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.

References

ACER (2021), *Guidance on the application of REMIT*, https://acer.europa.eu/en/remit/Documents/ACER_Guidance_on_REMIT_application_6th_Edition_Final.pdf. [23]

ACER (2014), *ACER Market Monitoring Report*, https://acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER_Market_Monitoring_Report_2014.pdf. [22]

Böckers, V., J. Haucap and U. Heimeshoff (2013), "Benefits of an integrated European electricity market: the role of competition", http://publications.europa.eu/resource/cellar/99d4fd94-7619-44f4-9f4b-5541235b90d1.0001.04/DOC_1. [20]

Chepeliev, M. (2021), "Possible Implications of the European Carbon Border Adjustment Mechanism for Ukraine and Other EU Trading Partners", *Energy Economics*, Vol. 2/1, https://doi.org/10.46557/001c.21527. [13]

Economic Truth (2022), *815 million in two weeks, or why the state needs an energy trader*, https://www.epravda.com.ua/rus/columns/2022/09 February 691071/ (accessed on 4 April 2023). [19]

ENTO-E (2022), *Further increase in the trade capacity with the Ukraine/Moldova power system*, ENTSO-E News, https://www.entsoe.eu/news/2022/09/04/transmission-system-operators-of-continental-europe-decide-to-further-increase-trade-capacity-with-the-ukraine-moldova-power-system/ (accessed on 10 March 2023). [16]

ENTSO-E (2022), *Commercial exchanges of electricity with Ukraine/Moldova to start on 30 June*, ENTSO-E News, https://www.entsoe.eu/news/2022/06/28/commercial-exchanges-of-electricity-with-ukraine-moldova-to-start-on-30-june/ (accessed on 10 March 2023). [15]

EU (2011), *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=1678963014 787 (accessed on 16 March 2023). [1]

European Commission (2022), *Carbon Border Adjustment Mechanism*, https://taxation-customs.ec.europa.eu/green-taxation-0/carbon-border-adjustment-mechanism_en (accessed on 4 April 2023). [14]

European Commission (2020), *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 (accessed on 16 March 2023). [2]

EXPRO Consulting (2022), *During March-August 2022, Ukraine exported 1.335 million MWh of electricity*, https://expro.com.ua/en/tidings/during-march-august-2022-ukraine-exported-1335-million-mwh-of-electricity (accessed on 4 April 2023). [17]

GLOBSEC (2022), *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. [8]

Hutarevych, N. (2022), "Implementation of REMIT into Ukrainian legislation", *Ukrainian Journal of Business Law* 11-12 November-December 2021, http://www.ujbl.info/article.php?id=1532. [3]

IEA (2022), *Energy Statistics Data Browser*, https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser (accessed on 4 April 2023). [6]

International Energy Agency (2021), *Net Zero by 2050 – A Roadmap for the Global Energy Sector*, http://www.iea.org/t&c/ (accessed on 4 April 2023). [5]

IRENA (2022), *Renewable Power Generation Costs in 2021*, https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021. [11]

IRENA (2015), *REmap 2030 Renewable Energy Prospects for Ukraine*, https://www.irena.org/Energy-Transition/Outlook/Renewable-energy-roadmaps. [9]

IRENA, Joanneum Research and University of Ljubljana (2017), *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. [7]

Morawiecka, M. and O. Savytskyi (2022), *Revitalising EU-Ukraine cross-border infrastructure for a secure, clean energy future*, Regulatory Assistance Project. [18]

NEURC (2020), *Annual Report*, https://www.nerc.gov.ua/pro-nkrekp/richni-zviti (accessed on 1 January 2022). [10]

Pollitt, M. (2019), "The European Single Market in Electricity: An Economic Assessment", *Review of Industrial Organization*, Vol. 55, pp. 63-87, https://doi.org/10.1007/s11151-019-09682-w. [21]

Seel, J. et al. (2021), "Plentiful electricity turns wholesale prices negative", *Advances in Applied Energy*, Vol. 4, https://doi.org/10.1016/j.adapen.2021.100073. [12]

UN (2023), *Causes and Effects of Climate Change*, https://www.un.org/en/climatechange/science/causes-effects-climate-change. [4]

Notes

[1] Law of Ukraine No. 1 540-VIII "On the National Commission, which carries out state regulation in the spheres of energy and utility services", 22 September 2016, https://zakon.rada.gov.ua/laws/show/1540-19.

[2] NEURC Decision No. 1 120 "On the approval of the procedure for the implementation of NEURC market monitoring in the spheres of energy and utility services", 14 September 2017, https://zakon.rada.gov.ua/rada/show/v1120874-17#Text.

[3] NEURC Decision No. 450 "On the approval of monitoring reporting forms for electricity market participants and instructions for filling them", 29 May 2019, https://zakon.rada.gov.ua/laws/show/v0450874-19#Text.

[4] NEURC Decision No. 2 647 "On the approval of the Instruction on the implementation of NEURC monitoring of the functioning of the electricity market", 23 December 2020, https://zakon.rada.gov.ua/rada/show/v2647874-20#Text.

[5] The operational monitoring data is published at https://www.nerc.gov.ua/monitoring-rinku-elektrichnoyi-energiyi/operativnij-monitoring-rinku-elektrichnoyi-energiyi.

[6] Sub-clause 1.8.4 of clause 1.8, NEURC Decision No. 307 "On the approval of the Market Rules", 14 March 2018, https://zakon.rada.gov.ua/laws/show/v0307874-18?find=1&text=%D1%81%D0%BF%D0%BE%D1%81%D1%82%D0%B5%D1%80%D0%B5%D0%B6%D0%B5%D0%BD%D0%BD%D1%8F#w1_1.

[7] Implementing Regulation (EU) No 1348/2014 of 17 December 2014 on data reporting implementing Article 8(2) and Article 8(6) of Regulation (EU) No 1227/2011.

[8] Decision of the Ministerial Council of the Energy Community DI2018I10IMG-EnC: implementing Regulation (EU) No 122712 011 of the European Parliament and of the Council on wholesale energy market integrity and transparency, https://www.energy-community.org/dam/jcr:_aec217c0-51fa-426a-a986-f36455546f51/Decision_2018_10_MC-EnC_Reg_1227-2011.pdf.

[9] Draft of NEURC Decision "On approval of requirements for the prohibition and prevention of abuse in wholesale energy markets", 24 24 December, file removed, https://www.nerc.gov.ua/news/oprilyudnyuetsya-proekt-postanovi-shcho-mae-oznaki-regulyatornogo-akta-zatverdzhennya-vimog-shchodo-zaboroni-ta-zapobigannya-zlovzhivannyam-na-optovikh-energetichnikh-rinkakh.

[10] Decision of the Ministerial Council of the Energy Community No; 2021/07/MC-EnC, 30 November 2021, https://www.energy-community.org/dam/jcr:682bff28-da85-4f85-afec-c5b77f721e1c/Decision2021-07-MC-EnC_Case%20ECS-4-21_Ukraine.pdf.

[11] Draft Law on "Amendments to certain laws of Ukraine on the prevention of abuse in wholesale energy markets", 1 April 2021 (registration), https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=5322&conv=9.

[12] CMU Order No. 605-r on Energy Strategy of Ukraine until 2035: Safety, Energy Efficiency, Competitiveness, 18 August 2017, https://zakon.rada.gov.ua/laws/show/605-2017-%D1%80#Text.

[13] The updated Nationally-Determined Contribution of Ukraine to the Paris Agreement, approved by the CMU Decree No. 868, 30 July 2021, https://zakon.rada.gov.ua/laws/show/868-2021-%D1%80.

[14] See information on the European Green Deal under https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

[15] The LCOE of a given technology is the ratio of lifetime costs to lifetime electricity generation, both of which are discounted using a rate reflecting the average cost of capital.

[16] The International Renewable Energy Agency calculated the real WACC by assuming an inflation rate of 1.8%. This corresponds roughly to average inflation in the United States between 2010 and 2021.

[17] NEURC Decision No. 641 "On the approval of legal acts regulating the activities of the Guaranteed Buyer and the purchase of electricity at the "green" tariff and at the auction price", 26 April 2019, https://zakon.rada.gov.ua/laws/show/v0641874-19#Text.

[18] Law of Ukraine No. 2 479-IX "On the peculiarities of regulating relations on the natural gas market and in the field of heat supply during martial law and the subsequent restoration of their functioning, 29 July 2022, https://zakon.rada.gov.ua/laws/show/2479-20#n243.

[19] Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32001L0077.

[20] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[21] Decision of the Ministerial Council of the Energy Community, D/2012/04/MC-EnC: Decision on the implementation of Directive 2009/28/EC and amending Article 20 of the Energy Community Treaty, 18 October 2012, https://www.energy-community.org/dam/jcr: f2d4b3b8-de85-41b2-aa28-142854b65903/Decision_2012_04_MC_RE.pdf.

[22] CMU Resolution No. 771 "On the approval of the Procedure for issuing, using and terminating the guarantee of the origin of electric energy for business entities producing electric energy from alternative energy sources", 27 July 2013, https://zakon.rada.gov.ua/laws/show/771-2013-%D0%BF#Text.

[23] Draft Law of Ukraine "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", 25 August 2022 (publication), https://www.mev.gov.ua/rehulyatornyy-akt/proyekt-zakonu-ukrayiny-pro-vnesennya-zmin-do-deyakykh-zakoniv-ukrayiny-shchodo.

[24] The ENTSO-E system consists of five synchronous areas: the Continental Europe Area, the Nordic Area, the Baltic Area, the British Area, and the Ireland and Northern Ireland Area. Ukraine is connected to Continental Europe Area.

[25] "Frequency support can be generically considered as an exchange of power between TSOs that is activated in real time. The support is provided by a synchronous area (SA) or a group of SAs either manually or automatically, to improve the operational situation of the requesting SA" https://eepublicdownloads.entsoe.eu/clean-documents/SOC%20documents/Operational_Limits_and_Conditions_for_Mutual_Frequency_Support_over_HVDC_Report.pdf.

[26] https://expro.com.ua/en/tidings/during-march-august-2022-ukraine-exported-1335-million-mwh-of-electricity, source from NEURC official website, https://www.nerc.gov.ua/monitoring-rinku-elektrichnoyi-energiyi/operativnij-monitoring-rinku-elektrichnoyi-energiyi/informaciya-shchodo-propusknoyi-spromozhnosti-mizhderzhavnih-peretiniv-ukrayini.

[27] Communication from the Commission COM/2022/233, Ukraine relief and reconstruction, 18 May 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022DC0233&from=EN.

[28] Joint communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, EU external energy engagement in a changing world, 18 May 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=JOIN%3A2022%3A23%3AFIN&qid=1653033264976.

[29] Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R1222.

[30] https://ips.ligazakon.net/document/KP220775?an=1.

[31] https://ua.energy/zagalni-novyny/ukrenergo-spryamuvalo-na-pidgotovku-do-ozp-dohid-vid-auktsioniv-na-dostup-do-mizhderzhavnyh-peretyniv-dlya-eksportu-elektroenergiyi/.

[32] https://ukranews.com/en/news/882457-ukrenergo-transfers-uah-6-billion-to-participants-in-electricity-market.