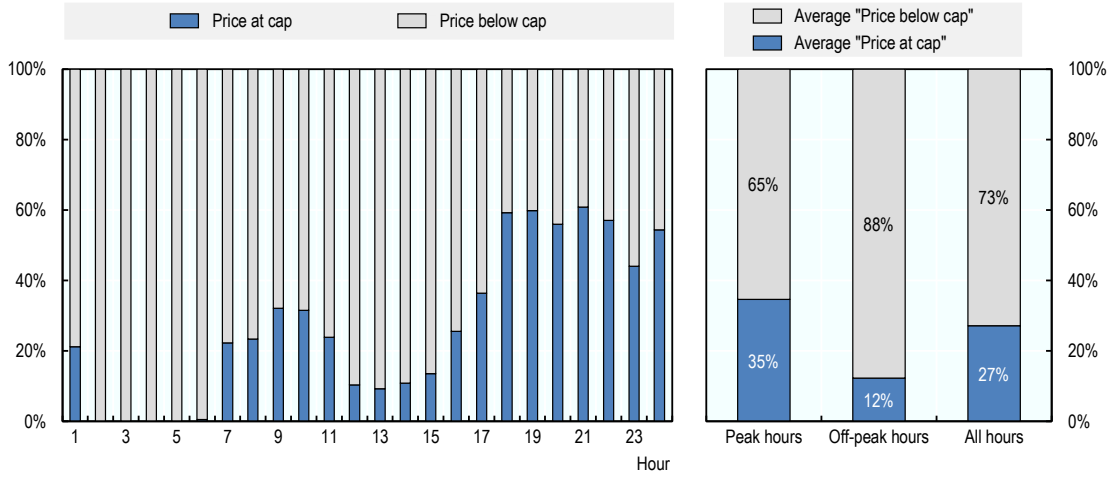
Figure 4.10. Price cap and monthly average prices on the DAM (IPS trade zone), August 2021-January 2022



Source: Market Operator (n.d.[17]), Hourly electricity purchase and sale prices on DAM, https://www.oree.com.ua/index.php/pricectr.

By looking at actual prices, rather than the average, the effect of price caps becomes more visible. Figure 4.11 shows the distribution of hourly prices between August 2021 and January 2022, covering the period after the latest change in price caps until Russia's large-scale invasion in 2022. Prices "at cap" mean they deviated by no more than 1% from the cap. The data shows that prices reached, or almost reached, the cap during 35% of peak hours, 12% of off-peak hours and during 27% of all hours. Between 6 p.m. and 10 p.m., more than half of prices reached the cap, suggesting strongly that price formation was affected during a significant number of hours, at least during the period shown.

Figure 4.11. DAM prices affected by the cap, August 2021-January 2022



Note: "Price at cap" is when the actual price is maximum 1% below the price cap.
Source: Market Operator (n.d.[17]), Hourly electricity purchase and sale prices on DAM, https://www.oree.com.ua/index.php/pricectr.

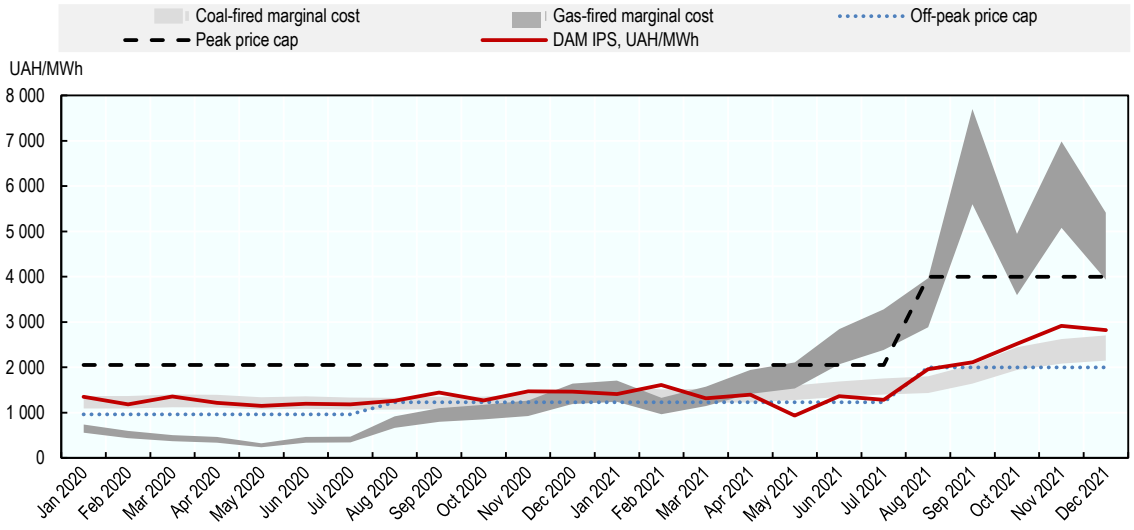
Overall, it appears that price caps prevent market-based price formation and affect prices to a significant extent, especially during peak hours. By preventing price peaks, they reduce incentives for demand response by large electricity consumers and to a lesser extent by residential consumers. Further, they hinder the emergence of new business models relying on prices reflective of supply-demand conditions, such as arbitrage using energy storage technologies, fast-start peak generation and aggregators. By allowing free price formation, both competition and the flexibility of the power system would improve.

Cost recovery and hidden costs

The methodology behind the calculation of Ukraine's price caps has never been officially disclosed, but it appears that they are based on the costs incurred by coal-fired power plants.

Figure 4.12 shows DAM price caps and the estimated marginal costs of coal and natural gas power plants. In 2020, the peak cap (the cap for hours of maximum load) was well above the marginal costs of coal-fired plants, while the off-peak cap (the cap for hours of minimum load) was somewhat below. To the extent that peak demand is met by coal-fired power plants, price caps set in such way should not substantially alter price formation. However, Ukraine's peak demand is met not only by coal-fired plants but also natural gas-fired plants. This was not relevant for price caps as long as natural gas prices were relatively low and the marginal costs of gas-fired plants were below those of coal-fired plants. But that changed towards the end of 2020, when the marginal costs of natural gas plants rose above those of coal-fired plants.

Figure 4.12. Comparison of price caps and estimated marginal costs, 2020-21



Note: Assumes procurement by coal-fired plant operators of 75% domestic and 25% imported coal.
Source: IEA, UEEX, NEURC, Ministry of Energy.

Following the increase in natural gas prices, international coal prices started to rise from the second half of 2020. At the end of July 2021, NEURC increased the off-peak price cap by 28%, but this did not fully offset natural gas price increases. As a result, the marginal costs of gas-fired power plants rose above the peak price cap around May 2021. This made the operation of natural gas-fired plants uneconomical, limited the ability of dual-fuel power plants to switch to natural gas, and gas-only combined heat and power (CHP) plants were unable to recover their costs.

To address this, NEURC issued a temporary order for the purchase of ancillary services, specifically the provision of replacement reserves, at the end of 2021.[8] This was introduced for gas-fired CHP plants and thermal power plants in case they were required to meet the balancing needs of the system or if there were coal shortages. The measure was financed via the TSO's dispatch tariff collected from network users (generators and DSOs). It provided additional income for certain producers and alleviated some of the financial problems they faced. However, it also created an additional source of market distortion by concealing the real price of electricity, and was discriminatory as it was available only to certain producers.

Any potential entrant would receive false signals on which type of generation was required or how it would be priced. With increasingly variable power generation, accurate price signals are critical to encourage market participants to adapt generation or consumption in close to real time, and to promote investments in flexible units of all types, including demand response and energy storage.

Focal points for tacit collusion

Price caps may affect the bidding behaviour of market participants in ways more subtle than simply preventing bids above the cap. A price cap can become a focal point for bidding and may lead to higher prices than the absence of caps. The risk can be highest when sellers expect the "true" market price to be somewhat below the cap. In such cases, it may be tempting to adjust bids upward and bid at or just below the cap. If several sellers engage in this strategy, they can push the price above its competitive level. In other words, the presence of a price cap price can facilitate tacit collusion as it offers a reference point for co-ordinated behaviour. In practical terms, price caps reduce the large number of electricity prices at which sellers may attempt to tacitly collude to one or two well-known prices, namely the peak and off-peak price

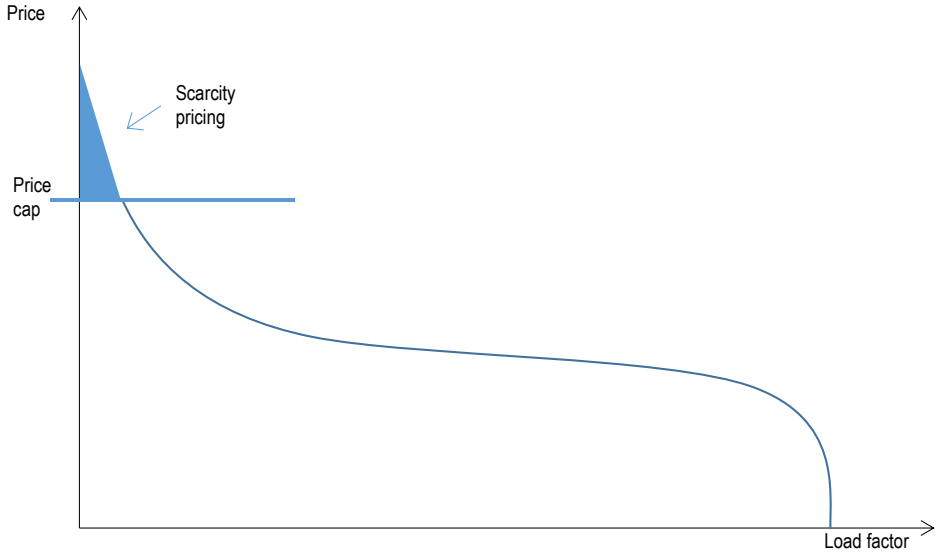
caps. In the Ukrainian context, some producers may also consider it justified to bid above their marginal costs because they may believe that price caps unfairly limit their revenues.

No scarcity pricing and the "missing money" problem

In competitive electricity markets, most producers bid at the level of their short-term marginal costs – the costs related to generating each additional MWh. The capital costs of inframarginal producers are recovered during hours when prices are set by higher marginal cost producers. The capital costs of marginal producers are recovered during hours when scarcity prices occur. Scarcity pricing occurs when market prices rise above the marginal cost of the marginal unit, under conditions in which the system lacks generation capacity to meet high demand. Scarcity pricing is necessary to generate profits to cover the capital costs of marginal producers.

Scarcity pricing is a natural occurrence in the market, as short-term price spikes reflect the mismatch between supply and demand during certain hours. By avoiding price spikes through price caps, a "missing money problem" may occur in electricity markets. This refers to unrealised revenue from high prices that is needed to cover the long-term marginal costs of some generators (see Figure 4.13). This revenue is crucial to incentivise optimal levels of investment. If high prices and corresponding revenues during times of scarcity cannot be collected, generators may be tempted to bid above their short-term marginal costs, resulting in higher average electricity prices.

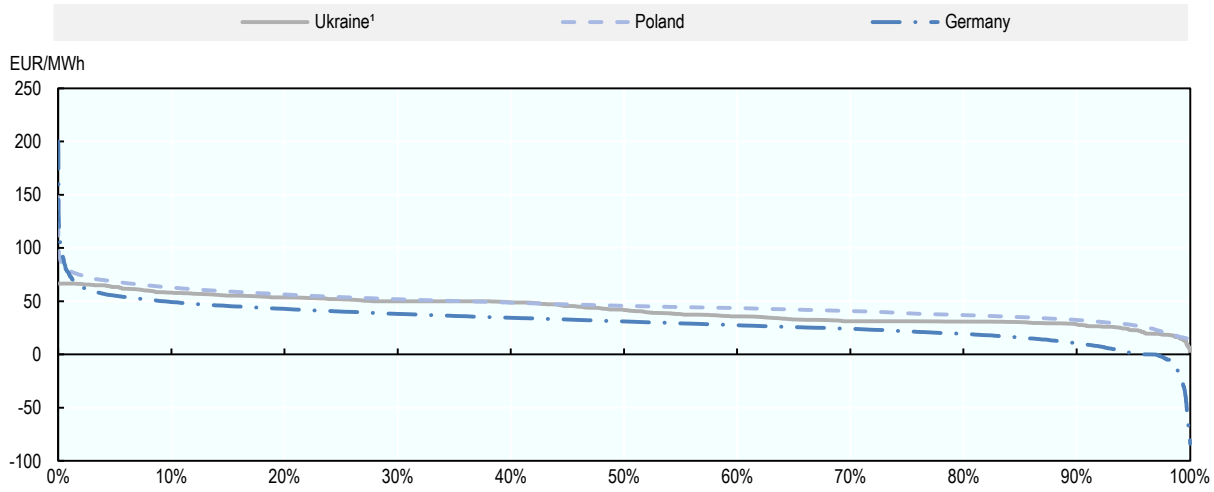
Figure 4.13. Illustration of the "missing money" problem



Source: OECD based on Grigorjeva (2015[18]), Capacity mechanisms in the Eu: Nationalizing energy security?, https://www.researchgate.net/publication/304668651_CAPACITY_MECHANISMS_IN_THE_EU_NATIONALIZING_ENERGY_SECURITY.

In Ukraine, price caps do not allow scarcity prices. Figure 4.14 shows the overall distribution of day-ahead prices in Ukraine, Poland and Germany in 2020.

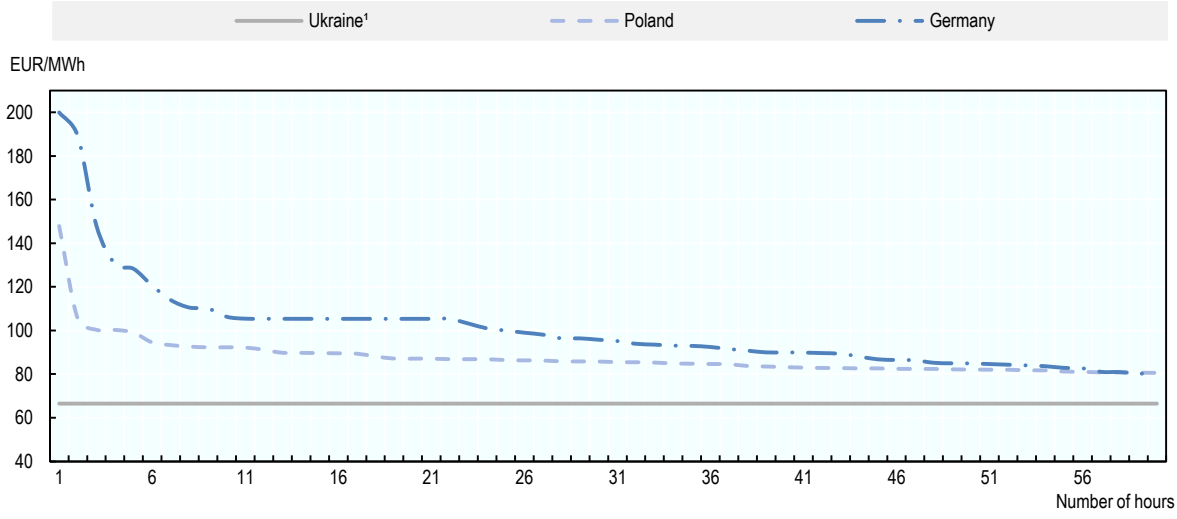
Figure 4.14. DAM price duration curves, 2020



1. IPS trade zone.
Source: ENTSO-E (n.d.[19]), Day-ahead Prices, https://transparency.entsoe.eu/; Market Operator, (n.d.[17]), Hourly electricity purchase and sale prices on DAM, https://www.oree.com.ua/index.php/pricectr.

When disregarding the highest and lowest 10%, prices in Ukraine and Poland were approximately within a range of EUR/MWh 60-30, and in Germany of EUR/MWh 50-10. However, when looking at top and bottom prices, the prices differ widely. Figure 4.15 shows the price duration for the most expensive 60 hours. Prices in Ukraine reach their maximum at 67 EUR/MWh, 1.6 times above the average. In Poland and Germany, prices not constrained by caps rose to 3.2 and 6.7 times higher than the annual average price.

Figure 4.15. Snapshot of price duration curves, 2020



1. IPS trade zone.
Source: ENTSO-E (n.d.[19]), Day-ahead Prices, https://transparency.entsoe.eu/; Market Operator (n.d.[17]), Hourly electricity purchase and sale prices on DAM, https://www.oree.com.ua/index.php/pricectr.

It is noteworthy that despite very high prices in some hours, the average price in Germany was lower than in Ukraine. This is partly due to some very low, negative prices.

The absence of scarcity pricing means accurate price signals are not sent to the market, which may hinder new entries as investors are unable to rely on scarcity events to generate additional profits. Also, without the ability to recover capital costs during scarcity hours, generators may be tempted to incorporate capital costs into their bids, potentially pushing average prices higher.

Limitation on cross-border commercial electricity flows

Price caps also affect cross-border electricity trading. In a free market, electricity is exported or imported depending on price differentials across interconnected countries, with electricity flowing from a country with low prices to one with higher prices. If electricity prices in neighbouring countries are market-based, cross-border trade increases total welfare and both exporting and importing countries benefit. However, when prices in one country do not reflect supply and demand, this is not necessarily true.

In Ukraine's case, price caps create distorted export opportunities and increase the profits of companies exporting electricity. At the same time, price caps can prevent or reduce imports, indirectly increasing the price of electricity in Ukraine and possibly undermining the security of supply.

European price limitation practices

EU Regulation 2019/943[9] on the internal market for electricity states that administrative and implicit price caps should be removed to allow scarcity pricing in the wholesale market. It does, however, allow for the application of technical bidding limits for the day-ahead, intraday and balancing markets. These should not "unnecessarily restrict trade and shall be harmonised for the internal market and shall take into account the maximum value of lost load". To this effect, it requires the implementation of a transparent mechanism to adjust automatically the technical bidding limits in the event they are expected to be reached.

The value of lost load (VoLL) is an indicator of the costs associated with an interruption of electricity supply, in other words, it is the average value consumers place on continued electricity supply.

ACER set the following harmonised minimum and maximum technical bidding limits:

- [-500, +4 000] EUR/MWh for single day-ahead coupling[10]
- [-9 999, 9 999] EUR/MWh for single intraday coupling[11]
- [-15 000, 15 000] EUR/MWh as transitional limits until July 2026, for balancing energy and cross-zonal capacity (based on average maximum VoLL among EU member states).[12]

The limits for the day-ahead and intraday markets are not explicitly based on VoLL but the automatic adjustment mechanism ensures that they do not restrict free price formation.

In contrast to Ukrainian practice, EU price caps are not intended to prevent suppliers from bidding at prices well above the average level. The risk of significant deviations from marginal costs and abuses of market power is addressed by monitoring and regulatory action under REMIT and by competition law enforcement.

4.4.2. Public service obligations

Ukraine's PSO for households affect both the wholesale and retail markets. The PSO for renewables affects the wholesale market but has implications for the finances of several key market participants.

PSO for households

As explained in Section 3.3.1, the PSO for households envisages direct sales of electricity by Energoatom to universal service suppliers (USSs) at average DAM prices, and to the DSOs at regulated prices below

the market price. Based on 2021 market volumes, this amounts to around 4 GW baseload capacity withdrawn from the competitive wholesale market and is equivalent to around 20% of all electricity injected into the grid, or 37% of Energoatom's net output.[13] At the same time, demand is reduced by the same amount. From the merit order perspective, the reduction of supply with low marginal costs and the equivalent reduction of demand should not significantly affect day-ahead prices. The main negative effect is a reduction in overall market liquidity.

Regulated access to the output of a company with unique access to resources exists not only in Ukraine but also in other countries, as in France's *Accès régulé à l'énergie nucléaire historique* (AREHN) or Regulated Access to Incumbent Nuclear Electricity, scheme (see Box 4.4). Such regulations aim to share the benefits of historical investments with consumers and reduce cost advantages over potential competitors.

Box 4.4. Regulated access to nuclear power in France

ARENH is a mechanism in France that allows electricity customers to benefit from historical investments that they have partly financed while at the same time allowing liberalisation of the electricity market by transferring the cost advantage of incumbents to other suppliers and new market entrants.

Under ARENH, the prices and volumes of regulated products were set administratively. Market-dominant generator EDF was obliged annually to sell up to 100 TWh of its nuclear production, around 25% of its average production, on demand to its competitors at a regulated price. The access price was set at a level ensuring fair compensation for EDF by a joint act of the ministers for economy and energy, proposed by the energy regulatory authority. Only suppliers serving final customers in France are entitled to benefit from the ARENH mechanism, with volumes proportional to their domestic customer base, and network operators for covering network losses. The measures must be limited in time (ARENH was set up for 15 years until 31 December 2025) and are subject to regulatory monitoring and review. The measures were notified and cleared by the European Commission as a PSO and comply with EU state aid rules.

It should be noted that the French competition authority has been critical of the ARENH mechanism and is of the opinion that it has not achieved the initial objectives set by legislators.

Source: Ambec and Crampe (2019[20]), Regulated Access to Incumbent Nuclear Electricity, https://fsr.eui.eu/regulated-access-to-incumbent-nuclear-electricity/.

The latest form of Ukraine's PSO for households combines supplies of baseload energy with financial contributions. This design has several drawbacks:

- Regulated prices for households do not cover the full cost of the electricity supplied (i.e. the sum of the cost of production, network tariffs and suppliers' margin).
- All household consumers benefit from the subsidy, independent of their income levels. Vulnerable consumers are not defined in the legislation. This increases the cost of the scheme.
- Artificially low prices for households reduce incentives for energy efficiency. They also reduce incentives to invest in small-scale renewables for self-consumption.
- Artificially low prices send distorted signals on choices between energy sources, i.e. whether to use electricity for heating or natural gas. This reduces the long-term elasticity of electricity demand.
- Artificially low prices for households reduce the scope for competition in the retail market.
- The PSO for households reduces liquidity in the wholesale market as around 20% of electricity volume is withdrawn from competitive trading.

- It creates financial liquidity problems for USSs as they must finance the difference between the prices at which they procure electricity and sell it to households. Eventually, Energoatom pays the difference (through the GB), but that can take several months.
- The PSO for households hides the total cost of regulated prices from taxpayers and citizens.
- The PSO for households is exposed and vulnerable to changes in market conditions. Household electricity prices are fixed while the cost of the mechanism is not. The cost varies with changes in wholesale electricity prices, TSO and DSO tariffs. For example, the cost of the mechanism increases when average market prices rise. Further, even when the cost is stable, the relative financial burden of the mechanism, borne by Energoatom and Ukrhydroenergo, can change. Whenever Energoatom or Ukrhydroenergo's production declines, they must use a larger share of their output and revenues for the mechanism.
- The PSO for households reduces Energoatom and Ukrhydroenergo's profitability and their ability to invest.

PSO for renewables

The design of the PSO for renewables requires renewable energy sources (RES) producers with the "green" tariff to sell their output to the GB, increasing concentration in the wholesale market. Further, RES producers cannot offer balancing services on a competitive basis. Instead, they are curtailed by the TSO when required, de-facto providing downward balancing services.

Since August 2022, RES producers can temporarily opt out of the renewable support scheme and the GB's balancing group and trade directly in the market. By the end of August 2022, a few dozen companies – mostly mid-sized solar producers – among almost 1 000 had decided to do so (Energy reform, 2022[21])

A switch to direct marketing by a significant number of RES producers would benefit competition by encouraging more diverse bidding strategies. Direct marketing for RES producers would also create stronger incentives to reduce forecasting errors and thereby lower the cost of balancing.

4.4.3. Rules for the bilateral agreement market

The bilateral agreement market (BAM) is Ukraine's biggest electricity market by sales volume. Most bilateral trading takes place on the auction platforms of the UEEX. Nevertheless, the BAM does not offer sufficient liquidity or depth, due to three main factors.

First, auctions at the UEEX are separated into a special section and a commercial section, the former being even further segmented. The separation between the sections and segments is legally imposed. Participation in the special segment is limited by legislation. De facto, the different parts of the UEEX are separate marketplaces. The only market-based part is the commercial section, where less than 20% of bilateral contracts are concluded by volume, meaning that the space for actual competition on the BAM is much reduced.

Second, the UEEX suffers from low level of standardisation. There are standard sales schedules (base, peak and off-peak) but many contract terms (such as payment terms, guarantee fees, additional conditions and delivery terms) are set by initiators of auctions. On the one hand, this flexibility is a welcome feature of bilateral contracts. On the other, it can be used to restrict equal access to electricity and negatively affect competition.

Third, regulatory uncertainties may discourage market participants from concluding longer-term bilateral contracts. In particular, market participants may be wary of changes to price caps. As a result, bilateral contracts tend to have a duration of one month or less in the commercial section. This makes the long-term procurement of electricity very risky.

In 2022, the UEEX introduced a platform with standardised products and a more trading-friendly design. It had not been used at the time of writing.

4.5. Barriers to entry

Ease of market entry is an important aspect of competition, limiting the ability of incumbents to sustain prices above competitive levels for significant periods of time. Even potential entry can deter the exercise of market power by incumbents because high profits resulting from high prices rather than efficiency often bring new participants into the market, reducing profit margins. Barriers to market entry are therefore a major competition concern over the long term. Many markets feature at least some barriers that make entry difficult.

Barriers to entry can be structural, legal or regulatory, or a combination of these. Structural barriers consist of absolute cost advantages, substantial economies of scale, capacity constraints, high sunk costs, and circumstances in which the provision of an output requires an input that cannot be technically or economically duplicated. Legal or regulatory barriers result from legislative, administrative or other measures that have a direct effect on the conditions of entry and/or the positioning of participants in the relevant market, including price controls or other price-related measures.

Competition in the electricity sector crucially depends on the distribution of generation assets such as power plants. Barriers to creating new generation capacity can be a major impediment to competition.

In Ukraine, investment opportunities in new generation capacity are limited by several factors. Certain fuels, such as water and coal, and access to nuclear technology are unlikely to be available to new entrants. Loans for coal-fired power plants are mostly unavailable from international banks. Price caps limit the profitability of generation assets, new and old alike. Before Russia's large-scale invasion in February 2022, there was also nominal overcapacity in the system that reduced incentives for new investment.

4.5.1. Non-replicable access to resources and limits to potential generation investment

Newly built power plants must be able to compete with incumbents' marginal costs. If some incumbents have a cost advantage that cannot be matched, it is unlikely that new entrants will constitute a source of competitive pressure.

Two of Ukraine's biggest players, Energoatom and Ukrhydroenergo, operate assets that competitors cannot duplicate due to a lack of access to specific resources: water flow from major rivers and nuclear technology. Most of the potential for large hydroelectric plants in Ukraine has been exhausted, and nuclear energy has very high barriers to entry.

Peak demand for thermal generation is met by coal-fired power plants. Domestic coal extraction is shared between DTEK Group and state-owned mines. Domestic coal is sold to incumbent coal-fired power plants at a lower price than imports. This means that any new investor in coal-fired generation will probably have to use more expensive imported coal, putting it at a competitive disadvantage.

Many international financial institutions have committed to ceasing investment in carbon-intensive projects, and every major development finance institution in the G20 has committed to ramping up support for green energy. It is therefore unlikely that new coal- and oil-fired plants can be financed in Ukraine, reinforcing the position of incumbent coal-fired generators in the market.

These barriers limit the range of technologies potentially available for investment in Ukraine, so new entry in the electricity market is likely to be limited to investments in renewables (excluding large hydro), modern storage technologies and gas-fired engines or turbines. Moreover, investments in gas-fired generation are

currently constrained by price caps that do not always allow the recovery of marginal costs (as discussed in Section 4.4.1).

Capital-intensive investments in renewables have relied on the green tariff support mechanism. This support scheme has proved to be very costly, and has led to late payment and non-payment of the promised green tariffs to RES producers. This has undermined investor confidence in Ukraine's renewables support mechanism and perhaps even in its electricity sector overall.

4.5.2. Nominal overcapacity in the power system

Growing demand for electricity offers greater opportunities for market entry as potential investors and incumbents compete on more equal terms to create new generation capacity. If demand is stagnant, new entrants find it hard to compete with incumbents – even more so if incumbents have spare capacity.

Overall installed dispatchable capacity in Ukraine before Russia's large-scale invasion was around 44 GW, while maximum demand in 2021 was 25 GWh. Before the invasion, Ukrenergo estimated annual demand growth of 1.5% for the next decade. Based on pre-war demand, this translates into 29-30 GW of peak demand in 2031 that would be sufficient to cover domestic demand, even if all export capacity were also used.

Since market liberalisation, no new capacity has been installed in Ukraine, except for renewables under support schemes and new pumped hydro plants built by incumbent suppliers. In fact, a significant amount of capacity is to be decommissioned. As member of the Energy Community, Ukraine is obliged to ensure that all large combustion plants meet EU requirements[14] on emissions limitations. In 2017, the Cabinet of Ministers of Ukraine (CMU) adopted the National Emission Reduction Plan[15] (NERP), setting out Ukraine's intention to significantly reduce emissions from existing large combustion plants. It identifies coal and gas-fired power to be successively decommissioned from 2018 until the end of 2033. Decommissioning has not proceeded according to the original schedule and in 2019 implementation of the NERP was postponed by two to five years. The Ministry of Energy proposed another postponement in 2020 (SaveDnipro, 2021[22]).

The government's policy has been to keep old power plants running for as long as possible while supporting investment in renewables. Amid overcapacity and lacking clear signals on the phase-out of old power plants, there has been no strong business case for new entries.

Discussions have taken place for years on the need for additional flexibility in Ukraine's power system (Natha, 2020[23]). In 2019, the CMU adopted a procedure for the construction of new generating capacity and demand management systems.[16] According to this, Ukrenergo can initiate a tender for the construction of balancing capacities with state support. Such tenders were announced several times, but they never took place. In principle, flexible capacity can and should be provided by the market and state support should be limited to special cases. Before implementing support through capacity mechanisms, efforts should be made to make market-based investments more attractive, in particular by removing price caps in the balancing market. Regarding the impact of flexible capacity on competition, it should be noted that such plants work relatively few hours and do not produce a significant amount of electricity annually. Such capacity would probably be offered in the balancing market and ancillary services, and not affect competition in the bilateral or spot markets.

Due to the war's dramatic impact on both generation capacity and demand, post-war, it will be necessary to reassess the need for additional capacity and the type of such capacity. To enable private investments, accurate supply and demand projections will be needed. Further, the role of state support for any new capacity needs to be decided and communicated.

4.5.3. Debt accumulation

The accumulation of significant debt in parts of Ukraine's electricity sector is a warning sign to potential investors. Without solving the underlying problems in a credible and sustainable way, attracting new investors will be challenging.

The financial and legal problems with the RES support scheme have been much publicised and are well known beyond the circle of existing RES producers. The large drop in electricity demand since February 2022 has also revealed a new financial threat to the RES support scheme. In theory, as total consumption decreases, the relative cost (i.e. cost per MWh) of the RES support scheme increases because the total cost is spread over lower total MWh consumed. In practice, huge damage to, and destruction of, solar and wind facilities has led to lower RES production, thus this problem has not materialised, even if for unfortunate reasons.

Non-payment problems in the balancing market are less widely known but pose a risk to wholesale market participants. Most non-payment can be attributed to customers of the supplier of last resort, namely Water of Donbass – a water supplier in the occupied territory of the same name – and state-owned coal mines. Coal companies cannot pay their electricity bills but, for environmental reasons,[17] legislation protects them from being disconnected from electricity supplies. The cost of supplying these companies ends up as an ever-increasing debt in the balancing market. According to Ukrenergo, that net debt had reached UAH 6.4 billion as of October 2022. (UAH 17.5 billion from market participants to Ukrenergo, UAH 11.1 billion of Ukrenergo debt to balancing service providers.) This creates problems for timely settlement with balancing service providers. Additionally, it makes it very difficult to increase or remove balancing market price caps. If caps were increased, the debt would increase even further and could undermine the financial stability of several market participants, including Ukrenergo, which performs several vital functions in the power sector. Without addressing the question of how to finance the debt source sustainably, a decision on abolishing price caps may be postponed indefinitely.

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Notes

[1] For more details see for example (Pham, 2019[24]).

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5 Assessment of the retail market

This chapter describes the division of the retail electricity market and the impact of this on competition. Supply to businesses is based on a competitive framework but low liquidity and other factors in the wholesale market limit the intensity of competition in this segment. The household segment shows no signs of competition due to the fact that prices are regulated well below market levels.

As described in Section 3.2, all electricity consumers in Ukraine are free to choose suppliers. This does not, however, mean that the retail market is fully open to competition. In fact, regulation divides the market into different segments with differing levels of competition.

Business consumers can be divided into two categories: small non-household consumers and medium-sized or large non-household consumers. Public institutions (also referred to as budgetary organisations) are treated as non-household consumers and, depending on their contracted capacity, fall into the small or medium-to-large category.

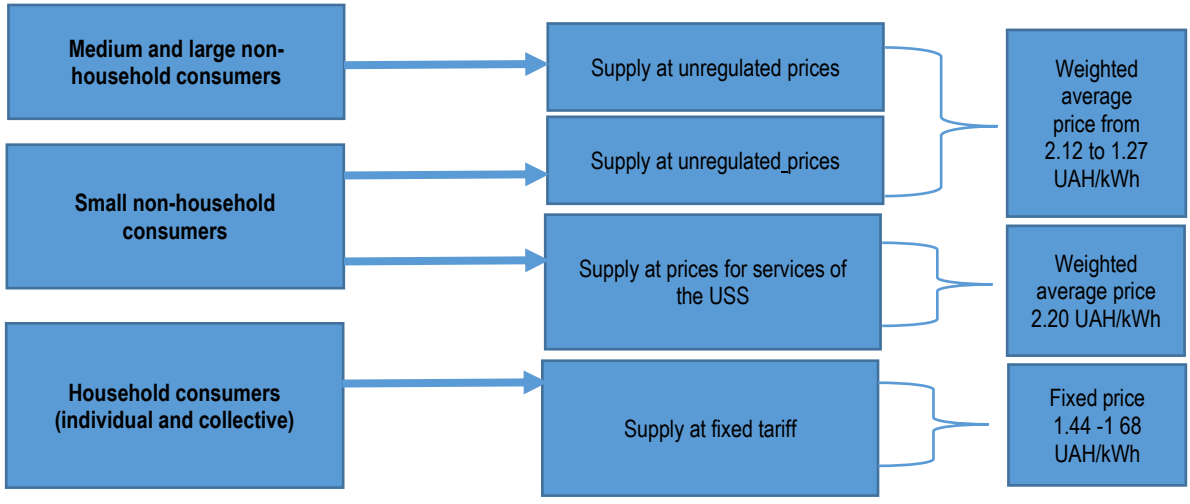
Businesses qualify as small non-household consumers if their connection to the electrical network has a contracted capacity of up to 50 kW. This status depends on the technical specifications of the consumer's equipment, which is included in the contract on the provision of distribution services concluded between the consumer and the distribution system operator (DSO). Businesses with contracted capacity of more than 50 kW are considered medium-sized or large non-household consumers within this classification.

Household consumers are divided into individual households that use electricity to meet their own needs and collective households – legal entities established to settle accounts for electricity consumed by groups of households.

All businesses have the right to purchase electricity from any licensed supplier by concluding contracts at unregulated prices. Small businesses additionally have the right to be supplied under transparent market conditions, which in practice means the right to be supplied by a universal service supplier (USS). Household consumers are also entitled to be supplied by a USS. For USSs, this translates into an obligation to supply small non-household consumers and households when requested.

The legal classification of electricity consumers has an important effect on the functioning of the retail market. Depending on the type of consumer, price formation and actual prices vary significantly (see Figure 5.1).

Figure 5.1. Customer categories and prices in Ukraine's retail electricity market



5.1. Business segment

The business segment comprises electricity supplies to all end users other than households, namely businesses and budgetary institutions. Prices in this segment are either unregulated or based on a methodology approved by the National Energy and Utilities Regulatory Commission (NEURC).

Electricity suppliers conclude network access agreements with those DSOs in whose area they want to supply customers. DSOs publish lists of suppliers that have concluded such agreements. DSOs are obliged to conclude such agreements on non-discriminatory terms with any suppliers requesting them. Since DSOs are unbundled, they have no structural incentives to discriminate and there are no indications of such behaviour taking place.

5.1.1. Supply at unregulated prices

The supply of medium-sized and large enterprises is the least regulated part of the retail market. Prices charged to such customers are unregulated.

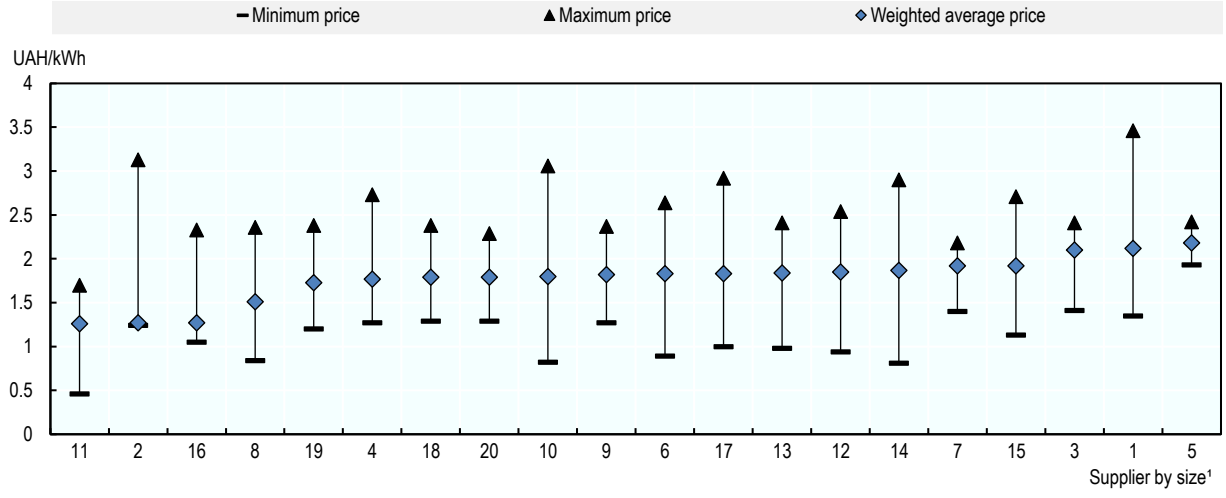
Supply at unregulated prices is usually based on standardised contracts, but conditions can be adjusted at prospective and existing customers' request. Standardised contracts are advertised as commercial offers. Suppliers have several commercial offers aimed at consumers with different consumption profiles. Small and medium-sized enterprises typically select commercial offers, while large enterprises may negotiate some adjustments to the standard conditions.

Suppliers are required to publish their commercial offers on their official websites. An exception is made for offers to large-scale industrial consumers with specific consumption patterns, the details of which are not required to be published. The main elements of commercial offers are stipulated by NEURC. Suppliers may offer fixed or variable prices. In the latter case, the elements of the price must be made explicit. This creates a relatively high level of transparency regarding the conditions offered.

To conclude a supply contract, consumers choose a commercial offer and send an application to enter the contract to the address of the supplier. NEURC publishes and periodically updates the list of suppliers with active commercial offers on its website.[1] The list provides only suppliers' names and links to their commercial offers on their own websites. As of 17 February 2022, 103 suppliers were fielding commercial offers. This had declined to 82 by 27 February 2023.

Figure 5.2 presents the minimum, average and maximum prices by Ukraine's largest retail suppliers to non-household consumers. The weighted average prices are between 1.3 and 2.2 UAH/kWh.

Figure 5.2. Non-household prices of the 20 largest suppliers in (excl. VAT and network tariffs), Q3 2021



1. The numbers indicate the suppliers' size. Number 1 is the largest supplier (by volume), number 2 is the second largest, etc.
Source: NEURC (2021[11]), Report on monitoring the functioning of the wholesale electricity market in the 3rd quarter of 2021.

A partial review of public commercial offers suggests that suppliers offer only variable prices. In fact, their offers show only price formulas without any quantification of the estimated price or price range. In terms of presentation and ease of use, the offers may be difficult for customers to access and understand. Suppliers' websites often contain several PDF documents describing general conditions and various public offers. The descriptions are complete, particularly in terms of commercial, technical and legal details of the contracts. No support in the form of simple descriptions or tools is made available to help prospective customers find the most suitable offers.

One mid-sized supplier, for example, has published 12 commercial offers on its website. It targets consumers with differing average monthly consumption over the past 12 months. Consumers must find the offer that most closely fits their consumption patterns, which requires opening and reading the descriptions. Customers then need to fill out an application form for an electricity supply contract (the request cannot be made online). The price is based on a formula plus a margin for the supplier. In contracts involving the largest volumes, the margin is 35 UAH/MWh. In those involving the smallest volumes it is 100 UAH/MWh. It should be noted that although the price formula is published, an estimated per MWh price is not. To learn final prices, customers must collect information from other sources, such as day-ahead prices published by the Market Operator and network tariffs published by NEURC, and make calculations themselves. This is feasible but time- and resource-intensive. For large enterprises with high electricity bills and dedicated purchasing departments, this should be manageable and worthwhile. Smaller enterprises may, however, be discouraged by the effort needed to compare offers and find the best option.

5.1.2. Supply at approved prices

Enterprises with contracted capacity not exceeding 50 kW can ask to be supplied by the USSs in their regions. Smaller enterprises and many public bodies, such as budgetary organisations, normally fall into this category of consumers.

The provision of universal services to such consumers must follow the price methodology set out by NEURC in 2018.[2]

The components of the price are:

- the price of electricity purchased by the USS under bilateral agreements and/or in organised market segments for supplying small non-household consumers (the price is assumed to correspond to the formula set out in the abovementioned procedure)
- the tariff for electricity transmission services
- the tariff for electricity distribution services (in case of connection to DSO networks) at the appropriate voltage class established by NEURC
- the tariff for the services of the USS.

USSs need to submit their price proposals to NEURC, which verifies the components, changes them if required, and approves the final price.

The weighted average price for universal services across all regions was 2 202.57 UAH/MWh (excluding VAT) in 2020. The largest component was USSs' purchase costs (64.6%), followed by tariffs for electricity distribution services (22.9%) and electricity transmission services (9%), and the margin for USSs (3.5%).

5.1.3. Competition in the business segment

At the end of 2021, Ukraine had 955 licensed electricity suppliers, 101 more than the year before. However, only 287 (30%) of licensed suppliers were active. (NEURC, 2022[2]) Active suppliers are counted based on NEURC's quarterly market monitoring. Suppliers that report at least one valid supply contract are considered active. The difference between active and non-active suppliers is explained largely by the fact that licensed

suppliers have the right – in addition to supplying retail customers – to purchase electricity on the wholesale market for their own needs or for resale. Many non-active suppliers are either industrial consumers purchasing electricity on the wholesale market to cover their own consumption or companies trading electricity on the wholesale market.

As of 31 December 2021, 38 291 contracts for the supply of electricity at unregulated prices had been concluded (NEURC, 2021[3]). More than 82% (31 555) of these had been concluded by suppliers performing the functions of USSs (NEURC, 2021[3]). The remainder (18%) had been concluded by fully commercial suppliers that did not provide universal services. At that time, Ukraine had 261 commercial-only suppliers and 25 USSs.

In terms of volume, supply at unregulated prices accounted for 66 503 GWh, 59% of the business segment. Universal service supplies accounted for 44 768 GWh, 40% of business segment (NEURC, 2021[3]). The remaining 1% was supplied by the supplier of last resort (561 GWh).

A significant part of the supplies at unregulated prices were provided by USSs acting as commercial suppliers. Overall, they had an 85% share of the business segment in volume terms, slightly higher than their share in terms of the number of contracts.

Before Russia's large-scale invasion of Ukraine, the number of business consumers exercising their right to switch suppliers had been increasing gradually (see Table 5.1). During 2021, 23% (32 802) of all non-household consumers changed suppliers.

Table 5.1. Evolution of supplier switching since market liberalisation

Figure	2019[1]	2020[1]	2021[1]
Number of active electricity suppliers	180	265	287
Number of non-household consumers that changed suppliers	6 563	12 498	32 802

1. Values are as of 1 January of the following year.
Source: NEURC (2022[4]), Bulletin to the Annual Report of NEURC, https://www.nerc.gov.ua/storage/app/sites/1/Docs/Byuleten_do_richnogo_zvitu/byuleten_do_richnogo_zvitu_nkrekp-2021.pdf.

In 2020, 6 946 complaints were received from consumers about changing suppliers (NEURC, 2021[3]). That was more than half the number of non-household consumers that changed suppliers. This suggests a high level of dissatisfaction among consumers with the procedures for changing suppliers. This situation is likely to improve with the roll-out of a simplified, automated procedure on Ukrenergo's Datahub platform. The testing of 11 new functions on Datahub, including changing electricity suppliers, began on 15 September 2022 (Ukrenergo, 2022[5]).

5.2. Household segment

The household segment of the retail market entails electricity supply to households. The supply side of the household segment consists of 25 regional USSs. Each USS has an exclusive supply territory – an administrative region, or *oblast* – in which no other company is authorised to supply electricity to households at regulated prices.

The demand side consists of individual and collective households eligible for supply at regulated prices.

5.2.1. Reasons for price regulation

The price for the supply of electricity to household consumers has remained regulated despite the liberalisation of Ukraine's electricity market.

Price regulation is considered economically justified in markets that are natural monopolies. In the electricity sector, transmission and distribution networks generally fall into this category, but the retail supply of electricity is not normally viewed as a natural monopoly. In Ukraine, the Electricity Market Law (EML) explicitly states that the supply of electric energy is a competitive activity.

Price regulation may also be justified in markets that lack effective competition. In such cases, regulation may be an appropriate tool to protect consumers against exercises of market power.

In liberalised electricity markets, there should be no significant administrative hurdles for companies to enter (or exit) the retail market and supply consumers. Setting up an electricity retail business requires expertise and investment, and fulfilment of special regulatory and administrative requirements. In Ukraine, retail electricity suppliers must be licensed, which represents an administrative entry barrier. However, none of the Ukrainian market's entry barriers appear insurmountable. In fact, as presented above, the presence of many licensed retail suppliers suggests that the regulatory and administrative burdens of obtaining licences are relatively light. Further, the fact that more than 200 suppliers are active in the retail market indicates that there is ample interest in supplying Ukraine's retail electricity customers.

In terms of business requirements, supplying electricity to households is not fundamentally different from supplying businesses, especially small enterprises. Retail suppliers currently active in the business segment are therefore well positioned also to supply households.

Overall, there are no clear indications that Ukraine's household electricity segment could not operate as a competitive market in the absence of regulated prices.

Box 5.1. EU legislation on price regulation

The legislation governing retail electricity prices in the EU is Directive 2019/944 on common rules for the internal market for electricity. As a general principle, it requires market-based prices for the supply of electricity and stipulates that "suppliers shall be free to determine the price at which they supply electricity to customers". This is based on the understanding that a fully liberalised, well-functioning retail electricity market stimulates price and non-price competition, and provides the right incentives for market entry and ultimately more choice and satisfaction for consumers.

The 2019 directive considers public intervention in market-based price formation "a fundamentally distortive measure that often leads to the accumulation of tariff deficits, the limitation of consumer choice, poorer incentives for energy-saving and energy-efficiency investments, lower standards of service, lower levels of consumer engagement and satisfaction, and the restriction of competition, as well as to there being fewer innovative products and services on the market". The legislation makes clear that public interventions in electricity prices are therefore justified only under certain conditions.

The directive recognises that a prerequisite for market-based prices is effective competition between suppliers, and it calls on EU member states to ensure that this condition is met. In the absence of effective competition, the directive permits public intervention in electricity prices for household customers and microenterprises, but only for a transitional period. During this period, member states must implement measures to achieve effective competition. Further, prices during the transitional period should be set above cost, at levels at which effective price competition can occur.

For the protection of energy-poor and vulnerable household customers, the directive advocates support through targeted social policy measures rather than public interventions in electricity price setting. It leaves the definition of vulnerable customers to the discretion of member states, but offers criteria such as income levels, energy expenditure as a share of disposable income, and the energy efficiency of homes as guidance.

Under special circumstances, the directive allows public service obligations in the form of price setting for limited durations. Market failures in which interventions by regulatory authorities and competition authorities have proven to be ineffective qualify as such circumstances, as do situations in which "supply is severely constrained, causing significantly higher electricity prices than normal".

Sources: Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU; Energy Community (2021[6]), Ukraine Annual Implementation Report, https://www.energy-community.org/dam/jcr:1731cc05-e414-47a8-95f8-4fb793fe0abd/IR2021_Ukraine.pdf.

In Ukraine regulated electricity prices are not set at the level of effective price competition and not even above cost. Further, the eligibility criteria for fixed prices are very broad, covering all private households and collective households. It appears that price regulation in Ukraine does not serve primarily as a protection against market power but as a tool to keep electricity prices below market-based levels. Although supporting the ability of households to pay for essential services such as electricity is a legitimate policy objective, price regulation is rarely, if ever, the most efficient way of achieving that objective.

Social policy – energy poverty

Electricity and, more broadly, energy are essential for everyday life. Energy bills often make up a significant share of household expenditure. This share varies significantly between countries, depending on average income levels, energy prices, climate and other factors. In the EU, electricity, natural gas and other fuels made up 4.3% of household expenditure in 2020, with the share ranging from 9.2% in the Slovak Republic to 2.2%, in Luxembourg (Eurostat, 2023[7]). Ukrainian households spent an average of 2.67% of their expenditure on electricity.

Under EU legislation, regulated electricity prices for energy-poor and vulnerable households are permitted, but only in exceptional situations and under strict conditions. The reason for this is that regulated prices create serious distortions of investment signals in generation and disempower consumers.

Ukraine has made some legislative progress towards defining the term "vulnerable consumer", but this concept was de facto replaced by a nationwide system of social support for certain categories of consumers. The main component of this system is a housing subsidy programme. Under the scheme, the state supports low-income families in paying for housing and communal services such as electricity, heating and water. Receiving such support requires making individual applications to social protection bodies that verify them and the fulfilment of certain criteria such as income per person. In principle, the housing subsidy programme could be extended to support vulnerable electricity consumers. It should be noted that the state budget is currently under huge pressure, which makes enlargement of the social support system very difficult. Since Russia's large-scale invasion, an estimated 44% of jobs in Ukraine have been lost and the poverty rate is expected to reach 58% in 2023 (World Bank, 2022[8]).

5.2.2. Costs and benefits of price regulation

Price regulation has kept Ukrainian households' electricity bills relatively low. In the absence of price regulation, the price of electricity for households would likely have been significantly higher. This represents a clear and significant benefit of price regulation. Administratively, regulated electricity prices are a simple way to make electricity affordable.

The benefits of price regulation should be balanced against its costs. The most obvious cost is the financial contributions paid by Energoatom and Ukrhydroenergo under the public service obligation (PSO) for households. Energoatom bears an additional cost in form of being constrained in selling its output at commercial terms. It is obliged to sell electricity to USSs to cover part of household consumption at a price linked to the DAM price. In absence of this obligation, it may be able to realise a slightly higher income,

which represents an opportunity loss. The OECD estimates the total cost to Energoatom and Ukrhydroenergo to have been around UAH 63 billion in 2021.

Energoatom and Ukrhydroenergo are both fully state-owned. Their profits and losses are attributed to the state, whose taxpayers ultimately bear and the cost of regulated electricity prices. The biggest beneficiaries of regulated electricity prices are households with high electricity consumption, which are often relatively wealthy. Regulated electricity prices therefore probably contribute to income inequality in Ukraine.

The financing and the effects of regulated prices on the electricity market are more complex and opaquer than direct support for electricity consumers by the state. The PSO for households depresses the revenues of Energoatom and Ukrhydroenergo, which reduces their ability to invest in modernising existing power plants and building new capacity. In case of Energoatom, the decommissioning of nuclear power plants will represent a huge cost in the future. Also, financing is needed for announced plans to build new nuclear units.

Another disadvantage of low regulated prices is that they do not encourage the economical use of electricity. Households are not encouraged to reduce their everyday consumption and invest in more efficient electrical devices.

5.2.3. Effects on competition

Regulated prices run contrary to the principles of a competitive retail market, distorting the production and consumption of electricity. When regulated prices are too low, retail suppliers will be deterred from competing for customers and may exit the market. When regulated prices are too high, benefits to consumers are reduced. Both excessively low and high regulated prices undermine the competitive functioning of the retail market. In theory, regulated prices could be set at the right level, but in practice, finding the right price is a daunting task that is most efficiently done by the competitive process.

Price regulation in Ukraine has de facto eliminated demand for commercial electricity supplies to households and in turn also supply. As long as regulated prices remain considerably below the market price, there is no prospect of competition in the household segment.

Finally, low regulated prices can also have negative consequences for investment into new power plants. They may be perceived as a sign of anti-market sentiment by prospective investors that may spread to wholesale markets.

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NEURC (2022), *BULLETIN TO THE 2021 ANNUAL REPORT OF NEURC*, https://www.nerc.gov.ua/storage/app/sites/1/Docs/Byuleten_do_richnogo_zvitu/byuleten_do_richnogo_zvitu_nkrekp-2021.pdf. [2]

NEURC (2022), *Bulletin to the Annual Report of NEURC*, NEURC, https://www.nerc.gov.ua/storage/app/sites/1/Docs/Byuleten_do_richnogo_zvitu/byuleten_do_richnogo_zvitu_nkrekp-2021.pdf (accessed on 23 February 2023). [4]

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World Bank (2022), *Ukraine Sectoral Briefs*, http://documents.worldbank.org/curated/en/099619207072274787/IDU0fe484568090020468 40bec102d3ffc294158. [8]

Notes

[1] NEURC lists the providers of commercial offers under https://www.nerc.gov.ua/sferi-diyalnosti/elektroenergiya/publichni-komercijni-propoziciyi/publichni-komercijni-propoziciyiyi.

[2] NEURC Decision No. 1 177 “On approval of the Procedure for forming prices for universal services”, 5 October 2018, https://zakon.rada.gov.ua/laws/show/v1177874-18#Text.

6 Other issues

This chapter covers three topics of great importance to Ukraine's electricity sector: effective market monitoring and surveillance, which are essential to reduce the risks of market manipulation; climate change, which requires decarbonisation of the global economy, mainly by the increased use of renewables; and the integration of Ukraine's electricity market with the EU electricity markets, which is not only a political priority for Ukraine but also a process with very significant benefits in terms of competition.

6.1. Market monitoring and surveillance

In the absence of a perfectly competitive market structure, markets must be subject to regular monitoring and surveillance to complement competition. The public interest in the uninterrupted supply of electricity calls for more intensive monitoring and surveillance of electricity markets than most other markets.

Market monitoring involves analysis of a market over a long period. Market surveillance, sometimes referred to as operational monitoring, has a shorter-term focus, looking at the behaviour of individual market participants and at market transparency.

Monitoring provides information on the structure and functioning of electricity markets, with regular reporting on such elements as liquidity, prices and market shares, and it enhances market transparency. This can benefit market participants and potential investors in their decision making. Market monitoring can also identify ways to improve market performance and serve as an input for policy makers.

Monitoring and surveillance are standard tasks of regulators in liberalised energy markets. With the liberalisation of Ukraine's electricity market in 2019, market monitoring and surveillance became key tasks for the National Energy and Utilities Regulatory Commission (NEURC).

6.1.1. Market monitoring

Ukraine's electricity market monitoring system corresponds broadly to regulatory practices in OECD countries. The market regulator systematically collects, analyses and publishes data about the state of the marketplace.

The monitoring powers and responsibilities of NEURC are set out in Article 20 of the Law of Ukraine on NEURC[1] and Article 6 of the Electricity Market Law (EML). NEURC adopted a procedure for market monitoring defining the organisational setup for monitoring, the main monitoring indicators and uses of monitoring results for publication and internally.[2] For data collection, NEURC created reporting forms and detailed instructions for market participants on how to provide the requested data.[3] Market participants are required to fill out monthly, quarterly and annual reporting forms. The data collected on the forms serves as the basis for NEURC's monitoring activities and publications. NEURC publishes quarterly and annual monitoring reports covering both the wholesale and retail electricity markets. With the adoption of martial law, NEURC suspended publishing most of its regular reporting, including its monitoring reports.

One weakness in the monitoring process appears to be a lack of common and harmonised indicators across the retail and wholesale markets. Further, the calculation methodology for indicators such as the Herfindahl-Hirschman Index, the Pivotal Supplier Index and the Residual Supply Index has not been published. NEURC has stated that it uses the standard calculation methodology for these indicators, but the calculations may include assumptions and variations that are not obvious.

6.1.2. Market surveillance

Ex-post market monitoring by NEURC is supplemented by market surveillance, referred to as operational monitoring. The objectives of operational monitoring are to:

- increase the efficiency of the electricity market
- identify practices that lead to violation of market rules, distortion or restriction of competition in the electricity market
- inform the public about the functioning of the electricity market.[4]

NEURC collects information from market participants with primary data about the wholesale market, mainly the Market Operator (MO), the Transmission System Operator (TSO) and the UEEX. The MO provides information on the day-ahead market (DAM) and the intraday market (IDM), the TSO on the balancing

market (BM), cross-border capacity, imports and exports, and the UEEX on bilateral agreements on its platform. NEURC publishes the operational data it receives on its website[5] without accompanying analysis.

The MO, TSO and UEEX are responsible for surveillance of their respective segments. If they detect any signs of market manipulation, they must notify NEURC and the market participant suspected of engaging in manipulation by the following working day.[6]

In addition to the current national monitoring system, Ukraine must transpose European legislation on energy market monitoring as a member of the Energy Community. Such obligations relate primarily to the implementation of EU rules prohibiting market manipulation and include the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT), REMIT Implementing Regulation,[7] and guidance documents issued by the European Union Agency for the Co-operation of Energy Regulators (ACER).

Box 6.1. REMIT

REMIT was introduced by the European Union in 2011. REMIT's objective is to improve the system of monitoring and regulatory oversight of transactions involving wholesale energy. Given the direct effect of its provisions in EU countries, REMIT forms a common legal framework for increasing transparency, market integrity and consumer protection

REMIT is based on four principles:

- transparency: the obligations of market participants to disclose inside information
- integrity: explicit prohibitions of abusive practices in wholesale energy markets
- monitoring: comprehensive and effective monitoring framework for wholesale energy markets
- co-operation: close co-operation and co-ordination between ACER and national regulatory authorities (NRAs).

ACER is responsible for monitoring energy trading to detect and prevent trading based on inside information and market manipulation. ACER collaborates with the NRAs of EU member states.

The costs of ACER's market monitoring and surveillance activities (collecting, handling, processing and analysing information) are financed by a fee imposed on market participants.

Sources: EU (2011[1]), Regulation (EU) No 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011R1227&qid=1678963014787; European Commission (2020[2]), Commission Decision (EU) 2020/2152 of 17 December 2020 on fees due to the European Union Agency for the Co-operation of Energy Regulators for collecting, handling, processing and analysing of information reported under Regulation (EU) No 1227/2011 of the European Parliament and of the Council, https://eur-lex.europa.eu/eli/dec/2020/2152/oj.

As part of the transposition of EU legislation, the Ministerial Council of the Energy Community adopted a "light" version of REMIT.[8] Compared to the full version, REMIT Light contains fewer and, in some cases, simplified rules. Most importantly, it does not provide for:

- centralised data collection by ACER
- reporting obligations of market participants
- co-ordination of cross-border investigations (Hutarevych, 2022[3]).

REMIT Light represents a preparatory stage upon which case-by-case investigations can build, but efficient screening of all transactions requires the full implementation of REMIT.

After the adoption of the Energy Community decision on REMIT Light, Ukraine began the process of transposition. This required amendments to primary legislation and the development of corresponding secondary legislation. In particular, the following had to be defined and established:

- basic terms and definitions of the REMIT regulation
- requirements regarding the prohibition of manipulation in wholesale electricity markets and the handling of insider information
- the procedure for obtaining and handling information necessary for the performance of the tasks assigned by REMIT from market participants and persons who professionally organise trade in wholesale energy (including the determination of the procedure for establishing marginal fees for the services of persons providing information on behalf of participants in wholesale energy markets), and the system for protecting documents and information received
- the obligation of NEURC to create and ensure the operation of a registry of participants in the wholesale electricity market, in accordance with REMIT requirements
- strengthening the regulatory powers of NEURC to carry out investigations of the wholesale electricity market and to co-operate with regulators in neighbouring countries and other authorities regarding the implementation of REMIT.

NEURC started the process of developing and discussing secondary legislation on transparency. In 2019, NEURC issued a draft of a resolution on the approval of requirements for the prohibition and prevention of abuse in wholesale energy markets".[9] The resolution required changes in Ukrainian law that have yet to be legislated. The lack of legislative action has prevented the implementation of the REMIT provisions set out in the NEURC resolution. On 30 November 2021, the Energy Community issued a decision on the failure of Ukraine to comply with the Energy Community Treaty and called upon it to rectify the situation by 1 July 2022.[10]

Several draft laws on the implementation of REMIT provisions have been registered by the Verkhovna Rada, Ukraine's parliament. The Draft Law on Amendments to Certain Laws of Ukraine on Prevention of Abuse in Wholesale Energy Markets[11] passed a first reading by the energy committee on 20 September 2022 and was accepted by the Verkhovna Rada for further consideration and final adoption. The provisions of the bill have received NEURC's support and that of the Secretariat of the Energy Community, but they must be revised to accommodate comments received during legislative hearings and submitted by the energy committee before they can be made law.

Without the implementation of transparency and prevention of abuse rules in the electricity market, which are provided for by the REMIT legislation, a risk remains that NEURC will be unable to perform its monitoring and market supervisory functions effectively.

6.2. Electricity generation from renewable energy sources

Globally, the main motivation for supporting electricity generation from renewable energy sources (RES) is climate change and its negative consequences for the environment, economy and society. The biggest contributor to climate change, by a large margin, is the burning of fossil fuels (UN, 2023[4]).

Historically, the aggregate investment and operational costs of electricity generation from RES have been relatively high. However, as prices of solar and wind technology fall, the cost-competitiveness of RES generation has been gaining on that of fossil fuel-based generation. Given the high prices of natural gas and coal amid the war in 2022, the cost of electricity from solar and wind power plants was lower than that of power from coal and natural gas plants.

The improving cost competitiveness of RES power, combined with its lower carbon footprint, makes it an attractive option to satisfy growing demand. Russia's large-scale invasion of Ukraine brought to light

another advantage of RES: its role in energy security. RES power represents a vast, sustainable, domestic resource. Electricity generation based on locally available sources paves the way for less energy importation and increased energy security.

Currently, the RES technologies with the greatest potential globally appear to be wind and solar power. From a market perspective, they have the disadvantage of not being responsive to demand; they may generate power at full capacity when demand is low or at reduced capacity when demand is high, depending upon weather conditions, straining the flexibility requirements of the power system.

6.2.1. Efforts to fight climate change

Current and previous Ukrainian Governments have committed the country to joining global efforts to combat climate change by reducing greenhouse gas emissions. The government in 2017 set out its main decarbonisation strategy in the Energy Strategy of Ukraine until 2035 [12] and in the Nationally Determined Contribution of Ukraine to the Paris Agreement.[13] In 2021, Ukraine also declared its support for the European Green Deal.[14] As part of its strategy, Ukraine aims to reduce the carbon-intensity of its electricity supply.

To meet global and national targets for greenhouse gas reduction under the Paris Agreement, power generation and other parts of the economy must transition away from fossil fuels. According to the International Energy Agency, to reach global net-zero emissions by 2050, the share of renewables-based generation needs to increase from around 29% in 2021 to more than 60% by 2030 (International Energy Agency, 2021[5]). Yet the electrification of transportation, residential and industrial heating, and industrial production is expected to significantly increase global electricity demand.

Globally, the main types of RES for electricity generation are hydro power, wind power, solar technologies and bioenergy. All these technologies are present in Ukraine's generation mix and have the potential to be expanded. The largest RES in Ukraine's electricity mix is hydro power, followed by solar, wind and biofuels. The share of other RES is negligible. All renewables combined account for around 13% of the country's electricity generation in 2021. This lags the average of European OECD countries, which stood at 42% in 2020 and is also well below the global share of renewables, which was around 23% in 2019 (IEA, 2022[6]).

Box 6.2. Ukraine's RES potential

Ukraine has supportive conditions for the development of wind, solar and biomass generation, and its large geographical area offers plenty of space for the installation of RES facilities.

Table 6.1. Cost-competitive generation potential in 2030

Type	Best case	Worst case
Solar PV	88 340	54 948
Wind	858 107	856 411
Biomass	88 340	54 948
Hydropower[1]	14 114	

1. Medium cost scenario.
Source: IRENA, Joanneum Research and University of Ljubljana (2017[7]), Cost-Competitive Renewable Power Generation: Potential across South East Europe, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/IRENA_Cost-competitive_power_potential_SEE_2017.pdf.

The most substantial and promising source of renewable energy in Ukraine is wind. Onshore wind power could generate almost 860 GWh of electricity by 2030. The Black Sea also offers considerable potential for offshore wind generation, although its development may not be feasible in the short to medium term due to security concerns.

Ukraine's strong agricultural sector offers significant development potential for combined heat and power (CHP) generation from biomass. The greatest potential lies with agricultural waste from crops such as grain, sunflowers and rapeseed. These crops are grown in great quantities in many parts of Ukraine, providing sufficient fuel for biomass plants and allowing short transport routes. Biomass can also be turned into biomethane and biogas through gasification, replacing or supplementing natural gas. The most economical means of using biomass would be the combined production of heat and electricity.

Ukraine already had 6.3 GW of solar capacity installed before Russia's large-scale invasion in February 2022. Due to war-related damage to the electricity system, many Ukrainian homes and small towns are relying on solar energy to maintain power supplies. Since Ukrainian energy companies already have experience of building and operating solar energy, it may be the most immediately available renewable energy source for Ukraine.

Sources: GLOBSEC (2022[8]), Renewable Energy in Ukraine: A Solution for European Energy Security and for Shifting the EU GND Eastward, https://www.globsec.org/what-we-do/publications/renewable-energy-ukraine-solution-european-energy-security-and-shifting-eu#_ftn9; IRENA (2015[9]), REmap 2030 Renewable Energy Prospects for Ukraine, https://www.irena.org/Energy-Transition/Outlook/Renewable-energy-roadmaps; IRENA, Joanneum Research and University of Ljubljana (2017[7]), Cost-Competitive Renewable Power Generation: Potential across South East Europe, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/IRENA_Cost-competitive_power_potential_SEE_2017.pdf.

6.2.2. Cost competitiveness

The cost competitiveness of renewable generation has improved over the years. Subsidies have helped to increase supply and allowed companies to develop economies of scale and reduce costs. In parallel, the efficiency of renewable technologies has improved, which has further increased their competitiveness.

From 2010 to 2021, the cost competitiveness of renewables technologies increased sharply. The generation cost of utility-scale solar power plants plummeted 88% and that of onshore wind dropped 67% against the global weighted average levelised cost of electricity (LCOE[15]) for newly commissioned installations.

It should be noted that although LCOE is a useful metric, it does not fully capture all factors relevant to the assessment of energy projects' competitiveness. In particular, it does not take into account a technology's generation profile, which affects expected revenues. Wind and solar generation are driven by weather conditions rather than demand and market price. These technologies may therefore earn less than the average electricity price. Conversely, generation from fossil fuels and other dispatchable technologies, such as biomass power generation, energy storage can react to price signals by adjusting output. By producing more when prices are high, they can achieve above average prices, which translates into higher revenues.

The combination of lower renewables costs and high fossil fuel prices created a market environment in which solar photovoltaic and hydro power became cheaper on an LCOE basis than any new fossil fuel-fired power generation option in 2021. Geothermal and bioenergy remain, on average, more expensive than the cheapest fossil fuel-fired option (NEURC, 2020[10]). If fuel prices fall, however, that cost advantage may diminish or disappear. Nevertheless, the long-term global trend appears clearly to favour electricity generation from RES.

The global cost advantage of wind and solar projects does not necessarily apply fully to the situation in Ukraine. The cost calculation depends on key assumptions relating to the weighted average cost of capital (WACC), projects' economic lives, and operating and maintenance costs.

The global LCOE values calculated by the International Renewable Energy Agency are based on technology-specific WACC values, which are averaged and weighted across countries. The real after-tax WACC for Ukrainian wind and solar projects is 9.9%, which is above the global weighted average of 7.5% (IRENA, 2022[11]). This means the cost of capital for such projects is relatively high in Ukraine, which reduces their cost competitiveness.

Another relevant variable is inflation,[16] which is factored into real WACC. A surge in inflation increases real WACC and thus the cost of capital. For the types of renewables most relevant for Ukraine (wind, solar and hydro power) the cost of capital is the main driver of cost competitiveness. Since such generation facilities run on free fuel, construction costs are the biggest component of total cost. For coal and natural gas power plants, fuel cost makes up a large part of the total cost, and the share of capital costs is consequently much lower.

6.2.3. Power system flexibility and prices

In addition to costs, several other elements influence the competitiveness of renewables, including the existing generation mix, the regulatory framework, market design, and the level of electricity prices and their distribution.

Ukraine's electricity generation is dominated by nuclear and coal-fired power plants, whose combined share of total generation was 84% in 2020. These plants are most efficient when producing at or close to full capacity. They are relatively slow to adjust their output and cannot quickly stop or start production. Switching nuclear plants on or off can take several days.

Generation flexibility is an absolute necessity for any power system to ensure that supplies of electricity always match demand. In Ukraine's power system, the most flexible capacity are hydropower and natural gas power plants. Their share of total generation was 13% in 2020, By comparison, hydro power and natural gas accounted for 39% of total generation in European OECD countries (IEA, 2022[6]). To compensate for this, coal-fired power plants in Ukraine operate as flexible generation, even though this

reduces their technical efficiency. The relatively low share of flexible capacity in Ukraine represents a long-term technical barrier for the large-scale deployment of wind and solar power plants, whose output depends on weather conditions and is thus volatile. To compensate for this volatility, sufficient flexible generation capacity and/or storage must be built into the system. At the current level of wind and solar generation in Ukraine, this is a manageable issue, but power system flexibility must increase to permit the integration of much larger amounts of intermittent or variable RES generation.

System flexibility can be achieved by various means, such as adding flexible generation units and storage facilities, unlocking the potential of demand response, and expanding interconnection capacity. A larger and more integrated grid – especially beyond national borders – can reduce the aggregated variability of RES generation, particularly wind power. To maximise flexibility, increasing interconnection capacity is considered the best measure.

International experience shows that integrating a large share of intermittent RES into power systems is feasible. Wind power in Denmark, for example, comprises 57% of total electricity generation, and solar power accounts for 4% (IEA, 2022[6]).

RES generation with very low or zero marginal costs, such as hydro, wind and solar, contributes to lowering wholesale electricity prices. They push more expensive producers down the merit order, which changes the shape of the merit curve and the market price of electricity. As a result, it becomes feasible to satisfy demand with less expensive power plants. The lowering of electricity prices due to an increased share of renewables is called “the merit order effect“.

The merit order effect reduces the number of hours that the most expensive conventional power plants are required to operate. To ensure that such power plants remain available if they are truly needed, it may be necessary for prices to rise steeply during certain hours. If prices are capped, expensive peak-power plants will exit the market. High prices during certain hours do not necessarily mean high prices on average because of the price dampening effect of RES generation.

Under certain conditions, RES generation can create an oversupply of electricity in the power system. This occurs predominantly when demand levels are low and RES production levels are high. The normal market reaction to oversupply is a drop in price to levels at which supply and demand resume a balance. In electricity markets, this may mean negative market prices on the DAM or IDM. In recent years, negative prices have become a regular, albeit infrequent, occurrence in some countries. In the United States, for example, prices at wholesale market nodes were negative during about 4% of all hours in 2020 (Seel et al., 2021[12]). Negative prices accommodate not only short-term adjustments in supply and demand but also signal the need to invest in transmission and storage. Currently, the Market Rules for the DAM in Ukraine do not permit negative prices.

More generally, a high share of intermittent or volatile RES generation tends to increase price volatility. Although the merit order effect pushes prices down, scarcity during times of low RES output can create price spikes. These provide incentives to operate and invest in flexible generation, storage and demand response. Limiting volatility through price caps prevents markets from sending the correct signals, which may raise balancing costs in the short term and reduce the long-term flexibility of the power system.

6.2.4. Moving towards competition

Past problems with the “green” tariff mechanism, major difficulties arising from Russia’s large-scale invasion and future challenges for reconstruction require a significant revision of Ukraine’s RES generation policies. In particular, exposing RES producers and investors to competition needs to be part of a new approach to the use of RES in Ukraine.

Under the current support system, RES producers have been effectively excluded from direct participation in the wholesale electricity market, as only producers that sell their output to the Guaranteed Buyer (GB)

are eligible for the green tariff.[17] Amendments to the EML in July 2022 have allowed RES producers receiving the green tariff to leave and crucially to return to the support system and the GB balancing group.[18] Leaving the system means direct responsibility for marketing the electricity produced and for imbalances. Under normal circumstances, leaving the support system is not an attractive option for RES producers because the green tariff is higher than the market price. However, problems with non-payment and late payment may induce some RES producers to exit the system and to participate directly in the electricity market. The possibility of re-entering the support system under the same conditions reduces risk and makes it a realistic option. The only restriction is a 60-day waiting period to return to the green tariff system and the GB balancing group. Significant voluntary exits from the green tariff system would reduce the financial cost of RES support and ease the financial burdens on the GB and the TSO. The extent to which RES producers will opt to leave the support system remains to be seen.

Regarding future deployment of RES generation, an important decision has been taken to move towards a more competitive support system. The predetermined green tariff will be replaced by auctions for RES capacity. Auctions are a competitive bidding process for electricity from RES. The government issues a call for tenders to procure a certain capacity of renewables-based electricity. Project developers that participate in the auction submit bids with a price per unit of electricity at which they are willing to realise the project. The auctioneer evaluates the offers based on the price and other criteria and signs a power purchase agreement with the successful bidder.

Auctions have been successfully introduced in several countries to ensure the cost-efficient deployment of RES capacity.

The new auction system is coupled with measures to expose future RES producers to market competition. They will sell directly on the market rather than through the GB and will be responsible for their imbalances. This will incentivise RES producers – in particular wind and solar generators – to better forecast their output to avoid imbalance payments.

To take full advantage of the planned support mechanism, additional measures to stimulate the participation of RES producers in the wholesale market could be introduced. For example, RES producers could play an active role in the BM. Most types of RES generation have the technical capability to offer balancing energy, mostly in a downward direction by decreasing production. However, RES producers lack incentive to participate in the BM because the existing support mechanisms reward only electricity output. Thus, they have no interest in reducing their output even when the BM offers high prices for lower electricity input into the system.

Periods of excess electricity may occur not only in the BM but also in spot markets. If prices were allowed to turn negative, wind producers could benefit from lowering their output if the support system accommodated this.

In addition to specific measures to reduce the costs of RES generation, such as capacity auctions, and better integrate them into the wholesale electricity market, a stable and transparent regulatory system, a reduction of state and regulatory interference in the market mechanism, and further integration into the EU energy market will remain crucial for the deployment of RES in Ukraine.

6.2.5. Moving towards a level playing field (guarantees of origin)

The main advantage of RES generation is its carbon neutrality. Putting a price on greenhouse gas emissions would create a level playing field, internalising environmental costs and equalising the conditions under which RES and fossil-fuel generators compete. In principle, this could eliminate the need for supporting RES generation. In practice, it takes a long time to transition to a system in which the negative effects of emissions can be fully internalised without disrupting electricity markets and undermining the security of supply.

Nevertheless, preliminary steps towards creating a level playing field for all generation technologies can and should be taken. The least intrusive measure would be the introduction of guarantees of origin (GO), which would track the source of electricity to the power plant that produced it. A GO is an electronic document that provides proof to end users that a given share or quantity of energy was produced from RES. In essence, it is an electronic mechanism to track the origin of every MWh of power produced.

GOs give consumers the opportunity to be supplied with verified renewable electricity. For RES producers and suppliers, they provide a new means of differentiating their product and gaining additional revenue. It should be noted that GOs ensure that renewable electricity is produced, not that it is delivered to the buyer. Physically, all customers receive the same electricity fed into the grid. This means that GO trading is completely decoupled from physical power trading.

In the EU, electricity suppliers marketing their power as renewable need to prove this using GOs. This requirement was introduced in the Renewable Energy Directive[19] in 2001.

Ukraine has no functioning GO system, despite international obligations and attempts to set one up. As a contracting party to the Energy Community Treaty, Ukraine committed to implementing the EU's 2009 Renewable Energy Directive[20] by 1 January 2014,[21] which required that the origin of electricity produced from RES could be guaranteed.

In 2013, Ukraine undertook the initial legal steps for the introduction of GOs by amending the Law on Alternative Energy Sources and adopting[22] the procedure for issuing, using and terminating GO certificates. However, GOs were not implemented because the required electronic register was not created. Development and administration of the register was entrusted to the State Agency for Energy Efficiency and Energy Saving of Ukraine, which lacked the necessary legal powers to introduce the system and the institutional capacity and financial resources to implement it. Another aspect of the non-implementation of the GO system was its incompatibility with the single wholesale buyer market model in operation at that time, under which the single buyer did not consider the implementation of GOs a priority.

With the liberalisation of the electricity market, incentives to develop GOs were strengthened. Under the existing support mechanism for RES generation, GOs would offer the possibility of additional revenue for the GB as it could market its electricity as green and sell certificates to suppliers or businesses. RES producers outside the support mechanism could also profit. In the future, this could provide an important consideration for investment in RES.

Proposed EU legislation on the introduction of a Carbon Border Adjustment Mechanism (CBAM; see Box 6.3) may provide an additional incentive to implement GOs.

Box 6.3. EU Carbon Border Adjustment Mechanism

In July 2021, the European Commission published a proposal for a regulation establishing a CBAM. Although the legislative process remains ongoing, the regulation is expected to enter into force on 1 October 2023.

The aim of the CBAM is to limit the risk of carbon leakage from the EU to other countries by imposing a carbon tax on certain imported products. Carbon leakage occurs if EU companies move their production abroad to avoid the cost of CO2 emissions under the EU Emissions Trading System (ETS) or import products that are not subject to a carbon price in their country of origin.

The initial CBAM proposal covers five sectors: aluminium, cement, electricity, fertilisers, and iron and steel. The final scope could be broader as the European Parliament has proposed including organic chemicals, hydrogen and polymers. In the long run, it could be expanded to other sectors covered by the ETS, such as paper, glass and chemicals.

After a three-year transitional period with some reporting obligations, EU importers of the products covered will need to pay for embedded emissions by purchasing CBAM certificates.

Ukrainian products, including electricity, are particularly vulnerable to CBAM implementation. According to modelling results by (Chepeliev, 2021[13]), electricity exports could fall by up to 12% and exports of ferrous metals, petroleum products and chemicals would also suffer.

To avoid the negative effects of the CBAM on its exports, Ukraine could aim to fulfil the conditions for an exemption. Exemptions will be available to countries applying the ETS or operating a domestic ETS linked to it. Alternatively, Ukraine could be exempted from the CBAM if its electricity market were integrated with the EU market through market coupling and if it fulfils certain additional criteria. In both cases, a functioning GO system would be essential.

Sources: Chepeliev (2021[13]), Possible Implications of the European Carbon Border Adjustment Mechanism for Ukraine and Other EU Trading Partners, https://doi.org/10.46557/001c.21527; European Commission (2022[14]), Carbon Border Adjustment Mechanism, https://taxation-customs.ec.europa.eu/green-taxation-0/carbon-border-adjustment-mechanism_en.

The Ministry of Energy has published a draft law on amendments to certain laws of Ukraine regarding the introduction of the register of issuance, use and termination of the guarantee of origin of electric energy produced from renewable energy sources.[23] The draft law has been received well by some stakeholders, such as the European-Ukrainian Energy Agency. It does not address the question of how a Ukrainian GO system would link to the EU's GO market, but this issue is expected to be dealt with by secondary legislation. Joining the European Energy Certificate System would enhance greatly the benefits of a future Ukrainian GO system.

6.3. Integration with EU energy markets

6.3.1. Current status and recent developments

As described in Chapter 1 of this report, Ukraine and Moldova synchronised with the European Network of Transmission System Operators for Electricity (ENTSO-E) system[24] on 16 March 2022. The synchronisation project began in 2017, with finalisation foreseen in 2023. However, due to Russia's war of aggression against Ukraine, emergency synchronisation was implemented in March 2022, ahead of the initial schedule. This allowed Ukraine to disconnect from the electricity system of the Russian Federation

and Belarus and access mutual frequency stabilisation support[25] and emergency supply from European TSOs, increasing the country's security of power supply and system resilience.

The emergency synchronisation was later extended to allow for commercial flows. In mid-2022, after fulfilment of technical preconditions by all TSOs concerned, commercial exchanges of electricity between Ukraine/Moldova and neighbouring EU countries resumed. In the first phase, 100 MW of trade capacity between Ukraine and Romania was made available (ENTSO-E, 2022[15]).

Limited electricity exports from Ukraine to Poland resumed in March 2022 and this was followed by the opening of exports to the Slovak Republic in July 2022. Initially, upon the opening of trade with Romania, the available transfer capacity on interconnections was limited to 100 MW in both directions and allocated at daily auctions. From 5 September 2022, the available cross-border capacity between Ukraine and the ENTSO-E system increased to 300 MW during the day and remained 250 MW during the night (ENTO-E, 2022[16]).

Overall, cross-border electricity trade fell significantly in 2022 from 2021. Between March and August 2022,[26] Ukraine exported a total of 1 335 717 MWh of electricity to Poland, Moldova, Romania and the Slovak Republic, around half the amount sent during the same period in 2021 (EXPRO Consulting, 2022[17]). Total cross-border capacity also slumped, from close to 5 900 MW before the war to around 900 MW as of July 2022, and 1 100 MW (for export) and 1 300 MW (for import) as of September 2022 (Morawiecka and Savytskyi, 2022[18]). A large part of this reduction in cross-border capacity was due to the cessation of interconnections with the Russian Federation and Belarus, which together accounted for 75% of Ukraine's electricity imports in 2021.

The expected expansion of cross-border trade and closer integration with EU electricity markets would offer great potential benefits to Ukraine's electricity sector, which will likely experience significant development in the years ahead as a result.

Most evidently, Ukrainian generators with surplus capacity could take advantage of higher electricity prices in neighbouring countries. For instance, on 2 September 2022, electricity prices on the DAM in Romania, Hungary and the Slovak Republic were above 500 EUR/MWh, while in Ukraine it was 84 EUR/MWh. Increased export volumes would provide an important source of revenue for Ukraine's electricity sector, while reducing prices elsewhere in Europe and contribute to the diversification of energy supplies. At times, increased exports would result in higher wholesale prices in Ukraine, but this would be offset by higher export revenues. However, it is important to emphasise that this scenario relies on the assumption that Ukraine possesses excess capacity and will continue to possess it in the future, despite infrastructure damage and reconstruction requirements. It should also be noted that transmission lines to Belarus and the Russian Federation represented around 4.3 GW of cross-border capacity (Morawiecka and Savytskyi, 2022[18]). To compensate for the lost interconnectivity with the Russian Federation and Belarus, interconnections with ENTSO-E will have to be reinforced substantially.

Table 6.2 lists existing cross-border power lines as of July 2022. It is important to note that in June 2022, consultations on the Rzeszów-Khmelnytskyi line between Ukraine and Poland resumed. The line, disconnected in 1995 when Poland synchronised with the continental European grid, could be restored during 2023. This would provide additional capacity of 1 GW for cross-border trade, effectively doubling cross-border interconnection capacity with the EU. Moreover, with the goal of further expanding cross-border trade, Ukrenergo is working towards an increase in connectivity, extending its cross-border capacity allocation to other interconnectors.

Table 6.2. Ukraine's cross-border power lines

Interconnector	Voltage level	Remarks
Ukraine – Poland	220 kV	Radial connection to the Dobrotvir power plant
Ukraine – Poland	750 kV	Disconnected

Interconnector	Voltage level	Remarks
Ukraine – the Slovak Republic	380-400 kV	Burshtyn Energy Island interconnectors
Ukraine – Hungary	750 kV	
Ukraine – Hungary	380-400 kV	
Ukraine – Hungary	2 x 220 kV	
Ukraine – Romania	380-400 kV	
Ukraine – Romania	750 kV	Under construction

Note: Data reflects lines' status as of July 2022.
Source: Regulatory Assistance Project (2022), *Revitalising EU-Ukraine cross-border infrastructure for a secure, clean energy future* https://www.raponline.org/wp-content/uploads/2022/06/rap-etcu-ukraine-interconnectors-2022-july-8.pdf. Based on ENTSO-E data.

Table 6.3. Ukraine's net cross-border transmission capacity, 2021

Interconnector	Available cross-border capacity (NTC) in MW	
	Export	Import
Hungary	650	450
Slovak Republic	560	650
Romania	400	200
Poland	210	0
Moldova	550	1 200

Source: NEURC, "The Transmission System Development Plan for 2022-31", https://www.nerc.gov.ua/news/oprilyudnyuetsya-proekt-postanovi-shchodo-skhvalennya-planu-rozvitku-sistemi-peredachi-na-2022-2031-roki downloaded in January 2022.

Increased cross-border capacity to enable electricity trading is one of the key actions foreseen under the framework of the REPowerUkraine initiative, aimed at building a better energy system for Ukraine, with a focus on decarbonisation and energy independence (Morawiecka and Savytskyi, 2022[18]). The initiative will be launched in the context of the European Commission's Ukraine Relief and Reconstruction Communication[27] and the new EU External Energy Strategy.[28] The potential benefits of market integration for the electricity sector, as well as current and future obstacles, are addressed in more depth in Section 6.3.3.

6.3.2. Functioning of cross-border trade

The TSO Ukrenergo is responsible for the allocation of cross-border capacity on the Ukrainian side through annual, monthly and daily auctions, while the EML defines the legal basis for conducting such auctions.

Although the EML introduces the possibility of conducting both explicit and implicit auctions, the mechanism currently used in Ukraine for cross-border trading is unilateral explicit auctions. In explicit auctions, market participants acquire the right to utilise a portion of interconnection capacity, which they can use to transport electricity produced or bought. Electricity exports and imports thus depend on the acquisition of transmission capacity and electricity, which can result in an inefficient utilisation of interconnectors. Explicit auctions do not ensure that exports and imports replace highest-cost generation with the least-cost generation. For example, a generator in Ukraine might acquire cross-border capacity and utilise it even though another generator has surplus capacity with a lower marginal cost but cannot export it due to a lack of cross-border capacity. Implicit auctions, conversely, combine capacity allocation and cross-border trading by connecting day-ahead markets in different countries. An algorithm similar to the one used for day-ahead auctions ensures that cross-border capacity is used to reduce the overall cost of electricity generation in a larger area.

Based on OECD discussions with stakeholders, it appears likely that the introduction of implicit auctions will be technically feasible by the end of 2023. However, implementation requires more than technical preparedness. Most importantly, Ukraine needs to implement the framework underlying EU-wide single

market coupling, the Guideline on Capacity Allocation and Congestion Management.[29] The introduction of implicit auctions probably remains a medium-term prospect and a key step towards future market coupling.

The outcomes of Ukrainian cross-border auctions have been rather varied. For instance, in 2022, only one company, DTEK Zakhidenergo, obtained transmission rights to Poland in monthly auctions, while for transmission rights to Moldova, capacity was split on average between three or four companies each month. Daily auctions for Romania and the Slovak Republic have also been mainly dominated by DTEK Zakhidenergo. However, Energy Company of Ukraine (ECU), a new state-owned trader, entered the market in August 2022, purchasing electricity in the domestic market and participating in daily cross-border capacity auctions to Romania and the Slovak Republic. In its first month of activity (19 August to 20 September), ECU acquired around 50% of the available electricity export capacity for both countries. The electricity exported by ECU was purchased from Energoatom under market conditions through the Ukrainian Energy Exchange (Economic Truth, 2022[19]). Overall, the two biggest exporters account for around 81% and 88% of cross-border capacity for the Slovak Republic and Romania, respectively (in the period August-September 2022).

In addition to the new entrant, the second half of 2022 saw several changes to the rules governing Ukraine's electricity exports. On 7 July 2022, the Cabinet of Ministers of Ukraine adopted Decree No. 775,[30] which imposes special obligations on companies exporting electricity to the EU, to ensure the interests of the general public are served in the functioning of the electricity market under martial law. According to the decree, exporters are required to conclude a security agreement with the GB and pay it a fee that equates to 80% of the profits they derive from exports, according to the formula in Article 6 of the decree. The GB is obliged to conclude security agreements with any interested exporter without discrimination. It must transfer the funds received from exporters to USSs to compensate them for losses incurred by supplying households under their public service obligation. The TSO is required to ensure that only companies that have concluded an agreement with the GB participate in auctions for cross-border capacity allocation. Further, the TSO must provide the GB with information on each exporter's hourly volumes of exports by country.

Another development is the amendments to the Law on the electricity market of 19 August 2022,[31] allowing Ukrenergo to spend 45% of the revenue it has earned from cross-border capacity auctions over the three years until 31 July 2022 to pay for the services of electricity producers on the BM. Half of the funds from cross-border auctions could be used to pay the GB for increasing the share of RES in power generation. As a result, in the first two weeks of September 2022, the TSO paid UAH 3 billion to electricity producers on the BM and another UAH 3 billion to the GB.[32] It is important to note that these measures are temporary, implemented under the emergency conditions of the war.

6.3.3. Market integration and competition

Current and foreseen developments mentioned in the sections above have the potential to significantly change the competitive dynamics in Ukraine's electricity sector. On the one hand, the gradual opening of trade with the EU and future market integration can bring substantial benefits to Ukraine and its electricity companies. Ukraine can gain much-needed revenue by exporting excess electricity, imports from Europe can help to increase the security of Ukraine's supply during periods of high demand, and cross-border trading can enhance wholesale competition. On the other hand, the potential benefits of integration depend heavily on the development of Ukraine's electricity sector – in particular the impact of the war on generation capacity, and on current regulatory constraints affecting market outcomes and future regulatory developments.

As mentioned earlier, the TSO and exporters can reap the benefits of synchronisation and the expansion of cross-border trade in the form of additional revenue. Exporters would be in a position to take advantage of higher European prices while optimising the operation of their generation assets. It should be noted that this may imply higher wholesale prices in Ukraine. For renewable generators in particular, this could also

mean less frequent curtailment. From a TSO perspective, cross-border capacity auctions generate additional revenue, allowing Ukrenergo to improve its finances. Moreover, in addition to providing frequency support, synchronisation could optimise grid utilisation and provide additional flexibility and balancing options (Morawiecka and Savytskyi, 2022[18]).

Although these developments would benefit the sector, from a competition perspective, the potential gains are not entirely clear cut. Due to the low wholesale prices in Ukraine compared to EU prices, regulatory constraints such as price caps in wholesale markets, a poor investment climate and legal uncertainty, it is unlikely that cross-border trade alone will attract foreign companies entering the Ukrainian electricity market and thereby boosting competition. Even in the absence of war, the abovementioned factors could deter foreign companies from entering Ukraine's electricity market.

The possibility of exporting electricity from RES to the EU has the greatest potential for attracting private investment in new power plants. Financing conditions, political and increasingly consumer preference for electricity from RES combined with the generally good endowments of Ukraine for wind, solar and biomass make renewables more attractive than fossil-fuel power plants. A key requirement for improving investment conditions for RES would be the introduction of GOs (see Section 6.2.5). These could incentivise new entrants to the market for electricity generation that aim to profitably export some of their production. However, financing conditions in the country, issues with feed-in-tariff payments, a lack of established GO certification for RES generation, and unstable market conditions with poor legal underpinnings could undermine this potential, as has been highlighted by several stakeholders.

Another aspect to consider is that Ukraine may need electricity imports to meet domestic demand. If the extensive damage to thermal and renewable power plants and other infrastructure cannot be repaired relatively quickly Ukraine will turn into a net importer for some time. Further uncertainty stems from the disconnection of the Zaporizhzhia nuclear power plant, the largest nuclear power plant in Europe. How the balance between exports, imports and domestic generation capacity will evolve, and how this will affect competition dynamics, market concentration and prices, has yet to be assessed.

Overall, synchronisation with ENTSO-E and the gradual opening of cross-border trade through explicit auctions are important first steps for the future of Ukraine's electricity sector. Under current conditions, cross-border trade offers additional revenue and increased security of supply but is unlikely to significantly constrain the market power of electricity generators. Although an increase in the number of firms that compete at the wholesale or retail level can be achieved by facilitating cross-entry between market participants in neighbouring countries, this is unlikely to happen in the short term due to the war and the features of the market mentioned earlier. Moving towards market integration, these considerations will change, particularly if market coupling becomes a reality.

The use of implicit auctions for market coupling allows market participants to directly bid for electricity on the integrated DAM/IDM rather than receiving individual allocations of cross-border capacity. The available cross-border capacity is then taken into account by the exchange in order to calculate the clearing price, minimising the price difference between market areas. Forming an interconnected market, market coupling systems – which exist both for the DAM and the IDM – harmonise neighbouring countries' electricity exchanges and reduce price differences, providing a more efficient form of trade. Market coupling thus avoids splitting electricity markets according to geographical borders, permits generation capacity to be used more efficiently, increases liquidity in the DAM and the IDM, and can lead to enhanced competition by broadening the market area in which producers and traders can compete (Böckers, Haucap and Heimeshoff, 2013[20]). The non-coincident peaks in demand and the different marginal generation technologies in neighbouring countries can also be exploited through cross-border trading (Pollitt, 2019[21]).

Moreover, due to the flow of electricity from low-price areas to high-price areas, if performing as intended, market coupling leads to a degree of convergence between wholesale electricity prices, which can be regarded as an indicator of market integration (ACER, 2014[22]). For example, following the extension of market coupling from the Czech Republic and the Slovak Republic to Hungary in September 2012, full

price convergence between these countries doubled from 37% of all hours in 2012 to 74% in 2013 (ACER, 2014[22]). Overall, as argued in (ACER, 2021[23]) "day-ahead market integration delivers cheaper electricity across Europe and facilitates the growth of renewables while increasing overall welfare". In addition to price convergence, ACER found that price volatility in integrated electricity markets is much lower than in isolated ones.

In the case of Ukraine, the potential benefits of market coupling should also be analysed in the context of other desired reforms mentioned in previous sections. For instance, while removing wholesale price caps as currently conceived and used in Ukraine is a key condition for successful market coupling, the short-term effects of such a reform – price increases, all being else equal – could be at least partly offset by the benefits of integration with the EU market in the longer term. Market coupling could thus be instrumental to achieve, in a more competitive and less distortive way, market outcomes such as price stability and security of supply that current regulations intend to bring about.

However, the benefits of integration can be diluted by a lack of regulatory uniformity between neighbouring countries and legal instability at the national level. As highlighted in (Pollitt, 2019[21]) In relation to the integration of EU electricity markets in the past decades, "harmonisation of the rules for new connection, third-party access to transmission and distribution systems, and retailing electricity to final consumers" have been a key part of the integration process. Market design and regulatory constraints would thus play a significant role not only in the process leading to the coupling of the Ukrainian market with European electricity markets, but also in the future performance of such a coupling.

The prospect of future market coupling, and its related benefits, should constitute a significant incentive for necessary regulatory reforms mentioned in previous sections that aim to improve the functioning of the electricity sector. Removing key regulatory constraints and current obstacles to competition would have the twin benefits of improving the sector at the national level and facilitating the process of integration with the EU electricity system, which in turn would further enhance competition in Ukraine. Institutions therefore need to ensure that both the physical infrastructure and the regulatory environment can support the transition, and that special attention is paid to governance and market monitoring and surveillance. Although the current level of synchronisation and opening to trade is a welcome and significant step for Ukraine, further integration is needed for the expected benefits to competition to materialise.

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7 Conclusion and recommendations

This chapter sets out the OECD's main findings on Ukraine's electricity market and offers recommendations to promote competition and more generally to improve its functioning.
The recommendations address issues relating to the wholesale and retail markets, renewables and cross-border integration. Some call for changes with wide-ranging consequences while, others target specific challenges.

Ukraine's wholesale electricity market is designed to function as a competitive market in which regulation complements competition. Despite the pro-competitive basic legal framework enshrined in the Electricity Market Law, most market participants and stakeholders are dissatisfied with the status quo. The reasons for their dissatisfaction vary and are not without individual bias, but one concern shared by an overwhelming majority concerns a lack of regulatory stability. Entering the electricity market, especially as a producer, requires a significant commitment in terms of capital, time, and technical and administrative resources. The long time horizon for recouping investment explains this sentiment.

Frequent, short-lived regulatory changes create uncertainties that have a destabilising effect on the functioning of Ukraine's electricity market and undermine confidence among both investors and potential investors. These include the frequent use of temporary measures, some of which are applied or extended several times. A shift away from the interventionist approach of the past few years would create a more stable and transparent regulatory environment. Once the war is over, the timely removal of temporary measures implemented under martial law, such as the export public service obligation (PSO), would send a clear signal that would increase market confidence and facilitate recovery efforts. More generally, regulatory decisions should follow standard procedures and include consultations with market participants, whose views should be carefully considered.

One of the most important problems identified by this study are price caps in the wholesale market. Market-based price formation lies at the core of the competitive process, even more so for a homogenous commodity such as electricity. Limiting price formation should be executed with extreme care and only in specific circumstances. From a competition perspective, price caps may be justified by the risk of excessive pricing and if there are no better alternatives. Ukraine's wholesale electricity market is characterised by a high level of concentration. Although this warrants the special attention of the energy regulator and the competition authority, it does not in itself justify the imposition of price caps. In fact, relatively high concentration in the wholesale market is common in many countries, including EU member states. In the EU, market monitoring and surveillance has proved sufficient to prevent common instances of excessive pricing, market manipulation, insider trading and similar harmful behaviours. As a contracting party to the Energy Community, Ukraine has committed to implementing a "lighter" version of the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT). As a candidate for EU membership, it will need to implement REMIT fully at some point. In this context, it would be opportune for Ukraine to set up a monitoring and surveillance system that operates as similarly as possible to the way REMIT does within the EU. With a solid monitoring and surveillance system in place, Ukraine should eliminate price caps. This will also be necessary for the continued integration with EU electricity markets. Market coupling, an important step in this direction, is inconsistent with wholesale price caps, and represents an additional reason to eliminate them.

Ukraine regulates electricity prices for households at levels well below market prices. This is not only an expensive policy but also detrimental to competition. At the wholesale level, the implementation of regulated prices has led to a segmentation of the market. This has had a negative impact on the liquidity of the wholesale market, making it less efficient and increasing the risk of abuse and manipulation. The small size of the commercial segment of the wholesale market also makes it harder for suppliers to procure electricity for the retail market. Regulated prices have a more dramatic and direct impact on the retail market, completely foreclosing competition in the household segment. It should be noted that support to vulnerable consumers is a perfectly justifiable policy and likely necessary in Ukraine. Direct and targeted support is the best way to implement it. At no higher cost than the current system, it could offer more and better support to those who need it the most.

Introducing new rules and revising existing ones is not the only way to promote competition in electricity markets. Investigations of potential cases of anticompetitive conduct and market manipulation, and the imposition of remedies and penalties in proven instances of such conduct, are necessary to ensure regulatory compliance. In Ukraine's organised electricity markets, in particular the day-ahead market (DAM), systematic market surveillance is essential to detect possible cases of market manipulation.

Implementation of a market surveillance system closely aligned to the EU's REMIT framework is the best means of achieving this. Market surveillance should be complemented by case-by-case investigations either by the Antimonopoly Committee of Ukraine or the National Energy and Utilities Regulatory Commission (NEURC), depending on the type of potential manipulation and on agreement between the authorities.

Since Ukraine joined the Energy Community, its energy sector regulatory framework has been intrinsically linked to that of the EU. The benefits of aligning Ukraine's regulatory framework with EU standards go beyond the legal obligation associated with Energy Community membership. Implementation of the EU acquis communautaire can increase trust in Ukraine's electricity markets and is necessary for their further integration with EU markets. With synchronisation and the prospect of EU membership, full integration offers the best opportunity to increase competition. Commercial exports and imports can reduce the market power of domestic producers and make the wholesale electricity market more competitive.

The timeframe for implementation and for the realisation of benefits differs between the recommendations. Some are likely to be easier to put into place than others and they will variously yield rapid or longer-term results. Most of the recommendations presented here are designed with the post-war period in mind, when Ukraine has successfully restored the normal functioning of its economy. However, some recommendations can be implemented earlier, and, in some cases, work is already under way to do so. Where relevant, this is pointed out in the recommendations.

Many recommendations are interconnected and should be seen as a package. Some can be implemented on their own, but others will require the implementation of appropriate support measures, and the expected impact of implementation varies by recommendation. To assist with implementation following this report, the OECD's recommendations are grouped, and within those groups are loosely ordered by suggested priority. The groupings are loose, as some recommendations may fit into more than one group. The first group concerns the wholesale market, and the second targets the retail market. The third group comprises issues specific to generation from renewable energy sources (RES). The fourth group of recommendations concerns continued integration with EU electricity markets.

7.1. Promote competition in the wholesale electricity market

Effective wholesale competition is the foundation of a broadly competitive electricity market. Measures to promote wholesale competition should therefore be implemented in advance of, and in some cases in parallel with, measures aimed at the retail market. The overarching objective should be to promote competition by increasing liquidity and improving price formation.

7.1.1. Improve price formation

Unrestricted price formation is a precondition for effective competition. It should be restricted only if absolutely necessary, and then only for the shortest time possible.

Remove price limits

Price limits, especially price caps, restrict and distort price formation in the DAM, the intraday market (IDM) and the balancing market (BM). It is of the utmost importance for the entire electricity market that prices on these markets correctly reflect supply-demand conditions. The most important market for price formation is the DAM, whose prices serve as the main price reference for other parts of the electricity market. Incorrect price signals on the DAM have a particularly distortive effect on the functioning of both the wholesale and retail market, and also on investment. Although the IDM and the BM are less influential in terms of overall price formation, accurate price signals in these markets are necessary to ensure that balancing costs are managed efficiently.

Price caps also represent a major hindrance for integration with European electricity markets and are incompatible with market coupling.

Enhanced market surveillance, alongside effective penalties for misconduct, can sufficiently reduce the risk of price manipulation, especially excessive pricing. Merger control and enforcement of competition rules can also contribute to mitigating this risk.

Ideally, an effective surveillance system should be in place when price caps are removed. To further reduce risks involved in the removal of price limits, they could be first increased in several steps.

Revise technical price limits

Ukraine should revise the current technical price limits applied on the DAM, the IDM and the BM. The technical price limit should be based on an estimate of the value of lost load or on an alternative mechanism with a similar effect, such as the adjustment mechanism applied in the EU. This would ensure that bids are restricted to a level that is in line with consumer demand.

Harmonisation of technical price limits with those in the EU will be necessary for cross-border trading under market coupling.

Allow negative market prices

Price signals should not be restricted by disallowing bids below 0 UAH/MWh. The DAM and IDM Market Rules should be adjusted accordingly. Under certain circumstances, negative prices can signal an oversupply of electricity and incentivise reductions in supply and demand response, fostering greater flexibility on both the supply and demand sides in the long term. Negative prices can contribute to a better integration of a higher share of RES generation in the wholesale market.

Negative wholesale electricity prices are not an imminent concern in Ukraine, and as such not the highest priority. Yet the change should be easy to implement.

7.1.2. Reduce market segmentation

Market segmentation imposed by regulation distributes electricity volumes over several market segments. This reduces the volumes available in the commercial segments of the wholesale market and hinders the development of liquidity, potentially facilitating market concentration. Low liquidity and high concentration make a marketplace less reliable and trustworthy, and more susceptible to manipulation.

Increasing volumes in the commercial segments of the wholesale market is a crucial step towards ensuring the necessary supply side conditions for competition to flourish.

Reduce market segmentation to increase liquidity

Significant volumes of electricity are sold in the special section of the Ukrainian Energy Exchange that are not available to the commercial segments of the wholesale market. This reduces liquidity in the commercial segments and makes them less reliable and more vulnerable to manipulation.

The largest proportion of the special section comprise electricity sold under the PSO for households, which prevents Energoatom from selling part of its output there. The objective of the PSO – to ensure viable regulated household prices – can be achieved by other, less distortive means. Addressing the difference between market prices and regulated household prices by using the state budget would not interfere with the functioning of the wholesale market. Alternatively, a fully financial PSO would represent a somewhat less distortive system than the current hybrid PSO. In the medium term, the gradual introduction of market-based prices for households should eliminate the need for the household PSO.

Promote direct marketing by RES producers

RES producers should be responsible for marketing their output and thereby participate more directly in the electricity market. The RES support scheme should incentivise direct marketing by current RES producers. RES producers opting for direct marketing should be offered a feed-in-premium to replace the "green" tariff.

7.1.3. Other steps to improve market function

The recommendations below aim to improve different aspects of the wholesale market. Developing better market surveillance and increased transparency are matters of the highest priority.

Improve market surveillance

REMIT is a comprehensive surveillance system for wholesale market transactions. Implementing it can reduce the risk of market manipulation, increasing transparency and trust in the market, which benefits liquidity and competition.

Ukraine should implement REMIT "Light" and prepare for the implementation of REMIT in full. As a preparatory step, NEURC should, for instance – and to the extent it has not already done so – join European Union Agency for the Cooperation of Energy Regulators working groups as an observer and consider organisational changes to accommodate REMIT requirements.

Ukraine's market surveillance system must be able to identify suspicious wholesale transactions in close to real time. Suspicious transactions should be investigated and, if justified, sanctioned.

As a general rule, producers other than pumped-storage hydro power plants and power plants or units that operate only a limited number of hours annually should bid at their marginal costs on the DAM. Bidding behaviour deviating from this rule should be the focus of in-depth investigations.

Increase market transparency by improving the quality of reporting

High-quality market reporting is an important tool for informing market participants and stakeholders about the state of electricity markets.

NEURC should report market indicators consistently across all market segments. It should develop and publish the methodology used to calculate indicators – especially those indicating market liquidity, concentration and power – and the underlying anonymised data to ensure its quality.

Since publication of sensitive information is restricted under martial law, this recommendation can be fully implemented only after the end of the war. However, development of the methodology need not wait for this.

Provide potential investors with reliable information on long-term generation capacity developments

Following the end of the war, up-to-date, reliable information should be provided on the phase-out of old fossil fuel plants under the National Emission Reduction Plan and the decommissioning of nuclear power plants, and on planned RES generation auctions. A firm and credible commitment should be made to shutting down old highly polluting plants and to organising RES auction plans. Whenever changes to phase-outs or RES auctions are inevitable, they should be communicated and explained to stakeholders without delay.

It is also vital to ensure the coherence of long-term plans in various high-level national policy documents, such as the National Energy Strategy of Ukraine until 2035, the National Energy and Climate Plan and the National Renewable Energy Development Action Plan, to minimise uncertainty and avoid misinformation.

Promote liquidity on the DAM

The DAM is a well-established market with a high level of transparency that offers reference prices for other market segments. Increased trading on the DAM is an appropriate way of ensuring that electricity is sold and purchased in a transparent manner. To improve liquidity, transparency and price formation, an increased minimum threshold for selling electricity on the DAM should be considered. This could serve as a temporary measure until trading on the bilateral market becomes more liquid.

Carry out an independent evaluation of bilateral electronic auctions on the Ukrainian Energy Exchange

There are indications that the outcomes of bilateral auctions do not always properly reflect market conditions. This may be due to sellers having too much scope for setting specific auction conditions, partly obstructing buyers' access to auctions.

The rules and outcomes of past auctions should be assessed with a view to improving the functioning of the bilateral agreement market. Based on an independent evaluation, the rules should be adjusted to reduce entry barriers for potential buyers.

Promote demand side response by consumers

Demand response increases the elasticity of demand, which reduces suppliers' ability to increase prices. The effect of doubling demand elasticity is equivalent to doubling the number of generators operating in the market.

Demand response can be incentivised by exposing consumers to short-term price signals on a voluntary basis. For example, time-varied electricity prices enable consumers to shift their electricity consumption away from times at which higher prices are charged and thereby reduce their energy bills.

The greatest potential for demand side response probably lies among large industrial electricity consumers. They can – and already do – participate in the wholesale market, but their participation should be encouraged further.

Finally, aggregators, as a new type of energy service provider that can regulate the electricity consumption of a group of consumers in response to real-time prices, should also be fostered.

Allow long-term commercial power purchase agreements for new generation capacity

Commercial power purchase agreements (PPAs) are one method of ensuring the financing of new generation capacity. Currently, the maximum duration of commercial PPAs is one year. Such a short duration is insufficient to secure financing for new generation capacity. For new power plants, the duration of PPAs should not be restricted. Restrictions on existing producers may be necessary to ensure market liquidity but should be imposed according to clear rules.

The removal of PPA duration limits for new power plants will be a simple measure to facilitate investment following the end of the war.

7.2. Promote competition in the retail electricity market

Measures to improve the functioning of the wholesale market, as outlined above, should be complemented by measures to boost competition in retail markets and ensure its full benefits are realised. This will be important in the short term to allow non-household users to benefit from greater competition. In medium to longer term, it can enable the introduction of effective competition in the household segment.

7.2.1. Phase out regulated prices for households

Regulated prices for households stifle competition in the retail market and result in high electricity consumption. Regulated tariffs should be abolished and replaced with more efficient pricing. To mitigate any negative effects of removing regulated tariffs for households, a gradual approach is recommended, as follows:

- **Narrow the eligibility criteria for supply at regulated prices.**

  At the most basic level, regulated prices should be granted only to individual households. Collective households should be ineligible for them.

- **Gradually increase regulated prices for households to competitive levels.**

  Regulated tariffs should be increased to the level of universal service supplier prices, which should take their place. Higher regulated prices should be accompanied by targeted support for vulnerable customers and extensive energy efficiency improvement initiatives. Direct support is more effective and less costly than keeping prices below market levels for all households.

  The phase-out of regulated tariffs should also be accompanied by the implementation of transparency-boosting measures such as price comparison tools for household consumers and easier switching of suppliers.

7.2.2. Simplify and improve ways to switch suppliers

Ukrenergo should automate processes for changing electricity suppliers. It should implement a procedure on its Datahub platform, reviewing it after one year and regularly thereafter. Ensuring an efficient procedure for switching suppliers will be of great importance when competition is introduced to the household segment.

7.2.3. Improve transparency of supply contracts in the business segment

Easier price comparisons allow customers to identify their best supply options and incentivise competition among suppliers. Commercial offers with variable prices should provide estimates of electricity prices and potential expenditures for various consumption patterns. NEURC should adjust the rules for commercial offers and specify a common methodology to provide price estimates. It should develop and operate a price comparison tool to facilitate consumer choice in the business segment.

7.3. Promote RES generation and market participation

Support for RES is needed to reduce greenhouse gas emissions and energy dependence. Integration of RES producers into the normal functioning of the market would reduce market concentration and increase competition.

7.3.1. Develop incentives for current and future RES producers to participate in the balancing market by providing balancing services

Improving price formation on the BM by phasing out price caps would provide a market-based incentive for increased participation in this market.

Any RES support scheme for new capacity should allow and incentivise future RES producers to offer balancing services on the BM. The latest version of the RES support schemes should be reviewed and revised accordingly.

Reviewing the RES support scheme for existing RES producers and future RES projects could identify adjustments to promote RES participation and should be carried out in close co-operation with RES producers and potential investors.

7.3.2. Implement a certification mechanism for electricity produced from RES (guarantee of origin)

Both RES producers and electricity consumers would benefit from a guarantee of origin (GO) system, which would allow RES producers to market their electricity at a premium and permit consumers to opt for certified green energy. The premium could improve investment in, and operational conditions for, RES generation. A GO scheme could also facilitate direct electricity exports by RES producers.

Implementation of GOs requires legislation to appoint an issuing body and the creation of an electronic registry. The issuing body should be equipped with the necessary legal powers and have the technical, financial and human resources to set up and operate the system. The GO system should be compatible with the European Energy Certificate System. As part of this progression, the Ukrainian issuing body should join the Association of Issuing Bodies.

Income from selling certificates under the current green support mechanism could go to the Guaranteed Buyer to help settle its financial obligations to RES producers and to ensure they are paid in full and on time. RES producers outside the support scheme should receive and be entitled to use their certificates without any restrictions.

7.3.3. Create a level playing field for zero-carbon generation technologies

Internalising the cost of CO2 emissions would put all generation technologies on an equal footing and reduce or eliminate the need to support RES generation. It could be implemented by setting the CO2 tax at a level fully reflecting the negative effects of greenhouse gas emissions. As an alternative, an emissions trading system compatible with, and ready to be linked to, the EU Emissions Trading System (ETS) could be introduced. The emissions trading system may be less disruptive to the economy than increasing the CO2 tax.

In setting up the system, Ukraine could benefit from the European Commission's technical support. It could also benefit from the experience Switzerland gained in linking its emissions trading system to the ETS.

7.3.4. Support for new (non-residential) RES facilities should be granted solely through competitive auctions

Auctions for RES facilities introduce an element of competition for market into the system of support for RES production. Auctions are more efficient than fixed feed-in-tariffs because competition can lower the cost of support. The success of auctions depends on many factors, including their design, regulatory stability and general economic conditions. It would be advisable to start with small-scale test auctions for RES capacity based on the latest provisions in renewables support legislation. The results of these auctions should be analysed and discussed with existing and potential investors, and adjusted, if necessary, before large-scale auctions are held.

RES producers should sell their output on the electricity market and be fully responsible for their imbalances. This should be a mandatory obligation implemented through contracts for difference.

7.3.5. Evaluate the cost-effectiveness of feed-in premiums vs. feed-in prices for RES auctions

Feed-in premiums and feed-in prices are two widely used options for supporting RES generation. Ukraine's new draft renewables support law promotes auctions with feed-in premiums. The premium exposes RES producers to market prices, but it creates significant uncertainty over revenues, which may increase

financing costs, pushing up the cost of support. Ukraine should evaluate the cost effectiveness of both approaches and, if justified, opt for auctions with feed-in prices in the form of contracts for difference.

7.4. Cross-border market integration

Successful synchronisation represents an important step towards Ukraine's electricity market integration with the EU. With Ukraine's EU candidate status, increased integration will likely become an essential part of the accession process.

Further, integration of Ukraine's wholesale electricity market with EU electricity markets presents a unique opportunity to improve competition over the long term. Increased interconnection capacities, coupled with the opportunity to import and export electricity, allow new players to compete, reducing market concentration and introducing competitive dynamics. In addition, they offer substantial benefits in terms of system security.

The recommendations below are interrelated, and their implementation should be undertaken as a package. The benefits of market coupling increase with higher cross-border capacity and vice versa.

7.4.1. Increase interconnection capacity to work towards the EU target of at least 15% by 2030

The EU set this target to improve cross-border electricity interconnections, which will allow countries to boost their security of supply and to integrate more renewables into energy markets.[1] Connecting previously isolated electricity systems mitigates the risk of electricity blackouts, reduces the need to build new power plants, and facilitates the management of variable renewable electricity sources such as solar and wind.

7.4.2. Work towards full market coupling

To achieve effective market coupling, implicit auctions should be organised and trading rules should be harmonised with those of the EU. As a short-term objective, Ukraine should implement joint auctions for cross-border electricity trading with neighbouring countries. Before such auctions are arranged, the EU guidelines on capacity allocation and congestion management[2] and on forward capacity allocation[3] need be implemented. Related cross-sectoral legislation on matters such as tax codes, and especially VAT rules, should be reviewed and revised as necessary to ensure barrier-free cross-border trading.

Timely implementation of this recommendation is crucial. Preparatory work is under way and Ukraine plans to implement the two guidelines by the end of 2023.

Notes

[1] Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, 11 December 2018, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0001.01.ENG.

[2] Commission Regulation (EU) 2015/1222 establishing a guideline on capacity allocation and congestion management, 24 July 2015, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R1222.

[3] Commission Regulation (EU) 2016/1719 establishing a guideline on forward capacity allocation, 26 September 2016, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.259.01.0042.01.ENG.

Competition Market Study of Ukraine's Electricity Sector

This market study analyses Ukraine's electricity sector from a competition perspective. It provides a detailed description and assessment of the regulatory framework within which the Ukrainian electricity markets operate, as well as an analysis of the obstacles to competition in the wholesale and retail markets. This report includes recommendations to address the underlying causes of ineffective competition that, if implemented in the recovery phase following Russia's war of aggression against Ukraine, can contribute to achieving a well-functioning, competitive electricity sector.

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