UKRAINE: IMPACT OF THE DESTRUCTION OF THE KAKHOVKA DAM

UKRAINIAN ENERGY SECTOR DAMAGE ASSESSMENT

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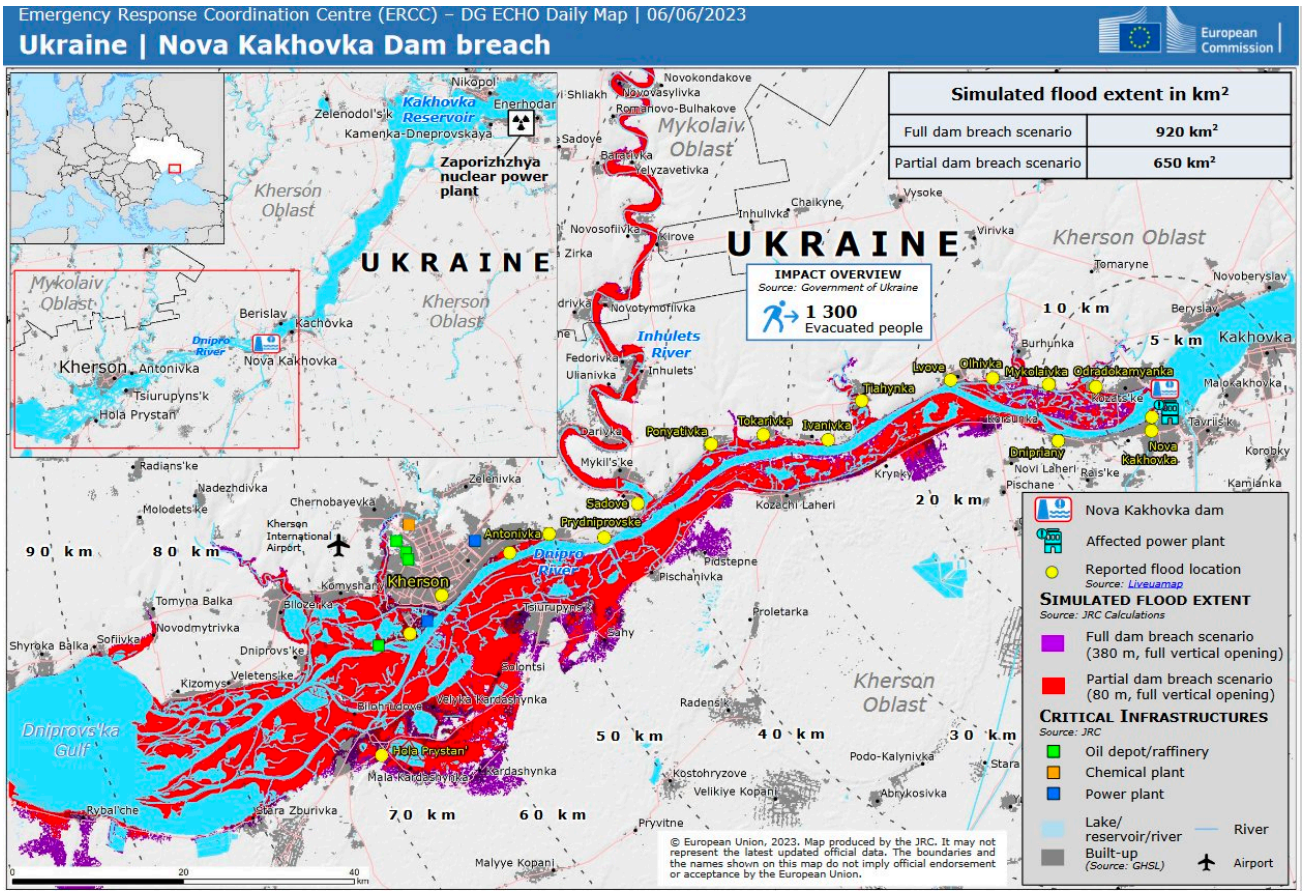
FOREWORD

The blowing up of the Kakhovka Hydroelectric Power Station dam is the largest catastrophe caused by Russian invaders since the beginning of the full-scale invasion. On the night of June 6, Russian occupiers blew up the dam of the Kakhovka Hydroelectric Power Station. As of June 9, the destruction of the dam and the earthen insert between the station building and the locks is ongoing. Within a 24-hour period on June 8, the water level in the Kakhovka water reservoir decreased by nearly 1 meter. Since the morning of June 6, the water level has already dropped by a total of 4.7 meters. The Kakhovka Hydroelectric Power Station dam held a volume of approximately 18 million cubic meters of water. Ukraine has already lost 6.5 million cubic meters of water. An area of about 600 square kilometers in the Kherson region has been flooded.

According to President Volodymyr Zelenskyy, this Russian crime of ecocide is the largest in Europe in decades. Volodymyr Zelenskyy announced the creation of a high-level international working group that will consolidate worldwide efforts to bring Russia to justice for the ecocide in Ukraine.



POTENTIAL LONG-TERM IMPACT OF THE DESTRUCTION OF THE KAKHOVKA DAM [1]

The Kakhovka dam's destruction on 6 June 2023, as a consequence of Russia's war on Ukraine, has led to the flooding of downstream communities, prompting an urgent need for population evacuation and humanitarian assistance.

Streets are flooded in Kherson, Ukraine, on June 7, 2023. Libkos / AP

The Kakhovka reservoir played a crucial role in providing energy, drinking water, irrigation, and river transport to various regions in southern Ukraine, as well as supplying water for industries in Kryvyi Rih, Nikopol, Marhanets, and other cities and areas. The release of over 18 cubic km of water within a span of 3-4 days poses a significant threat to nearly 80 settlements, potentially affecting around 100,000 inhabitants directly, while up to one million people could lose access to drinking water.

However, the destruction of the dam, beyond these immediate humanitarian needs, will have a significant impact in the longer term on a much larger geographical area

[1] Potential Long-Term Impact of the Destruction of the Kakhovka Dam UNCT Joint Analytical Note – 9 June 2023

and population. It will have severe, long-term impacts on Ukraine's environment, economy, and society, including possible displacement and migration of population, and is likely to cast a dark shadow over the country for decades to come.

A view of a flooded neighborhood in Kherson, seen on June 8, 2023, Libkos / AP

1. HEALTH, WATER AND SANITATION

The Kakhovka reservoir served as a crucial water source for numerous major cities located to the north, west, and south, including Kryvyi Rih, Mykolaiv, Berdyansk, as well as many smaller cities and settlements. The destruction of the dam has disrupted or contaminated the water supply in all these regions. The interruption in water flow has affected not only households but also municipal networks and agricultural irrigation systems in Kherson, Zaporizhzhia, and Crimea.

The flooding poses additional long-term health risks due to the discharge of hazardous chemicals from manufacturing plants located downstream. The floodwaters are also contaminated with biological hazards such as sewage wastewater and dead wildlife. This creates a heightened risk of waterborne diseases, including cholera, diarrhea, and others. The water supply challenges resulting from the dam's destruction may also lead to the temporary closure of health facilities, causing disruptions in essential health services. This situation is particularly concerning for the older population and

people with disabilities residing in the area, many of whom have chronic non-communicable diseases. Additionally, the crisis will have a significant impact on the psychological well-being of the affected population directly, but also indirectly on Ukrainian society in general.

2. CHEMICAL HAZARDS

The breach of the dam has resulted in the release of approximately 150 tons of oil products from the hydropower plant, which may spread downstream all the way to the Black Sea. Immediate actions should be taken to install floating booms in areas where the oil is visible in order to contain and pump it as soon as possible. The discharged oil products have the potential to contaminate soil, wildlife, and vegetation, posing a significant threat to natural life and habitats.

The floodwaters will also carry waste from industrial sites, and sewage facilities, as well as fertilizer depots, causing extensive pollution of water and land resources. The State Emergency Service of Ukraine has reported that there are no chemical installations within the potential flooding area. However, there are approximately 64 infrastructure and industrial facilities identified as being in areas at risk of flooding, with 20 of them in high flood-risk areas. Although these locations may not store large quantities of chemicals, the flooding of these sites and surrounding settlements, including light industries, storage facilities, garages, agricultural areas, and workshops, may result in multiple small- to medium-scale chemical releases, including pesticides.

The process itself of clean-up after flood waters recede also has the potential to create secondary contamination if not done according to international standards.

The port area in Kherson city, which served as a significant storage site for fertilizers and chemical cargo, could become a pollution hotspot, not only in its immediate vicinity but also downstream into the Black Sea. The flooded area also encompasses various manufacturing plants that could discharge chemicals into the floodwaters, further exacerbating pollution and health risks. Additionally, the disturbance of bottom sediments from the reservoir during the flood wave is a concern.

These sediments, with a contamination history spanning over 60 years since the dam's construction, may contain heavy metals, persistent pesticides, nutrients, and other pollutants. Proper mapping and assessment of this sediment are crucial to address potential environmental concerns.

3. AGRICULTURE, FISHERY, AND FORESTRY

Initial satellite imagery suggests that many thousands of hectares of agricultural land on both sides of the Dnipro River have been affected. If the flooding persists, it could lead to crop losses without sufficient time for replanting during this season. The reduced water levels in the Kakhovka Reservoir will likely have an impact on crop production in Kherson region and other areas surrounding the reservoir in southern Ukraine. Additionally, the reservoir and the upstream Dnipro River served as vital fishery resources for the region. Rapid drainage may cause significant damage to these resources, potentially disrupting spawning grounds in the long term.

The forestry resources in the region may also suffer adverse effects. Large areas along the south bank of the Dnipro River are home to Crimean Pine, Common Pine, and White Acacia, none of which are well-suited to prolonged moisture exposure. Consequently, these tree species may perish due to the extended period of flooding.

4. ENVIRONMENT

The dam destruction has devastating effects on the ecosystems of the Kakhovka reservoir and the lower Dnipro River. Repercussions will extend to the flora and fauna of the Black Sea. An estimated 80,000 hectares of protected areas, including the Lower Dnipro natural reserve and Askania-Nova reserves, are at risk of destruction and will be carried downstream towards the Black Sea. This includes several Ramsar wetland sites of international significance, which require special attention and necessitate adaptations to their management plans. The breeding grounds for protected bird species and the spawning areas for fish, particularly within the Kakhovka reservoir, will be significantly impacted, resulting in substantial casualties, especially among fish populations.

Two UNESCO-designated Biosphere Reserves are situated nearby. The Chornomorskyi Biosphere Reserve, located approximately 45 km southwest of Kherson, has already experienced the consequences of the disaster. The Volozhyn forest spanning 203 hectares has been flooded, a 0.5-hectare estate in the town of Hola Prystan has been destroyed, and 500 hectares of the Ivano-Rybalchyne plot and 500 hectares of the Soleno-Ozerna have both been inundated. Ongoing monitoring is being conducted to assess potential threats to the Askania-Nova Biosphere Reserve.

The long-term environmental impacts in the region may include alterations to local climatic conditions due to the loss of a large water body. The dried-up lakebed could

release dust and contaminant particles into the air, leading to changes in the local climate.

5. COMMUNITY INFRASTRUCTURE, DEBRIS REMOVAL, AND MINE CONTAMINATION

The floodwaters are set to impact over 80 communities, causing irreparable damage to their critical and social infrastructure. These areas will require complete reconstruction before the population can return to their homes. Over 120 educational institutions are at risk due to the flooding. The proximity of these communities to the frontline and ongoing hostilities will pose significant challenges to debris removal and infrastructure reconstruction efforts.

Extensive efforts will be necessary for the removal of debris resulting not only from destroyed infrastructure but also from various forms of natural and man-made waste that have been carried downstream by the floodwaters. This includes the presence of hazardous materials such as asbestos panels widely used in previous construction materials. However, the most pressing and severe consequence of the flooding is the significant number of mines and unexploded ordnance that have been swept downstream and, as the floodwaters recede, now remain scattered throughout the affected communities, resulting in new low-density non-recognized minefields. The flood-affected area already had a considerable number of confirmed minefields, and numerous others remain unconfirmed.

Given the circumstances, it can be assumed that all of these mines have shifted and settled in the silt, rendering the entire flood zone a contaminated area, complicating detailed assessments and remediation efforts, leaving many people unable to return and those who remain at risk of diminished livelihood opportunities and longer-term need for social protection services. For those with specific vulnerabilities, such as the elderly or those with a disability, access to key services may be cut off, increasing needs in both the immediate and longer term.

The flooding may also impact local media outlets, further limiting access to critical and verified information for the affected population, including information on mine contamination, chemical hazards, water availability, humanitarian assistance, evacuation efforts, etc. While the exact number is being verified, it is estimated that around ten media organizations were directly based in the flooded areas, according to the Ukrainian Media Business Association (UMBA).

6. ENERGY

The breach of the dam has resulted in the loss of the Kakhovka hydropower plant (HPP), a crucial source of clean energy for southern Ukraine. The reconstruction of the HPP is estimated to cost more than 1 billion USD. While the HPP has already been disconnected from the main power system of Ukraine, the consequences of this disaster are significant. The destruction of the Kakhovska HPP in the long term diminishes the automatic frequency restoration reserves within Ukraine's power system, making system balancing more challenging and costly. The flooding has caused the destruction of electricity infrastructure, leaving approximately 20,000 residents without power. Moreover, there is a risk of the Kherson Heat and Power Plant being affected, which could impact around 140,000 individuals.

Furthermore, the Zaporizhzhya Nuclear Power Plant (ZNPP) relies on water from a reservoir directly connected to the Kakhovska HPP's reservoir. The potential loss of the primary cooling water source further exacerbates the already challenging nuclear safety and security situation.

7. HOUSING

The extensive flooding has inflicted severe damage to residential properties, leading to both immediate and long-term housing challenges. The depth of the floodwater, averaging over 3 meters, is expected to cause significant harm to more than 2,500 homes. As of now, more than 200 houses have been confirmed as destroyed, but this number is likely to increase substantially once the water recedes and access to the affected areas can be secured. Given the circumstances of the evacuation, it is to be expected that many people have been left without documentation that may be crucial to access services, especially if displacement becomes extended.

The structural integrity of houses will be compromised, resulting in various forms of damage. The foundations of the buildings will be eroded, walls weakened, and load-bearing structures compromised. Consequently, cracks, sinking, or even collapse of houses is already being observed and may occur further. In many cases, repair and rehabilitation of the affected houses may not be feasible, necessitating costly and time-consuming debris removal and reconstruction efforts. The overall impact on housing will involve both immediate needs for alternative housing options and long-term reconstruction projects to restore the housing stock to pre-flood condition.

8. INTERNAL DISPLACEMENT AND POTENTIAL OF OUT-OF-COUNTRY MIGRATION

One of the immediate as well as medium-term impacts of the destruction of the dam will be further displacement of the population from the affected areas which may eventually lead, at a later stage, to a more consolidated process of internal and possibly out-of-country migration. Initial assessment indicates that 2,200 people have been displaced from their place of habitual residence in flood-affected areas and 81 percent of those remain currently within Kherson region.

However, the lack of adequate housing, access to clean water and environment, risks posed by mine contamination, loss of livelihood opportunities, and food insecurity as well as the overall insecurity in the region could impact mid- to long-term mobility decisions. It is anticipated that climate displacement and migration may prompt up to 400,000 people to leave the southern regions of Ukraine in the coming years. Immediate as well as midterm solutions for livelihood opportunities, shelter and housing and sustainable access to essential services, will need to be identified to prevent massive population displacement and internal/external migration from this region.

9. CULTURE

Approximately fifteen museums, archaeological sites, and historical locations could be directly affected by the floodwaters. Among the areas being examined to evaluate potential damage are Nova Kakhovka, Korsunka, Dnipryany, Lviv settlement (4th century BC - 4th century AD), Burgun settlement, Mykolaivka village (2nd-5th centuries), Tyagin fortress site, Tyaginka village (13th-17th centuries), and the historic settlement of "Ponyativske" in Ponyativka village (4th century BC - 4th century AD). The flooding is likely to result in structural damage and the weakening of these cultural institutions. Archival collections and moveable heritage are also at risk of deterioration, compromising their integrity and making them susceptible to looting and illicit trafficking.

Ministry
Of Environmental Protection
and Natural Resources
Of Ukraine

Briefing on the environmental damage caused by the Russia's war of aggression against Ukraine (June 9, 2023)

The blowing up of the Kakhovka Hydroelectric Power Station dam is the largest catastrophe caused by Russian invaders since the beginning of the full-scale invasion.

At night of June 6, Russian occupiers blew up the dam of the Kakhovka Hydroelectric Power Station. As of June 9, the destruction of the dam and the earthen insert between the station building and the locks is ongoing. Within a 24-hour period on June 8, the water level in the Kakhovka water reservoir decreased by nearly 1 meter. Since the morning of June 6, the water level has already dropped by a total of 4.7 meters.

The Kakhovka Hydroelectric Power Station dam held a volume of approximately 18 million cubic meters of water. Ukraine has already lost 6.5 million cubic meters of water. An area of about 600 square kilometers in the Kherson region has been flooded. As of the morning of June 9, 46 settlements have been inundated.

In the evening of June 8, President Volodymyr Zelenskyy held a video call with representatives of the global environmental protection community, including politics and public figures, opinion leaders, and environmental experts.

In his speech, the President of Ukraine emphasized that the Kakhovka hydroelectric power plant disaster is not a natural disaster or a manifestation of the climate crisis, but a disaster ordered by Putin personally.
According to the President, this Russian crime of ecocide is the largest in Europe in decades. The Head of State also drew attention to the fact that due to the destruction of the Kakhovka hydroelectric power plant dam, fuel storage facilities, warehouses with chemicals and fertilizers, animal burial grounds, including two "anthrax burials" on the temporarily occupied territory, were flooded; sewage got into the water.

Volodymyr Zelenskyy announced the creation of a high-level international working group that will consolidate worldwide efforts to bring Russia to justice for the ecocide in Ukraine.

Due to the destruction of the Kakhovka dam, 160,000 birds and over 20,000 wild animals are under threat. This was reported by Ruslan Strilets, the Minister of Environmental Protection and Natural Resources of Ukraine, during a telethon.

On June 8, Minister Ruslan Strilets, as part of a delegation headed by President Volodymyr Zelenskyy, visited the Kherson and Mykolaiv regions. The Minister expressed his gratitude to all environmentalists for their dedicated work during these extremely challenging times.

"This is the largest environmental catastrophe in Ukraine since Chernobyl. Approximately 40,000 cubic meters of water are flowing out of the Kakhovka reservoir every second. Ukraine has already lost 6.5 cubic kilometers of water. We are in negotiations with the OSCE and UNEP regarding the involvement of their experts. We need a clear understanding of how this act of 'desperation' by the Russians will affect the environment and how we can restore nature where possible," emphasized Minister Ruslan Strilets.

Nuclear and radiation safety threats

According to Energoatom, despite blowing up of the Kakhovka Hydroelectric Power Station dam by the Russian occupiers, the situation at **the Zaporizhzhia Nuclear Power Plant** remains under control.

As of 8:00 on June 9, the water level in the Kakhovka reservoir near Nikopol is 11.74 meters, while in the cooling pond of the Zaporizhzhia NPP, it is 16.66 meters. This is sufficient to meet the station's needs. The Zaporizhzhia NPP units have not been operational since September 2022, so active evaporation of water from the cooling pond has not been occurring since then.

Despite numerous calls from the IAEA and world leaders, Russian occupiers continue to transform the Zaporizhzhia Nuclear Power Plant into a military base.

According to the Main Intelligence Directorate of Ukraine's Ministry of Defense, military personnel of the Russian aggressors, armored vehicles, and trucks are constantly present near power units No. 1, 2, and 4, and their numbers are constantly increasing.

Ukrainian employees of the rotating shifts, who are supposed to inspect power units of the Zaporizhzhia Nuclear Power Plant at least 1-2 times a week, are not allowed to do their work. Those who attempted to carry out inspections have been beaten and tortured by Russian terrorists. Several employees of the ZNPP are in critical condition in the hospital.

On May 30, Rafael Grossi, the Director General of the International Atomic Energy Agency (IAEA), announced 5 principles for ensuring the security of the Zaporizhzhia Nuclear Power Plant at a UN Security Council meeting. The IAEA Director General assured that the agency's representatives would monitor their implementation and publicly report any violations.

Energoatom informs that the liberation of the Zaporizhzhia Nuclear Power Plant, the expulsion of the Russian aggressors from Energodar, and the transfer of control over the plant to its legitimate Ukrainian operator are the only way to stop Russian lawlessness at the nuclear power plant and ensure its safety.

Recent attacks on infrastructure and industrial sites

On the night of May 25, the terrorist country attacked Ukraine with 36 Shahed drones.

On May 26, the Russians carried out a mass nighttime attack, launching 17 missiles of various types and 31 strike drones across Ukraine:

- a fire broke out in two private enterprises in Dnipro, and a gas station was damaged;
- debris from a Russian missile fell in two districts of Kyiv, causing damage to a shopping mall;

In the morning of May 26, the aggressor country destroyed a medical facility in Dnipro with a missile attack, resulting in 4 deaths and 32 injuries, including children.

On May 28, during the night, the Russians launched a record number of 59 kamikaze drones, targeting Ukraine. The falling debris from the drones caused casualties and destruction in various districts of Kyiv and in the Zhytomyr region. The roof of a shopping mall caught fire in Kyiv, a fire broke out at an industrial facility, and warehouses caught fire.

On the night of May 29, Russia once again attacked Ukraine. Ukrainian defenders shot down 36 cruise missiles and 30 strike drones. There was a hit on a port infrastructure facility in Odesa, but the fire was promptly extinguished. In the daytime of May 29, Russia attacked the Kyiv region with ballistic and cruise missiles.

On the night of May 30, Russia attacked Kyiv with drones. Falling debris caused casualties and destruction in various areas of Kyiv. 17 residential buildings were reported damaged.

On May 31, the enemy attacked a transport company in the Mezhyricka community of the Dnipropetrovsk region.

On International Children's Day, June 1, Russia launched Iskander missiles at civilian and critical infrastructure facilities in the Kyiv region. As a result of the attack, three people were killed in Kyiv, including one child.

On June 2, two people were killed in Zaporizhzhia as a result of Russian shelling on a multi-story building in Komyshuvakha.

On June 3, a Russian missile strike on multi-story buildings in the Dnipropetrovsk region injured22 people, and one child was killed.

On June 5, in the Kupiansk district of the Kharkiv region, Russian occupiers damaged an ammonia pipeline, causing a leakage. The safety valves at the station were activated, and the ammonia leak was minimal.

On June 6, the terrorist country once again shelled the ammonia pipeline in the Kupiansk district. Measurements showed that there was no ammonia in the air in the populated areas of the Kupiansk district.

Since the first day of the full-scale war, Ukrainian energy facilities have been targeted by Russian forces. Ukraine’s energy system has withstood hundreds of attacks and even experienced the first blackout in its history. Overall, about 50% of the country's energy infrastructure has been damaged. Renewable energy facilities, which accounted for over 13% of the country's electricity production before the full-scale war, have not been spared and have seen a decline in their capacities.

In the fall of 2022, almost all wind power plants and nearly half of the solar power plants were out of operation. As a result, the share of renewable energy sources in energy production has more than halved. The damage to Ukraine's renewable energy facilities is discussed in detail in an article by Ekonomichna Pravda.

Pollution caused directly by hostilities

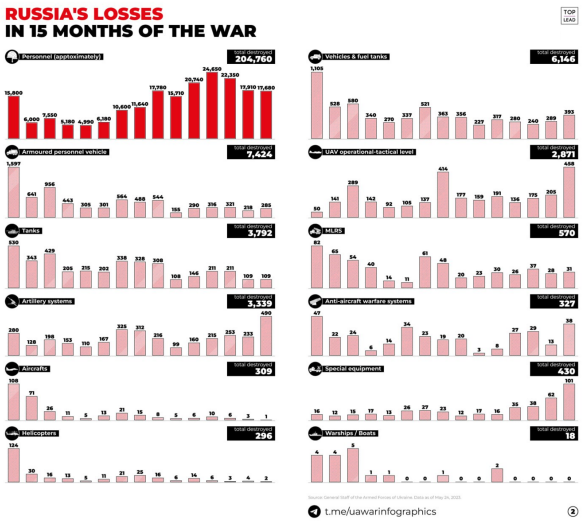
According to the State Emergency Service of Ukraine, from February 24, 2022, to June 9, 2023, 397,527 explosive objects were neutralized on the territory of Ukraine. An area of 890 square kilometers was surveyed.

During a briefing, Colonel Serhiy Reva, the head of the Humanitarian Demining Department of the State Emergency Service of Ukraine reported that the main efforts of rescuers were focused on demining the occupied territories of the Kyiv, Chernihiv, Sumy, Kharkiv, Mykolaiv, Kherson, and Donetsk regions. The most challenging situation has arisen in the Kharkiv and Kherson regions since they have been under enemy occupation for the longest time, and Russian forces had significant capabilities for mining.

The highest priority for pyrotechnicians is inspecting critical infrastructure objects such as roads, power transmission lines, and gas pipelines. Rescuers have already inspected 5,800 kilometers of power transmission lines, 370 kilometers of gas pipelines, 600 kilometers of railway tracks, and nearly 3,500 kilometers of roads.

According to the Mariupol City Council, the Russians have killed tens of thousands of innocent people in temporarily occupied Mariupol, destroyed over 1,300 buildings, and continue to demolish the damaged buildings. The destruction of buildings and settlements leads to environmental pollution with construction debris and asbestos. The consequences of such pollution will be felt for years to come.

In over 15 months of the full-scale war, the Armed Forces of Ukraine have already destroyed more than 26,000 units of Russian military equipment, amounting to nearly 500,000 tons of metal scrap waste. The burning of this equipment has resulted in the release of over 52,000 tons of pollutants into the atmosphere.



Damage to natural reserves and protected ecosystems

Artificial flooding caused by the Kakhovka dam blast claims not only human lives but also thousands of innocent animals. Ukrainian rescuers, local residents, and representatives of volunteer organizations are doing everything possible to rescue the animals.

In the first hours after the dam explosion on June 6, over 300 animals drowned in the Kazkova Dibrova Zoo in the temporarily occupied Nova Kakhovka.

Due to the destruction of the Kakhovka Hydroelectric Power Plant dam, thousands of species of animals and plants, which have different conservation statuses, are now at risk of extinction.

9 sites from the Emerald Network (Dnipro-Bug Estuary, Black Sea Biosphere Reserve, Oleshky Sands) and 5 Ramsar sites are under threat and in the affected zone.

Ukraine may lose some ecosystems forever, including in the Lower Dnipro, Great Meadow, Kamianska Sich, and Ivory Coast of Sviatoslav national parks.

A mass death of fish is happening in the Kherson and Zaporizhia regions due to the rapid drop in water levels in the Kakhovka reservoir.

In the **Lower Dnipro National Park**, almost all islands (approximately 50) have been flooded. As of today, the water level near the islands has risen by 5.5 meters, covering an area of about 80,000 hectares. This is approximately equivalent to the area of the city of Berlin.

The intensity of flooding is decreasing, but water is still arriving. There are observed landslides and the transfer of rock debris by water. The flooding has affected all species of flora and fauna in the national park. Some species may disappear. The flooding has affected areas where typical and rare groups of floodplain forests, swamps, meadows, sandy steppes, steppe slopes of the Dnipro, ravines, and rock outcrops are preserved.

In total, the park's flora includes 1,016 species: 834 species of higher vascular plants, 111 species of lichens, 21 species of lichenophilic fungi, and 50 species of mosses. All of them have been damaged. Among the animals that may perish are wild boars, red deer, roe deer, fallow deer, pheasants, beavers, and muskrats.

The State Environmental Inspection has assessed the damage to the Lower Dnipro National Park. According to the estimation methodology, the estimated cost of damage is UAH 46.55 billion (EUR 1.17 bln). The approximate losses if wild animals have died amount to UAH 71.5 million (EUR 1.8 mln).

In the occupied **Great Meadow National Park**, there is a risk of shallowing the water and marshland areas of the "Archipelago of Great and Small Kuchugury" due to the water level decrease.

Due to ecosystem changes, 54 species of fish and 156 species of birds that inhabit the archipelago islands are at risk. Currently, a shallowing of 1.7 meters has been recorded, with the water receding 17 meters from the shore. The critical level is 8 meters.

The Seven Lighthouses Bay archipelago within the territory of the Great Meadow National Park is estimated to be 50% shallower with a 9-meter decrease in water level (complete shallowing will occur with a 14-meter decrease). This will result in the disappearance of 47 fish species, with risks for 137 fish species.

Due to the destruction of the dam, the water level in the Kakhovka reservoir within **the Kamianska Sich National Park** has decreased by 4 meters and continues to fall.

This could lead to the irreversible loss of entire ecosystems in the plant and animal world. The reservoir banks will become unsuitable for the existence of all living organisms for decades, turning into saline areas.

More than 19 endangered Red Book plant species, and dozens of wetland bird species protected under the Bern Convention, will permanently disappear from these areas. What could not be destroyed during the 8 months of Russian occupation in 2022, was destroyed by the blowing up the dam by the invaders.

Approximately 55,000 hectares of forests have been inundated, of which 47,000 hectares are located in the area temporarily occupied by Russians.

The left bank of the Dnipro River in the Kherson region is covered by pine forests. If the flooding water remains stagnant for up to 20 days (as forecasted), trees aged up to 10 years old will be particularly at risk.

While there may still be hope for preserving plants in the forest, animals are essentially doomed. This includes deer, roe deer, and wild boars. Lizards, snakes, hares, and hedgehogs have no chance of survival.

Furthermore, due to the destruction of the Kakhovka Hydroelectric Power Plant dam, at least 150 tons of machine oil have leaked into the Dnipro River. Pollution of plants with oil leads to irreversible consequences in the process of

Extensive forest fires are recorded **on the Kinburn Peninsula.** This is evidenced by data from the automated satellite system. The peninsula has been cut off from mainland Ukraine by the water. The road in the vicinity of the village of Heroiske, which connected the peninsula to the mainland, is completely flooded. It is no longer possible to reach the mainland from the peninsula by land transport.

Prior to the full-scale invasion, the Lyman forestry in the Donetsk region was involved in the forestry management of the region. It oversaw 27,000 hectares of forests, with 18,000 hectares as part of the Holy Mountains National Nature Park.

The forest area, along with Lyman district, was occupied by Russians from May to October 2022. During the occupation, some fires were left unextinguished, resulting in many trees and plant species being lost. Over 6,500 hectares of forest were damaged by fires as a result of the hostilities. A significant area of the forests was destroyed due to explosions, with craters from the blasts and fortification structures damaging a large portion of the soil. It is currently impossible to determine the exact extent of the damage due to the contamination of the forests and forest roads with explosive objects.

New seedlings have already been planted in some of the damaged forest areas affected by active hostilities. On World Forest Day, March 21, 9,000 pine seedlings were planted on a 3-hectare plot of land. The planting material was grown in the Lviv Tree Nursery from seeds collected by foresters in the territory of the Lyman forestry. More details about the plans for the restoration of the Lyman forestry can be found in the article published by the Eastern Variant media outlet.

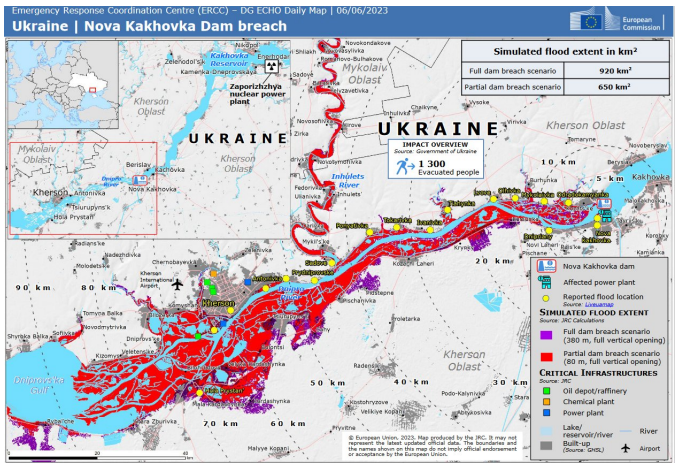
According to the Forests of Ukraine State Enterprise, Ukrainian foresters have planted 111 million new trees this spring. The largest number of trees were planted in the Rivne, Zhytomyr, and Kyiv regions. During the spring afforestation campaign, foresters planted forests on 15,458 hectares of land, including planting new forests on 739 hectares.

Damage to freshwater resources

At least 150 tons of oil from destroyed Kakhovka HPP have already leaked into the Dnipro River. This will lead to a deterioration in water quality, accumulation, and spread of toxins. All aquatic organisms will be affected.

Ukraine's Ministry of Environmental Protection and the State Environmental Inspection are assessing the damages. Exceedance of petroleum product concentration in water by several times has been recorded, but there is a tendency for this pollution to decrease.

Preliminary damage (to water resources only) amounts to UAH 2 billion (EUR 50 mln).



According to the Donetsk Regional Military Administration, on May 25, Russian military forces destroyed the dam of the Karlivka water reservoir with a missile strike. The settlements of Halytsynivka, Zhelanne-1, and Zhelanne-2 are now at

Since the beginning of the large-scale invasion, the Russian occupation army has consistently shelled Karlivka, specifically targeting the dam, disregarding the fact that civilians would be the primary victims of these actions.

The Karlivka reservoir is a source of water supply for several towns in the Donetsk region, including Kurakhove, Novohrodivka, Pokrovsk, Selidove, and Myrnograd. Communities located in the potential flood zone have been warned, and if necessary, the evacuation of the civilian population will be launched.

According to the State Environmental Inspectorate, in October 2022, as a result of a kamikaze drone attack on one of the major exporting enterprises in Mykolaiv, vegetable oil leaked into the waters of the Bug Estuary. Approximately 750 square meters of the estuary's waters were contaminated, and 675.8 cubic meters of oil were collected from the water surface.

Despite efforts to clean up the contamination, some amount of oil remains on the surface. The oil is almost insoluble in water at low temperatures and floats on the surface. During this time, various bird species' deaths were observed as the oil coated their feathers, preventing them from flying.

Over time, the oil acquired a milky-white color, high viscosity, and, mixed with accompanying pollutants, settled as a dense layer on the bottom of the Bug Estuary over a significant area. As a result, some fish species were left without their food base, and spawning grounds were contaminated, decreasing their population.

Black and Azov Seas

As a result of the water stream caused by the explosion by Russian occupying forces at the Kakhovka Hydroelectric Power Station, a rapid flow of debris, fragments of various objects, boats, and even building structures is being carried downstream by the Dnipro River and partially into the Black Sea.

The currents have also swept away mine and explosives that the occupiers had set up on the left bank of the river. Currently, a large number of mines are drifting in the water along the flow. One of such anti-personnel mines was washed ashore in the Odesa region. Defense forces have safely neutralized the threat.

In the context of the ongoing emergency situation caused by the destruction of the Kakhovka Hydroelectric Power Station, the mine danger has been significantly increased along the banks of the Dnipro River, the Dnipro-Bug Estuary, and the entire Black Sea coastline of the Mykolaiv and Odesa regions.

Russian occupiers continue destroying the unique Dzharylgach National Park in the Kherson region. The scale of the environmental damage will depend on the intensity of the Russian military's use of the island's territory. According to Professor Yevhen Khlobystov from the Kyiv-Mohyla Academy, the entire national park will be destroyed within 1-2 months if the occupiers engage in purely military activities.

Dzharylgach is a 42-kilometer-long island that is home to nearly 500 species of rare plants. "There is unique biodiversity there, with dozens of species listed in the Red Book, unique sands. Sometimes Dzharylgach is referred to as the Ukrainian Maldives. Russian military forces have already destroyed the natural uniqueness of Cape Opuk in occupied Crimea, so it is highly likely that they will do the same to Dzharylgach Island," added the professor.

Ivan Rusiev, a Ukrainian scientist, reported another incident of a dead dolphin being washed up on the coast of the Tuzla Estuaries National Park. According to the scientist, during March-April 2023, dolphin deaths were recorded in the bays of Sevastopol and other coasts of occupied Crimea, as well as near Novorossiysk, Sochi, Gelendzhik, and Anapa, including injured animals. The activity of sonars used by Russian submarines and surface vessels in the Black Sea near occupied Crimea and Novorossiysk is likely the main factor contributing to the continued death of rare Black Sea animals.

Ukrainian energy sector evaluation and damage assessment - X

(as of May 24, 2023)

Cooperation for Restoring the Ukrainian Energy Infrastructure project

Task Force

CONTENTS

INTRODUCTION

The full-scale military aggression by the Russian Federation launched on February 24, 2022 has had a significant negative impact on the Ukrainian energy sector. Due to their economic, humanitarian and geopolitical importance, energy infrastructure facilities have been among the primary targets for the Russian army.

The first Ukrainian energy sector evaluation and damage assessment report was published on August 24, 2022, on the six-month anniversary of Russia's full-scale invasion[1]. Since then, the Task Force regularly provided the international community with reliable information on key energy sector damages on a monthly basis[2]. This is the ninth edition of the document that provides a concise overview of key attacks and damages inflicted on the Ukrainian energy infrastructure from April 25 to May 24, 2023.

Russia occupied, damaged or destroyed about 50% of the country's installed power capacity, thousands of km of electric, gas and heat networks, transformers, compressor stations, heat-only boilers and other infrastructure facilities. The oil refining industry was destroyed. Electricity and natural gas consumption decreased by 30-35% compared to 2021.

According to the latest analysis as of March 2023, the direct losses of the Ukrainian energy sector, including utilities and district heating sectors, were estimated at **$11 bln** by the Kyiv School of Economics[3] and **$10.6 bln** by the World Bank[4]. It is expected that the actual damages may be higher, as there is no complete information on energy facilities located in the temporarily occupied territories, and considering the current restrictions on publishing detailed information on the damages caused to the country's energy infrastructure facilities.

The damage assessment report was developed by the Task Force comprised of representatives of Ukrainian authorities and the Energy Charter Secretariat, established under the project "Cooperation for Restoring the Ukrainian Energy Infrastructure" and in cooperation with other Ukrainian and international organisations. The general objective of the project is to assist the Government of Ukraine in the cost-effective restoration of energy infrastructure, taking into account the clean energy transition while ensuring energy security. The project is funded by the European Commission and implemented by the Energy Charter Secretariat.

DISCLAIMER

Information contained in this work has been obtained from sources believed to be reliable. However, the Task Force does not guarantee the accuracy or completeness of any information published herein, and the Energy Charter Secretariat shall not be responsible for any losses or damages arising from the use of this information or from any errors or omissions therein. This work does not attempt to render legal or other professional services.

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[1] Task Force, "Ukrainian energy sector e valuation and damage assessment – I (as of August 24, 2022)", 2022, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/20220829_UA_sectoral_evaluation_and_damage_assessment_final.pdf

[2] Task Force, "Ukrainian energy sector evaluation and damage assessment – II – IX:
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_09_30_UA_sectoral_evaluation_and_damage_assessment_Version_II.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_10_24_UA_sectoral_evaluation_and_damage_assessment_Version_III.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_11_24_UA_sectoral_evaluation_and_damage_assessment_Version_IV.pdf
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https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_01_24_UA_sectoral_evaluation_and_damage_assessment_Version_VI.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_02_27_UA_sectoral_evaluation_and_damage_assessment_Version_VII.pdf
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https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_04_27_UA_sectoral_evaluation_and_damage_assessment_Version_IX.pdf

[3] $147.5 billion — the total amount of damages caused to Ukraine's infrastructure due to the war, as of April 2023, https://kse.ua/about-the-school/news/147-5-billion-the-total-amount-of-damages-caused-to-ukraine-s-infrastructure-due-to-the-war-as-of-april-2023/

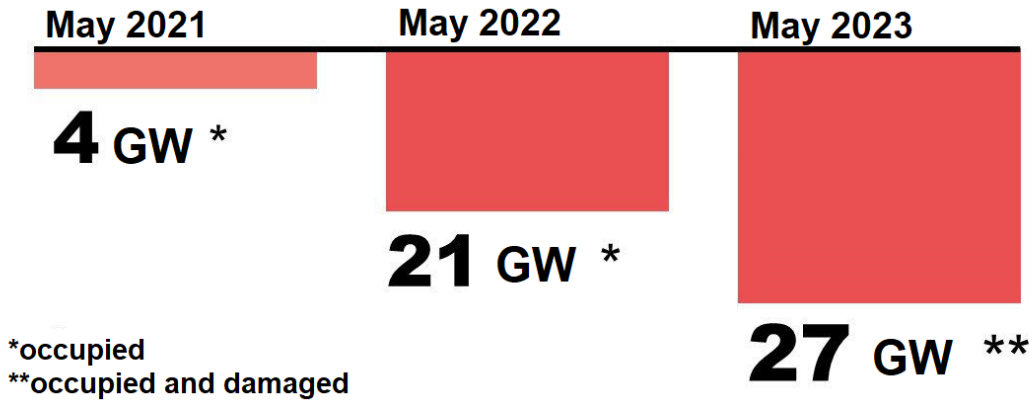
[4] Rapid Damage and Needs Assessment, February 2022 – February 2023, https://documents1.worldbank.org/curated/en/099184503212328877/pdf/P1801740d1177f03c0ab180057556615497.pdf

KEY CHANGES IN THE UKRAINIAN ENERGY SECTOR (April 25 – May 24, 2023)

As outlined in the ninth report[5], no European power system has ever suffered, endured and withstood such large-scale destruction, including during the First and Second World Wars. Since the Russian Federation changed its tactics and resorted to massive attacks on critical energy infrastructure facilities on 10 October 2022, the Russian military forces mainly targeted power plants, high-voltage substations and other critical elements of the power sector as their damage and destruction had the most devastating effect on the civilian population, especially during the heating season, i.e. power outages directly caused the disconnection from cold and hot water and heat supply as well caused significant disruptions in internet connectivity and access to information.

According to NEC Ukrenergo, Transmission System Operator (TSO), as of May 2023, the Ukrainian power system temporarily lost about 27 GW or more than 45% of its total installed capacity.

Temporary losses of the installed capacity of the Ukrainian power system



Source: NEC Ukrenergo

Taking into account the magnitude of energy sector destructions and the fact that 2022/2023 was the most challenging winter season for Ukraine over the last 30 years, Ukrainian authorities and energy sector companies started preparing for the next heating season at the end of April, which is much earlier than in previous years. According to the Ministry of Energy, the preparation for the 2023/2024 heating season requires about $3.4 bln[6], including $3.4 bln for emergency restoration of the power grid and generating facilities.

As outlined in the previous reports, the Russian Federation constantly changed its tactics to inflict maximum damages on critical energy infrastructure facilities, including the use of different types of air-based and sea-based long-range missiles, kamikaze drones and guided air bombs. At the same time, the Russian Federation continued its regular attacks on the energy infrastructure facilities in the frontline Ukrainian regions using artillery and rocket launcher systems. In addition to the attacks on energy infrastructure facilities, the Russian Federation continued its tactic of targeting the personnel of the energy companies performing emergency repairs to inflict the maximum casualties on the energy sector employees and reduce Ukraine's ability to efficiently restore the power supply.

The information below provides a concise overview of key attacks and damages inflicted on the Ukrainian energy infrastructure from April 25 to May 24, 2023.

[5] Task Force, "Ukrainian energy sector e valuation and damage assessment – IX (as of April 24, 2022)", 2023, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_04_27_UA_sectoral_evaluation_and_damage_assessment_Version_IX.pdf

[6] Ukraine needs 3.4 billion dollars to prepare for the heating season - Ministry of Energy. https://www.epravda.com.ua/news/2023/04/30/699612/

On April 27, 2023, one power sector employee was killed, and four employees were injured while repairing the power grid in the Kharkiv region.

On April 28, 2023, one of the generation facilities and its equipment was damaged in the Donetsk region.

On April 28-29, 2023, the Russian military forces again attacked the Donetsk region. As a result of the attack, one generation facility was disconnected from the power system.

On April 30 – May 1, 2023, the Russian military forces launched another massive attack which caused significant damage to the power distributing networks. As a result of the attack, a part of Dnipro city and the Dnipropetrovsk region were disconnected from the power supply. More than 18,000 consumers in Kherson city and its region were also disconnected due to multiple shellings.

On May 3, 2023, the Russian Federation attacked energy facilities in the Sumy region using guided air bombs. As a result of the attack, a power substation was significantly damaged.

On May 3, 2023, three power company employees were killed as a result of the shellings in the Kherson region.

On May 4, 2023, the Russian military forces attacked a generation facility in the Donetsk region. The overhead power lines in the region were also damaged due to heavy shellings. As a result, more than 100,000 consumers, including coal mines, were disconnected from the power supply.

On May 5, 2023, Russia attacked a Thermal Power Plant (TPP) in the Donetsk region using artillery. The plant had to proceed with the emergency shutdown.

On May 10, 2023, the Russian military forces attacked the administrative building of "Kharkivoblenergo", a power Distribution System Operator (DSO).

On May 14, 2023, two high-voltage overhead lines in the South-West and the East of Ukraine operated by NEC "Ukrenergo" were damaged.

On May 15, 2023, the Russian military forces shelled a TPP in the Donetsk region.

On May 18, 2023, Russia launched another massive attack on the whole Ukrainian territory using missiles and drones. Several energy facilities were damaged.

On May 19, 2023, three energy sector employees died as a result of a drone attack in the Sumy region.

On May 22, 2023, Russia launched a new massive attack using missiles and drones. As a result of the attack, the power grid was damaged in several regions. 24 settlements in the Dnipropetrovsk region were disconnected from the electricity supply. More than 246,000 consumers were also disconnected in the Zaporizhzhia region as a result of damages to the power infrastructure and substations. The last power line connecting the Zaporizka Nuclear power plan (ZNPP) with the Ukrainian energy sector was cut off due to the shellings. The safe operation of the plant was ensured by diesel generators for the seventh time since the beginning of the war.

In May 2023, NEC "Ukrenergo" together with the Polish operator PSE modernised the transmission line between Poland and Ukraine, and one of the Ukrainian power companies started exporting limited amounts of electricity to Poland using the restored interconnector on May 15, 2023.

DAMAGES AND LOSSES OF THE ENERGY INFRASTRUCTURE

The full-scale military aggression by the Russian Federation caused significant damage to the Ukrainian energy sector. As of April 24, 2023, there were two up-to-date key studies estimating damages and losses in the Ukrainian energy sector:

- Report on the direct damage to the infrastructure from the destruction caused by Russia's military aggression against Ukraine a year after the start of the full-scale invasion, as of March 2023, by the Kyiv School of Economics (KSE)[7], including the updated analysis as of April 2023[8].
- Rapid Damage and Needs Assessment (RDNA), February 2022 – February 2023, as of March 2023, by the World Bank[9].

According to the KSE's assessment, the damages to the Ukrainian energy sector, were at least **$11 bln,** including **$8.3 bln** in the energy sector and **$2.7 bln** in the utility infrastructure (including the district heating, water supply and drainage, and household waste management facilities).

Direct losses from damages to hydropower plants (HPP) and pumped storage hydropower plants (PSHPP) are estimated at $464 million. According to Ukrhydroenergo, the total losses of the hydropower sector are about $1 billion, including losses of the Kakhovska HPP and the energy supply system of Zmiiny Island (about $400 million). The direct losses of renewables (excluding large HPP and PSHPP) are estimated at $220 million.

According to RDNA, damage to the energy sector of Ukraine is estimated at **$10.6 billion**, including **$6.5 billion** damage in the power sector only. The total needs for recovery and reconstruction of the energy sector are estimated at **$47 billion**.

In addition to the inflicted damages, the Russian Federation also took control of Ukraine's mineral deposits worth at least **$12.4 trillion**. Ukraine has lost 63% of coal deposits, 11% of oil deposits, 20% of natural gas deposits, 42% of metal deposits and 33% of deposits of rare earth elements and other critical minerals, including lithium.[10]

It should also be noted that the actual damages and losses most likely will be higher as there is no complete information on Ukrainian facilities located in the temporarily occupied territories and no publicly available information on the detailed damages caused to the country's energy infrastructure facilities.

On May 16, 2023, the Methodolody on the Assessment of the Damage and Losses of Energy Infrastructure Facilities in Ukraine Due to the Military Aggression of the Russian Federation, which was jointly developed by the Ministry of Energy and the State Property Fund of Ukraine, came into force.[11] The Methodology was developed according to national and international standards and the World Bank's guiding principles on damage assessments. The new Methodology is mandatory for the assessment of damages for related legal enquiries and court proceedings.

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[7] Report on the direct damage to the infrastructure from the destruction caused by Russia's military aggression against Ukraine a year after the start of the full-scale invasion, https://kse.ua/wp-content/uploads/2023/03/UKR_Feb23_FINAL_Damages-Report.pdf

[8] $147.5 billion — the total amount of damages caused to Ukraine's infrastructure due to the war, as of April 2023, https://kse.ua/about-the-school/news/147-5-billion-the-total-amount-of-damages-caused-to-ukraine-s-infrastructure-due-to-the-war-as-of-april-2023/

[9] Rapid Damage and Needs Assessment, February 2022 – February 2023, https://documents1.worldbank.org/curated/en/099184503212328877/pdf/P1801740d1177f03c0ab180057556615497.pdf

[10] In the Ukraine war, a battle for the nation's mineral and energy wealth, https://www.washingtonpost.com/world/2022/08/10/ukraine-russia-energy-mineral-wealth/

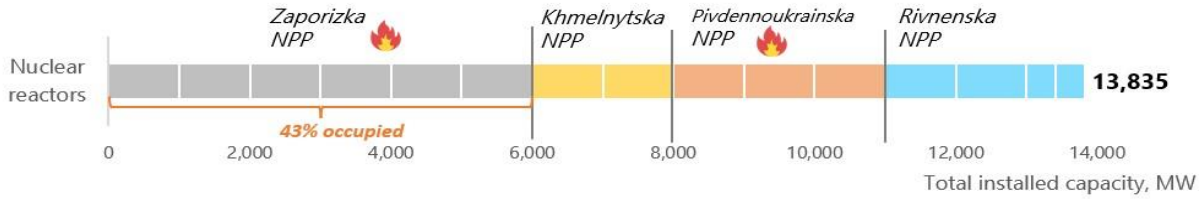
[11] Methods of assessment the damage and losses of energy infrastructure facilities of Ukraine due to the military aggression of the Russian Federation https://zakon.rada.gov.ua/laws/show/z0708-23#Text

GENERAL SITUATION

Power sector

Nuclear energy

Nuclear energy provides a reliable base load and covers more than half of the electricity production in Ukraine (55.5% in 2021). There are four operating NPPs in Ukraine with a total installed capacity of 13,835 MW (15 reactors in total, including 13 reactors with a capacity of 1,000 MW and two reactors with a capacity of 415 MW and 420 MW, respectively.

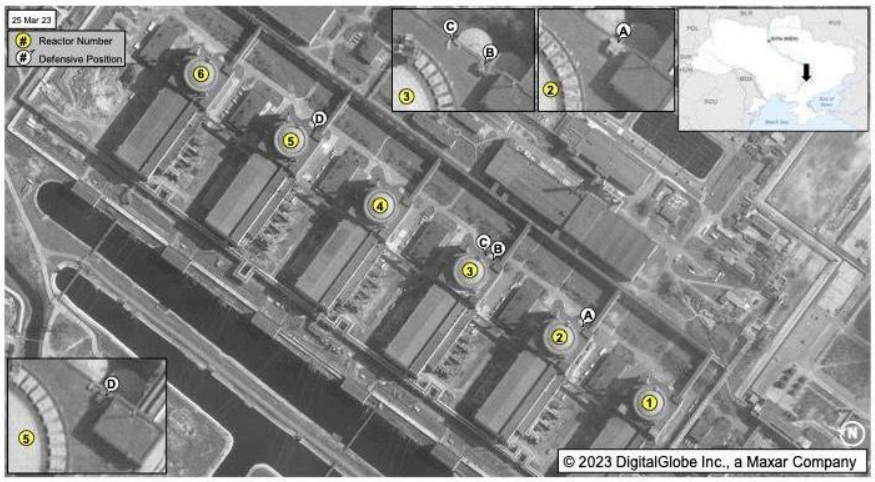


Source: Energy Charter Secretariat (ECS) based on publicly available data

Zaporizka NPP (ZNPP), the largest nuclear power plant in Europe and the fifth largest in the world (Power Technology, 2019)[12], has been occupied by the Russian military forces since early March 2022. The installed power capacity of the plant is 6,000 MW, which is 43% of Ukraine's total nuclear power installed capacity. Before the Russian large-scale military invasion of Ukraine, the plant covered about 25% of electricity production in Ukraine. Since September 11, 2022, the operation at ZNPP was suspended. Pivdennoukrainska NPP was shelled. Khmelnytska NPP and Rivnenska NPP were also affected due to attacks on transmission system infrastructure.

State Company (SC) Energoatom, the operator of all Ukrainian NPP's, conducted a preliminary analysis of the damages inflicted by the Russian military forces on the ZNPP. According to the analysis, the estimated value of destroyed and damaged assets as of March 2023 was about $0,8 bln. The final amount of losses and damages inflicted by Russia on the ZNPP will be determined after the liberation of the plant.

Russian defensive positions constructed from sandbags on ZNPP reactor buildings



Source: The UK Ministry of Defence

[12] "Top ten nuclear power plants by capacity", Power Technology, 2019, https://www.power-technology.com/analysis/feature-largest-nuclear-power-plants-world/

In May 2023, Russia continued increasing their military presence at the ZNPP and created defensive positions constructed from sandbags on reactor buildings (see photo above). According to IAEA, the Russian military forces stored military equipment, weapons and explosives materials in the turbine hall of reactor #4[13]

In May 2023, the Russian Federation also imposed draconian measures on the staff, increased pressure and threats on the plant's employees and forbade the workers to communicate with each other[14] . As of mid-May 2023, only 2,500 ZNPP workers were still operating the Plant[15]. In contrast, there were about 11,000 employees at the ZNPP before the beginning of the war[16]. The duress under which NPP staff are having to operate is an imminent threat to the safe operation of the Ukrainian NPPs. Operating under such stress exacerbates the impact of human error and hinders the safe operation of the Ukrainian NPPs[17].

According to Energoatom, after the liberation of the Zaporizhzhia NPP and the satellite city of Energodar, it would take at least two months to defuse the explosive devices installed by the Russian military Forces, check the condition of equipment related to the safe operation of the plant, facilities and the surrounding area.

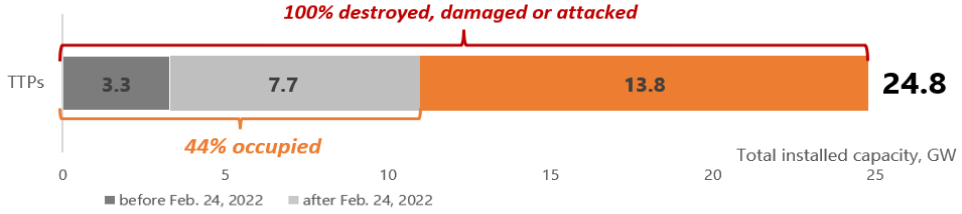
Thermal energy

At the beginning of 2022, there were 12 TPPs in Ukraine with a total installed power capacity of 21.5 gigawatts (GW) (excluding the plants located in the territories temporarily occupied by Russia before February 24, 2022). Most TPPs are using coal as a primary fuel. In 2021, the TPPs' share in electricity production was 23.8%. Since 2014, two TPPs with an installed capacity of 3.3 GW have been located in the occupied Donbas region.

After February 24, 2022, Russian military forces occupied three TPPs (Zaporizka TPP, Luhanska TPP, and Vyglehirska TPP) with a total installed capacity of 7.7 GW. As of April, 2023, Ukraine lost about 78% of its thermal power capacities.

All TPP's under Ukrainian control before February 24, 2022 were either destroyed or damaged (see figure below). The majority of TTP's were attacked more than one time. Almost twenty TPP power units remain damaged due to constant attacks.

DTEK Energy, the largest operator of TPPs in Ukraine, estimated damages from Russia's attacks on these plants at $160 million. In total, the facilities of the company were attacked 30 times and more than one thousand pieces of equipment were damaged. The TTPs of the state-owned company "Centrenergo" were targeted during 13 out of 15 massive missile attacks and were hit 32 times during the 2022/2023 heating season.



Source: ECS based on publicly available data

Combined heat and power

At the beginning of 2022, the total installed power capacity of combined heat and power plants (CHPs) was 6.1 GW (excluding the plants located in the territories temporarily occupied by Russia before February 24, 2022). Most CHPs are using natural gas as a primary fuel. In 2021 the share of CHPs and cogeneration units in electricity production

[13] Russian occupants located military equipment and explosives in the turbine room of ZNPP Unit 4, Russian occupants located military equipment and explosives in the turbine room of ZNPP Unit 4 | State Nuclear Regulatory Inspectorate of Ukraine (snriu.gov.ua)

[14] At ZNPP, control over nuclear workers has strengthened: staff is forbidden to even communicate with each other, https://www.energoatom.com.ua/app-eng/eng-1605231.html

[15] Ibid.

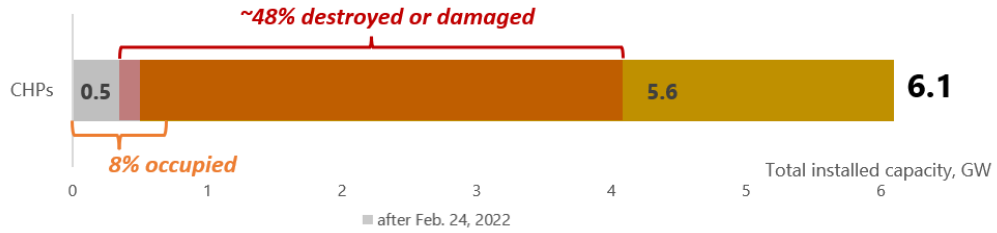
[16] https://interfax.com.ua/news/general/884989.html

[17] Dangerous Targets: Civilian Nuclear Infrastructure and the War in Ukraine. Preliminary Lessons for Safety and Security in War Zones, https://static.rusi.org/398-SR-Dangerous-Targets-web-final.pdf

was 5.5%.

As of today, around 8% of the installed capacity from CHPs is under occupation, while at least 48% of installed capacities (including 2/3 capacities of CHPs used for balancing the power system) are either destroyed or damaged as a result of Russian attacks (see figure below).

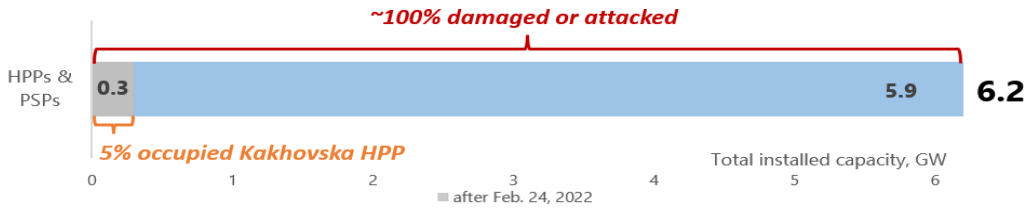
According to preliminary estimates, during the period of the full-scale invasion, five CHP located near the frontline were completely destroyed, while eight CHPPs in Kharkiv, Sumy, Mykolaiv, and Kyiv regions were damaged.



Source: ECS based on publicly available data

Large hydropower

At the beginning of 2022, there were ten large hydropower plants (HPPs) with a total installed power capacity of about 4.7 GW (101 units in total). Three pumped storage plants (PSPs) with an installed capacity of 1.5 GW (11 units ranging from 33 MW to 324 MW per unit) (see Annex 1 for more details). Hydropower plays a crucial role in the functioning of the Ukrainian power system, as HPPs and PSPs are the main providers of auxiliary services to meet the peak demand of the power system and balance intermittent RES capacities. PSPs also contribute to flattening the night "gaps" of electricity consumption. In 2021, the share of HPPs and PSPs in electricity production was 5.8% and 0.8%, respectively. All of the Ukrainian hydropower facilities were either damaged or attacked.



Source: ECS based on publicly available data

Since the first day of the war, Kakhovska HPP (343.2 MW or about 5% of installed capacity) has been occupied and damaged by the Russian army. Public Joint Stock Company (PJSC) "Ukrhydroenergo", the main operator of HPPs and PSPs in Ukraine, has already filed a claim at the European Court of Human Rights regarding the damages caused to the Kakhovska HPP and the unfinished wind power plant on Zmiiny Island. The total amount of the claim is above $0.5 bln.

During the 2022/2023 heating season, there were more than 30 missile hits on hydropower facilities. According to Ukrhydroenergo in total company lost 2,000 MW of generating capacity during the war. As of April 2023, the company restored 500 MW and another 1,500 MW remained damaged or destroyed. As of April 2023, powerlines connecting the HPPs to the grid, including reserve ones, were able to transmit only 50-70% of the installed capacity of operating plants due to the inflicted damages and required urgent restoration.

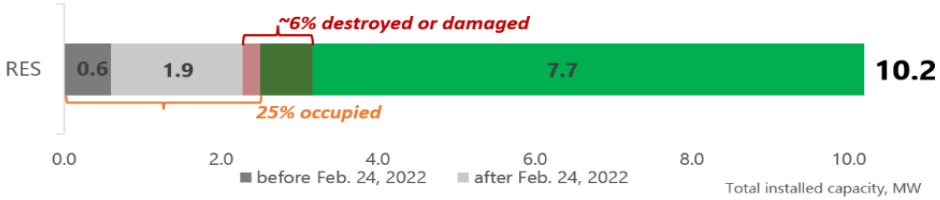
According to publicly available information, in May 2023, Russian military forces uncontrollably discharge water through the damaged Kakhovskaya HPP that may further cause the destruction of the power plant, in particular, its underwater part[18].

[18] https://censor.net/ua/video_news/3416838/okupanty_skydayut_vodu_z_grebli_kahovskoyi_ges_video

Renewable energy (excluding large HPP)

Ukraine has the highest technical RES potential among other countries in Southeast Europe - 874 GW[19], including solar - 83 GW, onshore wind - 438 GW, and offshore wind - 250 GW. Due to its high RES potential and efficient support mechanisms, Ukraine's renewable energy sector has been developing rapidly, with the share of RES in electricity production increasing from 1.8% in 2018 to 8.2% in 2021. At the beginning of 2022, the total installed RES capacity (all grid-connected) reached 9.5 GW (excluding 0.6 GW of RES capacities located in the territories temporarily occupied by Russia before February 24, 2022). About $12 bln was invested in the Ukrainian RES sector during 2009-2021.

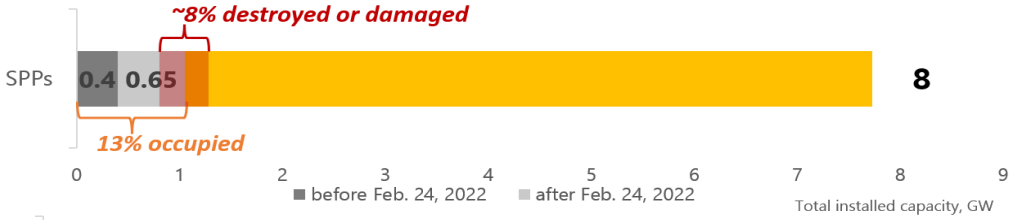
As of today, 2.5 GW (25%) of RES facilities are under occupation. About 6% of the total installed RES capacity has been destroyed or damaged.



Source: ECS based on publicly available data

Solar

The photovoltaic (PV) sector had the highest growth rate among other renewable energy sources in Ukraine during 2019-2021. At the beginning of 2022, the total installed PV capacity (excluding 0.4 GW located in the territories temporarily occupied by Russia before February 24, 2022) reached 7.6 GW or 80% of the total RES installed capacity in Ukraine (including 45,000 prosumer installations with a total capacity of 1.2 GW). In 2021, Ukraine was ranked 7th in Europe for the development of solar generation (IRENA, 2022).[20]



Source: ECS based on publicly available data

Currently, about 13% of Ukrainian PV capacities are under occupation. About 8% of the total installed solar capacity has been destroyed or damaged, including hundreds of prosumer installations.

As outlined in one of the previous reports[21], after the liberation of territories temporarily occupied by the Russian Federation, RES facilities were gradually put into operation. For example, the results of the preliminary inspection indicate that about 20% of the solar panels at the liberated Tryfonivska SPP with an installed capacity of 10 MW were damaged. As of April 2023, due to the damage to the power grid, the SPP could inject into the power system only 20% of its installed capacity, i.e. 2 MW.

Wind

At the beginning of 2022, Ukraine's total installed capacity of wind power plants (all onshore) was 1.6 GW (excluding 0.2 GW located in the territories temporarily occupied by Russia before February 24, 2022). Almost all wind power plants in Ukraine were built in the southern regions nearby the Azov and Black seas coasts (Kherson

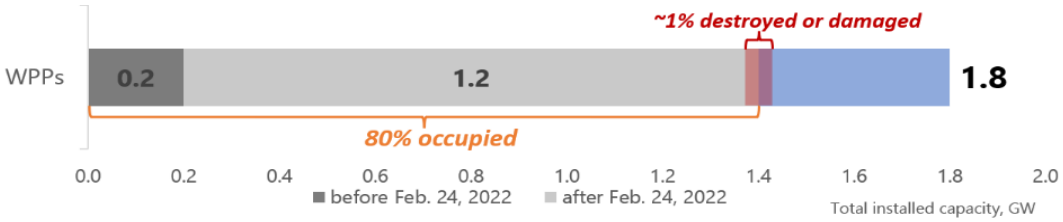
[19] "Renewable energy sources of Ukraine", National Academy of Sciences of Ukraine, 2022, https://www.ive.org.ua/wp-content/uploads/atlas.pdf
[20] "Renewable Energy Statistics 2022", IRENA, 2022, https://www.irena.org/publications/2022/Jul/Renewable-Energy-Statistics-2022
[21] Task Force, "Ukrainian energy sector evaluation and damage assessment – VI (as of January 24, 2023)", 2023, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_01_24_UA_sectoral_evaluation_and_damage_assessment_Version_VI.pdf

and Zaporizhzhia regions), where natural conditions for wind power plants are the most favourable.

Currently, the Russian Federation occupies the south of Ukraine, where the highest wind potential is available. Thus, approximately 80 % of wind generation capacities are located in the occupied territories. As of today, at least 10 wind turbines are known to be damaged or destroyed as a result of the hostilities by the Russian army (about 1 % of the total installed wind capacity).

According to preliminary estimates of the Ministry of Energy and the Ukrainian Wind Energy Association, financial losses from the destruction, damages or theft of wind power plant equipment by the Russian Military Force were estimated at more than 50 million euros. At the same time, the lost revenue of the Ukrainian wind power industry due to the war was estimated at more than 500 million euros.

In May 2023, one of Ukraine's largest private energy companies, put into operation phase I of the Tyligulska Wind Power Plant (WPP) located just 100 km away from the frontline in the Mykolaiv region. The plant has 19 turbines with an installed capacity of 114 MW, generating up to 390 MWh/year, i.e. enough to power 200,000 households.

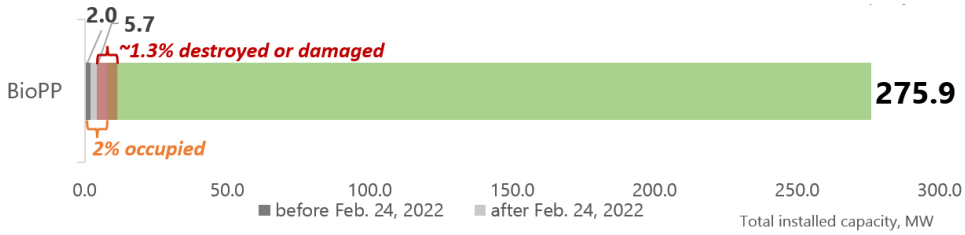


Source: ECS based on publicly available data

Bioenergy

At the beginning of 2022, the total installed capacity of bioenergy power facilities was 273.9 MW (excluding the 2 MW biomass power plant located in the territories temporarily occupied by Russia before February 24, 2022). In 2021, the share of bioenergy in electricity production was 0.6%.

As of today, 5.7 MW (1.3%) of bioenergy facilities are under occupation. It is known that at least four plants were shelled and damaged.

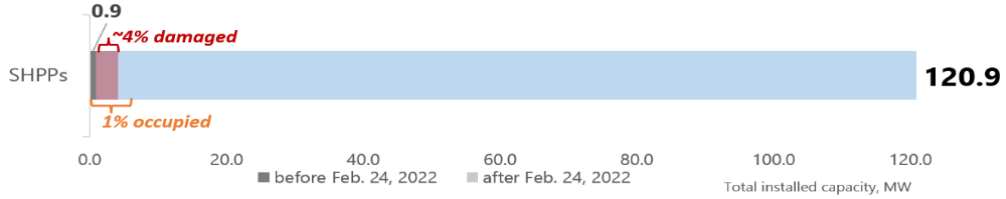


Source: ECS based on publicly available data

Small hydro (<10MW)

At the beginning of 2022, there were 177 small hydropower plants (SHPPs) in Ukraine with an installed capacity of 120 MW (excluding one SHPP (0.9 MW) located in the territories temporarily occupied by Russia before February 24, 2022). In 2021, the share of SHPPs in electricity production was 0.1 %.

Due to the liberation of Ukrainian territories in November, 2022, all SHPPs occupied by the Russian Federation after February 24, 2022, returned under the control of Ukraine.



Source: ECS based on publicly available data

Storage

In 2021, the first pilot energy storage facility with an installed capacity of 1 MW was built at the Zaporizka TPP, while at least 212 MW of storage capacities were at different stages of development.

Nowadays, the only electricity storage facility in Ukraine is under occupation, and the implementation of all planned projects has been temporarily suspended.

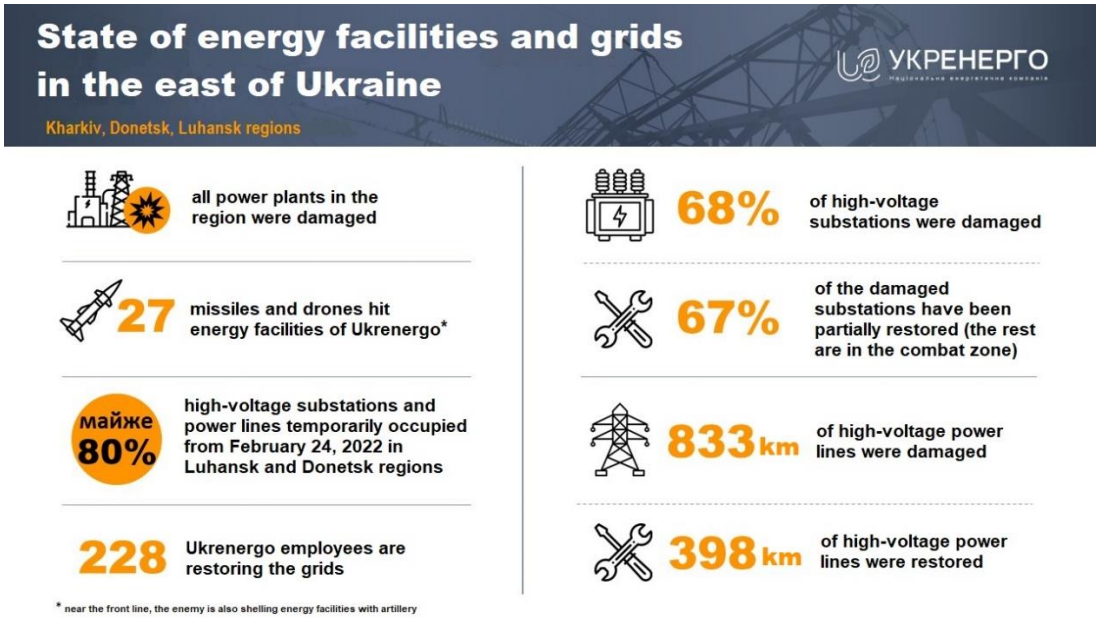
Transmission system

The Ukrainian electricity transmission system includes 23,600 km of overhead lines and 141 substations with a voltage of 110–750 kV operated by the Ukrainian transmission system operator (TSO) National Energy Company (NEC) "Ukrenergo". 25% of transmission substations were located in the territories temporarily occupied by Russia before February 24, 2022 and 12% were occupied after. Due to Russian targeted attacks on transmission system infrastructure, about 45 % of controlled transmission substations were destroyed or damaged. Some of the substations were attacked more than one time.

On March 16, 2022, Ukrainian and Moldovan Power Grids successfully synchronised with the Continental European Grid (ENTSO-E) in response to Russia's invasion of Ukraine. On June 30, 2022, Ukraine started commercial electricity export to the EU countries. Within 10 months in 2022, Ukraine exported electricity worth $542.5 mln. The massive attack and consequential damages to the power sector also resulted in the Ukrainian government's decision to stop electricity export to the European Union (EU) starting from October 11, 2022.

As of April 2023, Ukraine continued importing small volumes of electricity from continental Europe's power system (ENTSO-E) as well as started exporting electricity to European countries. On April 18, 2023, Transmission System Operators of Continental Europe increased cross-border capacity for import to Ukraine to 1,050 MW.

In April 2023, NEC "Ukrenergo" published the preliminary estimates of the company's damages and losses in the Kharkiv, Donetsk and Lugansk regions as a result of the Russian aggression.



Source: Ukrenergo

Distribution networks

The electricity distribution systems in Ukraine include more than 800 thousand km of overhead and cable lines with 0.4–150 kV voltage and about 200,000 6-150 kV transformer substations operated by 32 distribution system operators (DSOs).

As of the beginning of January 2023, more than one thousand overhead lines (6-150 kV) and more than eight thousand transformers (6-150 kV) were damaged or disconnected due to continuous shelling and hostilities (not including power infrastructure disconnected due to emergencies).

Demand and supply

At the beginning of 2022, there were 17.7 mln electricity consumers in Ukraine, including 17.2 mln households and 0.5 mln commercial customers.

As a result of hostilities, electricity demand decreased by 30-35% compared to 2021. The consumption pattern also changed due to the shutdown of industrial enterprises and the massive displacement of consumers from Eastern to Western Ukraine. It is foreseen that the total electricity generation in 2022 will be 25% less than the "pre-war" forecast due to Russian military aggression. Since February 24, 2022, almost all consumers have been temporarily disconnected from the electricity supply.

Ukrainian TSO and DSO's restore electricity supply where possible, but regular attacks by Russian forces lead to new damages and destructions.

Natural gas sector

Natural gas production

Ukraine has Europe's third-largest natural gas reserves (up to 719 bln cubic meters (bcm)) (EY, 2020)[22]. The largest reserves are located in the Poltava, Kharkiv, and Lviv regions and on the Black and Azov Seas shelf. In 2021, there were about 542 issued licenses and 25 large companies operating in the oil and gas exploration and production sector, including three state-owned and 22 companies with Ukrainian and foreign investments. Over the last 20 years, the volume of natural gas production in Ukraine was about 20 bcm/year (about 55 mln cubic meters (mcm)/day). Ukraine's main gas production regions (excluding the temporarily occupied territories by Russia before February 24, 2022) are the Poltava and Kharkiv regions (about 90% of total production).

After February 24, 2022, approximately 15% of the country's natural gas reserves are under Russian occupation. More than 150 gas production facilities, primarily located in the Kharkiv region, were suspended because of hostilities. Therefore, the average daily production decreased by almost 11% (about 49 mcm/day).

At the end of October 2022 JSC "Ukrgazvydobuvannya" restored the operation of several infrastructure facilities in the de-occupied territory of Ukraine and has been preparing to launch others. The result will be additional production of about 0.5 mcm/day. However, in mid-November 2022, Russia started attacks on natural gas production infrastructure. The information on damages to natural gas production facilities is restricted.

Since the beginning of the Russian full-scale military aggression, 350 gas and oil facilities of the Naftogaz group were destroyed. The number of damaged Naftogaz facilities significantly increased in October-December 2022.

In 2022, about 18.5 bcm of natural gas was produced in Ukraine or only 6% less than in 2021 (19.8 bcm) However, it was lowest level of Ukraine's natural gas production over the last 20 years[23].

The main reason for the reduction in production is the full-scale war that Russia started in Ukraine at the end of February 2022. The occupation of part of the territory of Ukraine (especially the Kharkiv region, where significant reserves and gas production capacities are concentrated) had a negative impact on gas production in these regions and near-front line.

[22] "National report of Ukraine 2020", EY Extractive Industries Transparency Initiative, 2020, https://www.geo.gov.ua/wp-content/uploads/presentations/en/UA_EITI_Report_2020_EN.pdf
[23] https://expro.com.ua/novini/ukrana-v-2022r-skorotila-vidobutok-gazu-na-6-do-185-mlrd-kub-m

As of February 2023, state-owned company Naftogaz estimated its war-related damages of gas infrastructure at $1 bln.

Underground gas storage

Ukrainian underground natural gas storages (UGS) are the largest in Europe and 3rd in the world after the US and Russia (Cornot-Gandolphe, 2018)[24]. There are 13 UGS facilities in Ukraine with a total working gas storage capacity of 31.95 bcm/year (including two UGS with a total capacity of 1.4 bcm/year located in regions temporarily occupied by Russia before February 24, 2022), with maximum gas injection and withdrawal capacities of above 250 and 260 mcm/day, respectively. Most UGS capacities are in Western Ukraine (25.32 bcm/year or 79%).

After February 24, 2022, the operation of one UGS in the East (0.42 bcm/year) was suspended due to hostilities, and one UGS in the central part of Ukraine (capacity 0.31 bcm/year) was damaged. Thus, about 8% of UGS capacities remain unavailable, including 5.7% (1.82 bcm/year) in the temporarily occupied territories, and 2.3% are damaged. There is no information about damages and losses on UGS located in the temporarily occupied territories and areas close to active hostilities.

As of April 2023, the Ukrainian UGS system stored more than 9 bcm of natural gas.

Gas transmission system

The Ukrainian natural gas transmission system (GTS) is one of the most developed in Europe, with a total length of more than 38,000 km and interconnections with the following EU member states Poland, Slovakia, Hungary and Romania. The total capacity of the GTS "entry" points is 281 bcm/year (770 mcm/day) and "exit" points – 146 bcm/year (400 mcm/day). 41.6 bcm of Russian natural gas transited via Ukraine GTS to Europe in 2021.

From May 2022, the volume of transit of Russian gas through Ukraine to EU consumers decreased by approximately 30% due to the interruption of gas transit through the "Sokhranivka" gas metering station (GMS) located on the territory temporarily occupied by Russia. As a result, from May to November 2022, the gas transit through Ukraine's territory decreased to 40-42.5 mcm/day or 37-39% of the capacity contracted by Gazprom (109 mcm/day). About 200 km of gas pipelines and equipment are known to be damaged due to Russian hostilities. Despite the damages, the Ukrainian TSO expressed its readiness to increase transit volumes to the EU via GMS "Sudzha" (capacity 77-244 mcm/day), while Gazprom reduced transit volumes.

Despite the suspension of natural gas transit via the Nord Stream 1 pipeline and increased demand on EU gas markets in August-November 2022, the Russian Federation did not increase the transit via Ukraine's GTS. On the contrary, Russia cut its natural gas production and increased flaring to keep EU market prices high.

In December 2022, the average volume of gas transit through the territory of Ukraine was 42.6 mcm per day which corresponded to 39% of the capacity officially contracted by Gazprom (109 mcm per day). It should also be noted that there is a high risk of a further reduction or suspension of gas transit via Ukraine's GTS due to the explosion of the "Urengoy-Pomary-Uzhhorod" gas pipeline located on the territory of the Russian Federation on December 20, 2022[25]. The pipeline crosses the Russian-Ukrainian border through the "Sudzha" gas measuring station, currently the only entry point for transiting natural gas from Western Siberia to Europe. The explosion further influenced the gas exchange prices on the European market. For example, the Dutch natural gas futures went up from €106.6/MWh to €115/MWh on the same date of the explosion in Russia[26].

At the end of December 2022, all heat only boilers in Donetsk region were forced to shut down as a result of the damage to the main gas pipeline in Kharkiv region, caused by the shelling, the main gas pipeline was damaged..[27]

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[24] Sylvie Cornot-Gandolphe, "Underground gas storage in the world - 2018 status", *Cedigaz Insight ed. 31*, November 2018, https://cdn2.hubspot.net/hubfs/1982707/Overview%20of%20underground%20gas%20storage%20in%20the%20world%202018%20(1).pdf

[25] Mind.ua, https://mind.ua/news/20250978-v-rosijskij-chuvashiyi-vibuhnuv-gazoprovid-cherez-ce-u-evropi-rizko-pidskochili-cini-na-gaz

[26] Trading economics, https://tradingeconomics.com/commodity/eu-natural-gas

[27] https://expro.com.ua/novini/na-harkvschin-poshkodjeno-magstralniy-gazoprovd-gazov-koteln-donechchini-zupinen

In 2022, Russia transported about 20.35 bcm of natural gas via the Ukrainian gas transportation system. This was the lowest level of transit flow since Ukraine became an independent state in 1991. Compared to the previous year, the volume of transit of Russian gas decreased by more than two times, i.e. from 41.6 bcm in 2021 to 20.35 bcm in 2022.[28]

In 2022, Gazprom reduced gas supplies to Europe by 45%, or from 185 bcm in 2021 to 100.9 bcm in 2022, the lowest level in the history of Russian Federation. The sharp reduction in Russian gas supplies is directly related to the Russian invasion of Ukraine and the response of EU Member states reducing the dependence on Russian gas import. In addition, Russia reduced gas supplies to "unfriendly countries" that refused to pay for gas in rubles.

On January 7, 2023, as a result of the explosion of the main gas pipeline in the city of Lutugino in the Luhansk region (under temporary occupation), about 13,000 consumers were left without natural gas supply. According to "Operator GTS of Ukraine" LLC, the explosion had no effect on the transportation of natural gas from the Russian Federation through Ukraine[29].

In January 2023, Moldova officially allowed for all companies to use virtual natural gas reverse flow. It opened opportunities for both Ukrainian (gas imports from Greek and Turkish LNG terminals through the Trans-Balkan Corridor in reverse mode) and foreign (gas transmission via the same route to Ukrainian storages) system users.

On January 19-21, 2023, the volume of gas transit through the territory of Ukraine ranged 24.5-24.7 mcm per day, i.e. only 22-23% of the capacity contracted by Gazprom (109 mcm/day). On February 22, 2023, Gazprom increased transit through the Ukrainian GTS to 42,2 mcm per day, i.e. about 40% of the contracted capacity. As of March 7, 2023, the volume of transit was 42,37 mcm per day.

Gas distribution networks

About 290,000 km of gas distribution networks are operated by 45 gas distribution system operators (DSOs) in Ukraine.

Since February 24, 2022, more than 7,000 km of distribution networks in Eastern and Southern Ukraine have been destroyed or damaged (approximately 12% of the distribution networks in Eastern and Southern Ukraine). More than 5,000 gas distribution control units were either suspended or damaged.

Demand and supply

At the beginning of 2022, there were 12.6 mln of natural gas consumers in Ukraine, including 12.5 mln households and 0.1 mln commercial customers.

As a result of the hostilities and damaged infrastructure, natural gas consumption decreased by more than 30% compared to daily consumption in 2021. As of January 24, 2023, about 600 thousand households were without the gas supply (5% of the total). Due to damages, natural gas consumers of the Donetsk region are almost entirely disconnected from the gas supply. Kherson, Dnipropetrovsk, Luhansk, Zaporizhzhia, Mykolaiv and Kharkiv regions had the most challenging situation. DSOs regularly restore gas supplies where possible, but regular attacks by Russian troops lead to new damages and destructions.
According to experts estimates, the consumption of natural gas in Ukraine in 2022 is expected to be 30% lower than in 2021, or 8.7 bcm less below the level of 202. The volume of gas imports from the EU to Ukraine in 2022 decreased by 42%.

[28] https://expro.com.ua/novini/tranzit-rosyskogo-gazu-cherez-ukranu-vpav-do-storichnogo-mnmumu-20-mlrd-kub-m-u-2022r
[29] https://expro.com.ua/novini/na-magstralnomu-gazoprovod-v-lugansky-oblast-stavsya-vibuh

Oil & petroleum products

Oil production

Ukraine's oil reserves are estimated at approximately 85 mln tons (EY, 2020)[30]. More than 51% of the total reserves are concentrated in the North and Central regions, 36% in the Western and 13% in Southern Ukraine. Oil and gas condensate production in 2021 amounted to 2.4 mln tons (6.66 thousand tons/day). In 2021, 25 large companies were operating in the oil and condensate exploration and production sector, including two state-owned (that produced about 80% of total oil production) and more than 20 companies with Ukrainian and foreign investments (up to 20% of total oil production).

After February 24, 2022, almost 10% of the country's oil reserves are located in temporarily occupied territories. The volume of oil production in areas close to active hostilities and under the constant threat of occupation has decreased significantly. The information on damages to oil production facilities is restricted.

According to Ukrnafta, the largest oil extraction company in Ukraine, the company's oil production decreased by 8.6% in 2022 compared to 2021. There is no publicly available data about the overall reduction of oil production in Ukraine in 2022.

Oil transmission system

In 2021, the oil transmission system of Ukraine included 19 oil pipelines with a diameter of up to 1,220 mm, a total length of 3,506.6 km and 176 pumping stations. The total capacity of the tank park was 1,083 thousand cubic meters. The total capacity of the oil transmission system at the "entry" points was 114 mln tons/year at the "exit" points - 56.3 mln tons/year in 2021.

The system transmitted oil from Ukrainian oil fields and seaports, i.e. imported by sea transport (including for the needs of the refinery of Belarus), as well as transited Russian oil through the "Druzhba" oil pipeline to Slovakia, the Czech Republic, and Hungary. In 2021, the Ukrainian oil transmission system transported 15.7 mln tons, including 12.7 mln tons of transit of Russia's oil and 3.0 mln tons to local refineries.

After February 24, 2022, a significant amount of principal and auxiliary equipment was damaged at three oil transmission facilities, including three cases of damage to cable communication systems. It is estimated that oil transit and transportation volume will be significantly reduced due to destroyed oil transmission facilities and Ukrainian refineries and the reduction/suspension of transit to Belarus in 2022.

On November 15 and November 23 2022, the oil transportation to Hungary, Czechia, and Slovakia via "Druzhba" oil pipeline was suspended due to the damages inflicted on the substation powering the pipeline by the Russian military forces. However, the oil pipeline operation was restored the same day due to Ukraine's coping mechanisms and the efforts of the power sector employees.

Oil refinery and gas processing

In 2021, there were six refineries and one gas processing plant (GPP) in Ukraine, with a total designed oil processing capacity of over 50 mln tons/year[31]. Still, the actual production capacity was about 7.5 mln tons/per year. It was mainly based on the capacities of two plants: Kremenchuk Refinery (up to 7 mln tons/year) and Shebelynka Gas Processing Plant (about 0.5 mln tons/year). The two plants covered about 25% of the needs of the Ukrainian demand for oil products, which was 12.35 mln tons in 2021.

After February 24, 2022, the work of the Shebelynka GPP was suspended due to Russian hostilities and the plant

[30] "National report of Ukraine 2020", EY Extractive Industries Transparency Initiative, 2020, https://www.geo.gov.ua/wp-content/uploads/presentations/en/UA_EITI_Report_2020_EN.pdf

[31] Note: Starting from 2014, only two out of six oil refinery and gas processing plants remained active in Ukraine, mainly due to changes in the structure of the owners as well as ageing refinery equipment.

was later damaged by a missile attack. In September 2022, the Russian military forces continued regular shelling of the Shebelynka GPP and its fuel reservoirs. Multiple missile attacks destroyed the Kremenchuk Refinery (in total, Russia shot 32 missiles at the Kremenchuk Refinery) and damaged the facilities of Odesa and Lysychansk Refineries (the latter is owned by the Rosneft - the second largest Russian state-controlled Company after Gazprom).

As a result, the Ukrainian oil refinery industry has been destroyed, and the country is almost 100% dependent on imported petroleum products. According to the State Customs Service, Ukraine imported 5.8 mln tons of petroleum products (gasoline, diesel fuel, fuel oil, jet fuel, etc.) in January-October 2022, which is 13.1% less than in the same period last year (6.67 mln tons). Despite the reduction of the import volume, the costs of the imported oil products were 70.2% higher than in January-October 2021. On December 20, 2022, Russia attacked oil and gas infrastructure facilities in the Kharkiv region. As a result of the attack, the fire spread to the area of 4,500 square meters[32].

On February 16, 2023, Russian forces launched 15th massive attack, primary targeting oil refinery infrastructure. Multiple missiles hit Kremenchuk and Drohobych oil refinery plants although plant in Kremenchuk had not been operating due to the damages inflicted during the previous attacks, and plant in Drohobych had been stopped about 10 years ago. Apart from large refineries and other energy facilities, the massive attack also targeted mini refineries, one of which was damaged in the Kyrovograd region.

KSE estimates damages and losses at Kremenchuk oil refinery at $405 million and at Lysychansk (LYNIK) - $126 million[33]. Equipment of both plants was seriously damaged due to Russians attack at the first months of the war.

Oil products storage (oil depots)

Since oil product storage capacities were among the primary targets for Russian military forces, the information about the total number of oil depots and "pre-war" status is restricted.

Since February 24, 2022, more than 30 oil depots have been destroyed or significantly damaged in almost all regions of Ukraine.

According to the Ministry of Environmental Protection and Natural Resources of Ukraine, the destruction of oil depots by the Russian military forces resulted in the additional emission of 499,000 tons of pollutants into the atmosphere. For comparison, the emissions of Ukraine's largest industrial polluter are estimated at 220,000 tons annually. The additional emissions pose substantial risks for neighbouring countries as, depending on the wind direction, dangerous pollutants from burnt oil products may move to the territories of other countries and fall there as acid rain. Since the beginning of Russia's invasion, the estimated volume of pollutants emissions has reached 46 mln tons. For comparison, this indicator was ten times lower in 2019 - about 2.4 mln tons, and in 2021 - 2.25 mln tons (Krechetova, 2022)[34].

Fuel stations

In 2021, there were more than 7,500 fuel stations in Ukraine, including petroleum, natural gas and electricity charging stations. The vast majority of stations belong to private companies.

Since the beginning of the full-scale invasion, Russia's attacks either destroyed or damaged more than 300 fuel stations[35]. It is impossible to accurately estimate the number of fuel stations damaged or destroyed due to occupation and ongoing hostilities.

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[32] Video of the explosion, NJSC "Naftogaz of Ukraine" https://www.naftogaz.com/news/rosiya-vkotre-obstrilyala-ob-ekty-grupy-naftogaz-video

[33] Damages caused to Ukrainian business as a result of Russian aggression are estimated at $13 billion — Kyiv school of economics, 2023 https://kse.ua/ua/about-the-school/news/zbitki-zavdani-ukrayinskomu-biznesu-vnaslidok-rosiyskoyi-agresiyi-otsinyuyutsya-v-13-mlrd/

[34] Diana Krechetova, "How did the destruction of oil depots and Russian missile attacks affect air pollution? The Ministry of Environment is in charge", Life Pravda, 2022, https://life.pravda.com.ua/society/2022/09/13/250436/

[35] "The total amount of damage caused to Ukraine's infrastructure is more than $136 billion" — Kyiv school of economics, 2022, https://kse.ua/about-the-school/news/as-of-november-2022-the-total-amount-of-losses-caused-to-the-infrastructure-of-ukraine-increased-to-almost-136-billion/

Coal

Coal production

Ukraine is a coal-rich country with the largest coal reserves in Europe (TheGlobalEconomy.com, 2022)[36]. According to various estimates, the total proved coal reserves are about 38 bln tons (including the coal reserves located in the territories temporarily occupied by Russia before February 24, 2022). About 92.4% of total coal reserves are located in the Donetsk hard coal basin (Donbas). In 2021, Ukraine produced about 29 mln tons of hard coal. For comparison, the average coal production before Russia occupied Donbas's territories in 2014 was 80 mln tons per year.

Currently, about 60% of the country's coal deposits are temporarily occupied by Russia. As of May 2023, Ukrainian companies accumulated about 1.5 mln tons of coal reserves in their warehouses.

Coal mines

There were 151 coal mines in operation in 2013 (before Russia temporarily occupied the Donbas region in 2014) and only 47 coal mines in 2021 (before the full-scale invasion of the Russian Federation of Ukraine on February 24, 2022).

Currently, 95 mines are located in the Ukrainian territories temporarily occupied by Russia, including 28 privately owned and 67 state-owned mines. According to publicly available data, at least six coal mines are flooded, threatening an ecological disaster in the region.

In the occupied city of Dovzhansk (Luhansk region), Russia suspended activities and transferred industrial equipment from the Chervonyi Partyzan and Kharkivska mines to the Krasnoyarsk region, the Russian Federation[37]. At the end of January 2023, Russia also closed down coal mines named after Zasiadko, Academician Skochynskyi and Kalynovska-skhidna which were also located on the territories temporarily occupied by the Russian Federation[38].

Uranium (mines and refinery)

There are three uranium mines and uranium refinery capacities in Ukraine located in Dnipropetrovsk and Kirovograd regions. In 2021, the domestic mining, processing of uranium ores and nuclear fuel production covered about 40% of the country's needs. In 2021, Ukraine commissioned the centralised storage of used nuclear fuel in the exclusion zone of the Chornobyl NPP. The life cycle of the storage is at least 100 years.

The exclusion zone of the Chornobyl NPP was under occupation from February 24 to March 31, 2022. As a result of the occupation, the Russian military forces looted and destroyed the newest Central Analytical Laboratory in Chornobyl, a unique complex with powerful analytical capabilities that could provide services related to radioactive waste management (from conditioning to disposal, as well as at the stage of research and development of technologies).

Ammonia

Ukraine's ammonia pipeline is the fifth largest in the world. Ammonia is transferred from the Russian chemical enterprise in Tolyatti to the Odesa Port Plant in Yuzhny city. The length of the pipeline is 2,417 km, of which 1,021 km passes through the territory of Ukraine. The capacity of the ammonia pipeline is up to 2.5 mln tons per year.

Even if there is no supply of ammonia from the territory of Russia, the pipeline has the potential to be used to

[36] "Coal reserves Europe – Country rankings", TheGlobalEconomy.com, 2022, https://www.theglobaleconomy.com/rankings/coal_reserves/Europe/
[37] Luhansk Regional Military Administration, https://t.me/luhanskaVTSA/6977
[38] https://ru.slovoidilo.ua/2023/01/25/novost/obshhestvo/okkupanty-donbasse-zakryli-shaxtu-im.-zasyadka

transport ammonia converted from "green "hydrogen.

On February 24, 2022, the first day of the Russian invasion of Ukraine, the transit of ammonia through the pipeline was stopped. On May 30, 2022, the Russian military forces damaged the ammonia pipeline branch in the Bakhmut district of the Donetsk region.

The UN calls for the restoration of the Tolyatti-Odesa ammonia pipeline. The President of Ukraine, Volodymyr Zelenskiy, said that Ukraine would agree to resume the supply of Russian ammonia through the pipeline through Ukraine only if Russia returned the Ukrainian prisoners of war.

Lithium

According to preliminary estimates, Ukraine's total lithium resource potential is relatively high (approximately 500,000 tons of lithium oxide) (Vasylenko & Uliana, 2022)[39]. This ultra-light metal is a critical element for the future of the Ukrainian power system as it is widely used to make power batteries, including energy storage and electric vehicles. There are two explored deposits and two pre-explored areas of lithium ores in Ukraine.

As of today, at least two lithium deposits are located in the territories temporarily occupied by Russia in Zaporizhzhia and Donetsk regions.

District heating

Thermal energy is mainly produced by CHPs (described above) and heat-only boilers (HOBs) in Ukraine. In 2021, there were 19,025 HOBs in Ukraine from which the thermal energy was transported by 1.9 mln km of pipelines and distributed through 5,523 central heating points. The energy balance in the district heating sector consists of gas and coal, which together make up 90%, and about 10% of bioenergy.

At end of November, 444 HOBs, 128 central heating points and more than 200 km of district heating networks were either destroyed or damaged. At the same time, 316 damaged facilities were restored[40]. Since the local district heating infrastructure has been severely damaged due to Russian hostilities, there are no heating season in some regions of Ukraine.

Electric vehicles

In 2021, there were 33,522 electric cars in Ukraine or about 1% of the total car fleet. Despite the energy crisis provoked by Russian attacks on energy infrastructure facilities in Ukraine, the demand for electric vehicles continues to grow. During November 2022, 1,447 battery electric vehicles (BEVs) were added to the car fleet of Ukraine, which is 60% more than last year but 10% less than in October this year.

Since the beginning of 2022, more than 12,500 cars with battery power sources have been registered for the first time in Ukraine, which is one and a half times more than in the same period of 2021. The total fleet of electric cars and hybrids in Ukraine exceeded 100,000 cars[41].

Climate impact

Among other aspects, Russia's attacks significantly affected and negatively impacted the global efforts to reach the objectives of the Paris Agreement. According to the latest study, greenhouse gas (GHG) emissions caused by Russia's full-scale invasion of Ukraine totaled at least 100 mln tons of CO2e (carbon dioxide equivalent) from February 24 to September 24, 2022[42]. This is the equivalent of the total GHG emissions of The Netherlands over

[39] Vasylenko, Svitlana & Uliana, Naumenko. (2022). PROSPECTS OF DEVELOPMENT OF LITHIUM RESOURCE BASE IN UKRAINE. InterConf. 10.51582/interconf.19-20.02.2022.072.
[40] The Ministry of Communities and Territories Development of Ukraine, https://www.minregion.gov.ua/press/news/minregion-vidbulos-11-zasidannya-shtabu-z-pidgotovky-do-opalyuvalnogo-sezonu/
[41] Ukrainian Motor Vehicle Manufacturers Assosiation, https://ukrautoprom.com.ua/statystyka-prodazhiv-avtomobiliv-u-lystopadi-2022
[42] Initiative on GHG accounting of war, CLIMATE DAMAGE CAUSED BY RUSSIA'S WAR IN UKRAINE, 2022, https://climatefocus.com/wp-content/uploads/2022/11/ClimateDamageinUkraine.pdf

the same period. These figures are likely even higher considering the massive attacks from September 25 to November 24. Therefore, the more Russia continues its aggression, the higher the negative impact on climate will be.

Since the beginning of the war, in 2022 about 2,300 crimes against the environment have been recorded. The damage caused to the environment has already exceeded $46 bln.

According to the Ministry of Natural Resources of Ukraine, at the end of April 2023, damages due to environmental pollution as a result of attacks only on facilities producing, processing, and storing fuel and lubricant materials were about $90 mln[43].

Cyber security

From February 24 2022, more than 1.2 mln cyberattacks have been carried out on energy infrastructure facilities. In comparison, there were 0.9 mln of cyber-attacks in 2021. It should also be mentioned that Russia began intensive cyber-attacks on the Ukrainian energy sector even before the full-scale invasion on February 24, 2022. Namely, from December 2021 to February 2022, Russia repeatedly tried to inflict maximum damage to the work of Ukrainian energy companies, including interfering with the work of dispatch centres and smart grids[44].

In 2022, more than 3 million cyberattacks were carried out on Naftogaz's network infrastructure or 12 times more than in 2021.

Information security

Since the beginning of Russia's full-scale military invasion of Ukraine, Russia has fabricated a set of false narratives and used disinformation and propaganda to inflict damage on the Ukrainian energy sector.

Even before the massive attacks on energy infrastructure, Russian media was trying to spread panic not only in Ukraine but in Moldova and EU member states. Another example of Russia's disinformation is fake news about GoU's request to citizens in March 2022 to turn off the lights in the evening. This information attack was aimed at complicating power system balancing, mainly when the Ukrainian power system was operating in an autonomous mode before joining ENTSO-E.

Since October 2022, Ukrainian citizens have been living under conditions of scheduled rolling and emergency blackouts. At the same time, Russia's false narratives, disinformation and propaganda are aimed at increasing public dissatisfaction and undermining citizens' trust in energy companies and Ukrainian authorities. Through manipulation and false narratives, Russia attempts to shift the responsibility for the blackouts and energy crisis from Russia to Ukraine, both in Ukrainian and European media.

For example, on December 18, 2022, Russian media launched an information attack by distributing a fake letter allegedly sent to the Ministry of Energy (MoE) by the CEO of NEC Ukrenergo. The fake letter allegedly requested the MoE to decrease the power supply to some Ukrainian regions to resume electricity exports to the EU countries. Thus, Russian media attempted to create fake narratives and to shift the responsibility for power outages from Russia to Ukraine, i.e. to convince the audience that blackouts were caused by allegedly deceptive decisions of the Ukrainian decision-makers rather than by the nine massive Russian missile attacks damaging energy facilities. The DTEK group also informed its clients that dozens of fake accounts using the company's name were created on social networks for disinformation, manipulation of public opinion and spreading panic among Ukrainian citizens.

[43] The Russian Federation destroyed 35 oil depots in Ukraine and caused UAH 3.3 billion in damage to the environment - Ministry of Natural Resources, https://interfax.com.ua/news/greendeal/907725.html

[44] Ministry of energy of Ukraine, https://www.mev.gov.ua/novyna/z-pochatku-viyny-zafiksovano-ponad-12-mln-kiberatak-na-enerhosektor-farid-safarov

Task Force "Cooperation for Restoring the Ukrainian Energy Infrastructure"

VASIL KISIL

KEY LEGAL DEVELOPMENTS IN UKRAINE'S ENERGY SECTOR - VIII

from 24 February 2022 to 31 May 2023

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CONTENT

I. INTRODUCTION

The full-scale military aggression by the Russian Federation, launched on 24 February 2022, has had a significant negative impact on the Ukrainian energy sector. Due to their economic, humanitarian and geopolitical importance, energy infrastructure facilities were and continue to be among the primary targets for the Russian army.

Since the full-scale invasion, Ukraine has implemented various coping mechanisms to manage the energy crisis related to the damaged energy infrastructure. Therefore, this document outlines coping strategies and emergency response mechanisms employed via legislative and regulatory changes. Most changes are meant to ensure the security of supply and the citizens' access to energy during wartime and to prevent humanitarian crises. Some changes were also made as a part of Ukraine's energy sector reforms that were initiated before the full-scale invasion and were halted due to hostilities.

The legislative and regulatory changes are meant to address the negative impact of the war and are normally introduced for the duration of martial law, which was imposed on 24 February 2022 when the President of Ukraine signed the relevant decree[1]. The decree is regularly amended to prolong martial law until the hostilities cease. Currently, martial law is imposed until 18 August 2023[2] and is expected to be prolonged again. Other legislative changes introduced as a part of Ukraine's reforms are not limited in duration.

The first Key Legal Developments in Ukraine's Energy Sector Report covered the period from 24 February to 20 October 2022[3] and was followed by regular monthly updates[4]. This is the eighth updated edition of the document that outlines the key legal developments during the full-scale invasion from 24 February 2022 to 31 May 2023 and aims to provide a concise but comprehensive overview of key legislative and regulatory changes introduced for the duration of martial law and as a part of ongoing energy sector reforms in Ukraine. The paper provides an overview of the approved legal changes and does not include information about draft legal acts at different stages of development and approval. The document was developed by Vasil Kisil and Partners in cooperation with the Task Force comprised of Ukrainian authorities and the Energy Charter Secretariat representatives, established under the project "Cooperation for Restoring the Ukrainian Energy Infrastructure". All comments and proposals for improvement can be sent to Oleksandr Antonenko at oleksandr.antonenko@encharter.org and Tetiana Revutska at revutska@vkp.ua.

DISCLAIMER

Information contained in this work has been obtained from sources believed to be reliable. However, neither Vasil Kisil and Partners nor the Task Force nor its other participants guarantee the accuracy or completeness of any information published herein, and neither shall be responsible for any losses or damages arising from the use of this information or from any errors or omissions therein. This work does not attempt to render legal or other professional services or advice and is not an invitation or a proposal to invest.

[1] Decree of the President of Ukraine "On the imposition of martial law in Ukraine" No. 64/2022 dated 24 February 2022.
[2] Decree of the President of Ukraine "On the prolongation of martial law in Ukraine" No. 254/2023 dated 01 May 2023.
[3] Key Legal Developments in Ukraine's Energy Sector – I (from 24 February to 20 October 2022), https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_10_26_Legal_developments_in_Ukraine_s_energy_sector.pdf & https://vkp.ua/en/publication/key-legal-developments-in-ukraine39s-energy-sector
[4] Key Legal Developments in Ukraine's Energy Sector - II – V (from 24 February to 24 April 2023):
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_11_20_Legal_developments_in_Ukraine_s_energy_sector_II.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/20221219_Legal_developments_in_Ukraine_s_energy_sector_III.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_01_27_Legal_developments_in_Ukraine_s_energy_sector_IV.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_02_24_Legal_developments_in_Ukraine_s_energy_sector_V.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_02_24_Legal_developments_in_Ukraine_s_energy_sector_VI.pdf
https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_04_24_Legal_developments_in_Ukraine_s_energy_sector_VII.pdf

II. UPDATES BETWEEN 25 APRIL 2023 AND 31 MAY 2023

On 01 May 2023, the President prolonged the martial law until 18 August 2023[5].

Strategic documents

On 25 April 2023, the Cabinet of Ministers (CMU) amended the list of government authorities responsible for fulfilling Ukraine's responsibilities as a member of international organisations. Namely, the CMU defined the Ministry of Energy of Ukraine (MoE) as the responsible authority for the working group on renewable energy sources (RES) instead of the State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE). The SAEE was also removed from the list of authorities responsible for the International Renewable Energy Agency (IRENA) and was replaced with the National Energy and Utilities Regulatory Commission (NEURC), while the previously appointed MoE and the Ministry of Foreign Affairs remained in the list[6].

Environment and renewables

On 02 May 2023, the President of Ukraine signed the law amending the Budget Code and establishing the State Fund of Decarbonisation and Energy Efficient Transformation from 01 January 2024. The Fund's expenses will be used in three directions: (1) state projects for energy efficiency, development of RES and reducing CO_2 emissions; (2) state guarantees for loan and leasing agreements of individuals and legal entities for RES and CO_2 emissions reduction projects; and (3) to repay state loans received for such projects[7].

Nuclear

On 02 May 2023, the CMU adopted a decision to start the corporatization of Energoatom and created the corporatization committee[8].

Import of hydrocarbons

On 09 May 2023, the CMU added Russian oil, oil products, natural gas and other hydrocarbons to the list of goods the import of which is prohibited to the territory of Ukraine, excluding transit via pipelines[9]. On 30 May 2023, the changes were further amended to allow the import of oil and oil products, if the importer provides a certificate of origin proving that the goods are not of Russian origin after the import[10].

Electricity supply

On 30 May 2023, the CMU increased electricity prices by 57-83% and approved a single tariff for households at UAH 2.64 (EUR 0.07) per kWh (VAT included) from 01 June to 31 December 2023[11].

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[5] Decree of the President of Ukraine "On the prolongation of martial law in Ukraine" No. 254/2023 dated 01 May 2023.

[6] Resolution of the CMU "On amending the list of central executive authorities and other state authorities responsible for fulfilling duties arising from Ukraine's membership in international organizations" No. 289 dated 25 April 2023.

[7] The Law of Ukraine "On amending the Budget Code of Ukraine" No. 3035-IX dated 11 April 2023.

[8] Resolution of the CMU "The matter of the transformation of the state-owned enterprise "National Atomic Energy Generating Company "Energoatom" into a joint-stock company, 100 percent of whose shares belong to the state" No. 2394-p dated 02 May 2023.

[9] Resolution of the CMU "On amending the list of goods originating from the Russian Federation banned from import into the customs territory of Ukraine" No. 459 dated 09 May 2023.

[10] Resolution of the CMU "On amending the Resolution of the CMU No. 1147 dated 30 December 2015 and No. 1466 dated 27 December 2022" No. 545 dated 30 May 2023.

[11] Resolution of the CMU "On amendments to the resolution of the CMU of 05 June 2019 No. 483" No. 544 dated 30 May 2023.

III. NATURAL GAS

3.1 Natural gas supply

On 26 February 2022, the Ministry of Energy of Ukraine announced an emergency crisis on the natural gas market[12]. This allows the government to impose multiple limitations on the market, e.g. forcing businesses to produce natural gas, promoting the reduction of natural gas consumption, requiring mandatory switches to other energy sources, etc.

The natural gas prices for household customers were frozen by imposing a moratorium on the increase of prices that had been in place as of 24 February 2022. The price freeze will be lifted six months after martial law ends. Until the price freeze is cancelled, the suppliers cannot resort to any means of collecting household customers' gas debts, including initiating court action, enforcing debt collection, cutting off the natural gas supply, etc[13].

The government undertakes to reimburse the gas suppliers the difference between their actual expenses and the revenue received from households. The government also undertakes to reimburse the suppliers for the amounts of the households' gas debts that cannot be collected due to the collection ban[14].

3.2 Heat and hot water produced from natural gas

A similar price freeze as for the natural gas prices (see section 3.1 of this Report) applies to heat producers for households.

3.3 Domestic natural gas pricing

To enable the price freeze mentioned above and to ensure the security of supply and the affordability of natural gas for households and thermal energy producers, the government imposed specific public service obligations (PSO) for JSC "Ukrgasvydobuvannya", the state-owned company responsible for producing 73% of natural gas in Ukraine. Namely, JSC "Ukrgasvydobuvannya" has been under the PSO to sell all domestically produced natural gas at a fixed price of UAH 7,240.00 (ca. EUR 178.77[15]) VAT included per thousand m^3 to National Joint-Stock Company "Naftogaz of Ukraine" (Naftogaz), that further supplies it to households and thermal energy producers[16].

The PSO is supposed to last until 30 April 2023[17] and may be prolonged further, meaning that JSC "Ukrgasvydobuvannya" will continue to sell the produced natural gas to Naftogaz at the regulated price until that date.

On 28 October 2022, LLC "Naftogaz Trading Gas Supply Company" was designated as the

[12] Decree of the Ministry of Energy of Ukraine "On the introduction of crisis situation at the emergency level" No. 87 dated 26 February 2022.
[13] Law of Ukraine "On peculiarities of relations on the natural gas market and in the heat supply sphere during martial law and following renewal of their functioning" dated 29 July 2022 No. 2479-IX, Article 1(2).
[14] Ibid, Article 2(3).
[15] Calculated using conversion rate effective on 31 May 2023.
[16] Procedure on imposing special obligations on natural gas market entities to ensure public interests in the process of functioning of the natural gas market, approved by Resolution of the CMU No. 222 dated 06 March 2022, clause 9.
[17] Resolution of the CMU "On amending the Procedure on imposing special obligations on natural gas market entities to ensure public interests in the process of functioning of the natural gas market" No. 1017 dated 30 September 2022.

company to purchase natural gas for heating during winter 2022-2023[18]. The funds for the purchase amount to UAH 12.7 billion (ca. EUR 314 million[19]) and will be provided via the state budget of Ukraine. Any funds received by LLC "Naftogaz Trading Gas Supply Company" from sale of the natural gas to the traders or consumers shall be paid back to the state budget[20].

On 09 December 2022, the CMU adopted the procedure for using the state budget funds for purchasing natural gas for 2022-2023 heating season, which allows the purchase of both domestic and foreign-produced natural gas[21]. On 27 December 2022, the procedure was amended, now allowing only purchase of foreign-produced natural gas with the seller's duty to deliver the gas to Ukraine's border[22].

On 23 January 2023, the CMU approved for National Joint-Stock Company "Naftogaz of Ukraine" (Naftogaz) a grant agreement with the European Bank of Reconstruction and Development for 3 UAH billion[23] (ca. EUR 74 million)[24], which are expected to be used for natural gas procurement.

3.4 Natural gas distribution

Ukraine has introduced a moratorium on raising tariffs for natural gas distribution for all consumer groups. The moratorium will be lifted six months after the month when martial law ends. The government undertakes to reimburse the distribution system operators the difference between their regulated expenses and the actual payments for distribution services received from customers[25].

Since 06 March 2022, LLC "Naftogaz Trading Gas Supply Company" has been under public service obligation to sell specific volumes of natural gas to the distribution system operators at a fixed price of UAH 7,420.00 (ca. EUR 183.21[26]) VAT included per thousand m^3. The specific volumes include normative losses and own consumption approved by the NEURC. For any excessive volumes not approved by NEURC, the price is based on the Slovakia virtual trading point (VTP) market price.

Apart from the above provisions, volumes of natural gas used to tackle situations caused by hostilities or to prevent or mitigate humanitarian threats are sold at the price of UAH 0.01 per thousand m^3 [27].

The public service obligations described above were introduced to ensure the social and energy security of Ukrainian citizens. Before the war, Ukraine was on track to fully liberalise

[18] Order of the CMU "On designation of the limited liability "Naftogaz Trading Gas Supply Company" as a business entity for the purchase of natural gas" No. 956-p dated 28 October 2022.
[19] Calculated using conversion rate effective on 31 May 2023.
[20] The Law of Ukraine "On amending the state budget for year 2022" No. 2549-IX dated 30 August 2022.
[21] Resolution of the CMU "On the approval of the Procedure for the use of funds provided for in the state budget for the purchase of natural gas for the heating season of 2022-2023" No. 1360 dated 06 December 2022.
[22] Resolution of the CMU "On Amendments to Clause 7 of the Procedure for the use of funds provided for in the state budget for the purchase of natural gas for the heating season of 2022-2023" No. 1443 dated 27 December 2023.
[23] Resolution of the CMU "Regarding certain matters of functioning of Naftogaz" No. 53-p dated 23 January 2023.
[24] Calculated using conversion rate effective on 31 May 2023.
[25] Law of Ukraine "On peculiarities of relations on the natural gas market and in the heat supply sphere during martial law and following renewal of their functioning" dated 29 July 2022 No. 2479-IX, Article 1(1).
[26] Calculated using conversion rate effective on 31 May 2023.
[27] Procedure on imposing special obligations on natural gas market entities to ensure public interests in the process of functioning of the natural gas market, approved by Resolution of the CMU No. 222 dated 06 March 2022, clauses 2(4), 6.

its natural gas market following the reforms started in 2015 by adopting the Law of Ukraine "On the natural gas market".

3.5 Production of hydrocarbons, including natural gas

In Ukraine, the production of hydrocarbons is performed based on a special license with a limited duration. Since the beginning of the full-scale military aggression, the government of Ukraine has introduced an automatic prolongation of the special licences for the duration of martial law plus three extra months after martial law ends[28].

On 26 July 2022, the terms for performing any works per the special licence and subsoil use agreement were also automatically prolonged for the period of martial law[29]. In case of the expiration of deadlines during martial law, the terms for performing works are extended to six months after martial law ends or 18 months if there is proof of the force majeure circumstances affecting the works.

On 26 July 2022, the CMU also amended four resolutions regulating subsoil use[30]. These amendments are not entirely related to wartime but are also aimed at developing and liberalising the subsoil use regulation. The key amendments include the introduction of electronic document flow instead of paper submissions, the improvement of electronic auctions for special licences, and a new formalised procedure for defining the price of special licences and geological information, which may now be calculated faster and automatically.

Some of the new amendments are aimed at disciplining subsoil users regarding the timely completion of planned works in the licenced areas. The amendment introduces a new procedure for prolonging the term of such works, which can now be prolonged only once and for an additional 36 months only. The reasons for such prolongation include difficulties preventing the completion of scheduled works on time and exclude the prolongation of "sleeping licenses". The latter changes effectively mitigate risks of disrupting or postponing the domestic production of hydrocarbons, i.e. when a holder of a special licence does not perform planned works on exploration and production but continues extending its special licence for multiple years.

On 24 December 2022, the President signed a subsoil reform law which will be effected on 28 April 2023. The law provides for (1) a comprehensive information system for the subsoil use, (2) ability to trade or contribute to charter capital the rights for subsoil use; (3) legislative grounds to introduce a subsoil use profit-sharing system among Ukraine's citizens, and (4) restricts Russian companies and citizens from owning the subsoil rights[31].

Most government inspections are temporarily cancelled and will not be held during martial law[32]. It concerns cancelling many types of inspections concerning subsoil users, including environmental ones.

[28] Resolution of the CMU "On certain matters of ensuring conduct of economic activity during martial law" No. 314 dated 18 March 2022, clause 1(5).
[29] Resolution of the CMU "On amending several resolutions of the CMU applicable to subsoil use" No. 836 dated 26 July 2022.
[30] Ibid.
[31] The law of Ukraine "On amendments to certain legislative acts of Ukraine regarding the improvement of legislation in the field of subsoil use" No. 2805-IX dated 01 December 2022.
[32] Resolution of the CMU "On termination of measures of state supervision (control) and state market supervision during martial law" No. 303 dated 13 March 2022.

3.6 Rent on natural gas

Effective from 01 April 2022, Ukraine increased rent rates for natural gas. The increase was announced before the full-scale military aggression and was motivated by changes in the natural gas prices on the Ukrainian market.

Before the increase, the rent rates depended on the type of a deposit or a well. After the increase, the rent is dynamic and increases with the sale price as follows[33]:

Type of deposit	Rent rate before the increase	Rent rate after the increase	
		Sale price per thousand m^3	Rent rate
Deposits less deep than five thousand meters	29%	USD 150.00 or less	14.5%
		More than USD 150.00 and up to USD 400.00	29%
		More than USD 400.00	29% for natural gas sold at the price of 400.00 USD, and 65% for natural gas sold at a higher price
Deposits deeper than five thousand meters	14%	USD 150.00 or less	7%
		More than USD 150.00 and up to USD 400.00	14%
		More than USD 400.00	14% for natural gas sold at the price of 400.00 USD, and 31% for natural gas sold at a higher price
Deposits less deep than five thousand meters, provided that they are developed with "new" wells which drilling started after 01 January 2018	12%	USD 150.00 or less	6%
		More than USD 150.00 and up to USD 400.00	12%
		More than USD 400.00	12% for natural gas sold at the price of 400.00 USD, and 36% for natural gas sold at a higher price
Deposits deeper than five thousand meters, provided that they are developed with "new" wells	6%	USD 150.00 or less	3%
		More than USD 150.00 and up to USD 400.00	6%
		More than USD 400.00	6% for natural gas sold at the price of 400.00 USD, and 18% for natural gas sold at a higher price

Until Ukraine allows the export of natural gas from Ukraine, the sale price is defined as the largest of these three prices: the Naftogaz purchase price at organised marketplaces, other market participants purchase price at organised marketplaces, or UA-VTP price which is calculated as the mean value between Bid and Ask according to Argus and ICIS reports[34].

[33] The Law of Ukraine "On amending the Tax Code of Ukraine and other legislative acts as to introduction of differential rent for natural gas extraction" No. 2139-IX dated 15 March 2022.
[34] The Law of Ukraine "On changes to Chapter XX "Transitional Provisions" of the Tax Code of Ukraine regarding taxation with rent for use of subsoil for extraction of natural gas" No. 2206-IX dated 20 September 2022.

Also effective from 01 April 2022, the natural gas producers are allowed to pay the rent not for all extracted natural gas volumes as usual, but only for the volumes that were extracted and sold. The rent for natural gas that was not sold and was injected in storage shall be paid three months after martial law ends[35].

3.7 Export, re-export and import of natural gas

On 03 March 2022, Ukraine prohibited the export of all natural gas from its territory[36]. The restrictions also applied to the natural gas stored in Ukraine's underground gas storages in a "customs warehouse" mode. Normally, the "customs warehouse" mode allows foreign companies to temporarily store their gas in Ukraine within 1,095 days without paying taxes and customs duties and re-export it when needed.

On 03 April 2022, the regulations were amended to allow the export of natural gas stored in the "customs warehouse" mode.

The ban on the export of natural gas produced in Ukraine remains in place to this day[37].

The CMU introduced a duty to provide security for customs fees for import and transit of goods in Ukraine, which are transported via a pipeline and are subject to excise tax, with certain exceptions. For natural gas, the security shall be provided if the natural gas is transported via internal transit, and if the declarant either has outstanding customs fees, or declares more natural gas then during the previous 365 days. For oil and certain oil products, the security shall be provided only for internal transit, thus is not required for the passing transit of those goods.

On 09 May 2023, the CMU added Russian oil, oil products, natural gas and other hydrocarbons to the list of goods the import of which is prohibited to the territory of Ukraine, excluding transit via pipelines[38]. On 30 May 2023, the changes were further amended to allow the import of oil and oil products, if the importer provides a certificate of origin proving that the goods are not of Russian origin after the import[39].

3.8 Storage of natural gas

On 01 July 2022, the tariffs for storing natural gas were increased, with the tariffs for storing and injecting natural gas being increased twofold and the tariff for withdrawal was increased by four times[40]. As of today, there are the following tariffs per thousand m^3 excluding VAT:

- UAH 0.40 (ca. EUR 0.01) per day for storing,
- UAH 243.52 (ca. EUR 6.01) per day for injection, and

[35] The Law of Ukraine "On the introduction of amendments to the Tax Code of Ukraine regarding the peculiarities of determining the rent for the use of subsoil for the extraction of natural gas during the period of martial law" No. 2261-IX dated 12 May 2022.
[36] Order of the Ministry of Energy of Ukraine "On prohibition of export of natural gas" No. 99 dated 03 March 2022.
[37] Resolution of the CMU "On amending Appendix 1 of the Resolution of Ukraine No. 1424 dated 29 December 2021" No. 666 dated 10 June 2022.
[38] Resolution of the CMU "On amending the list of goods originating from the Russian Federation banned from import into the customs territory of Ukraine" No. 459 dated 09 May 2023.
[39] Resolution of the CMU "On amending the Resolution of the CMU No. 1147 dated 30 December 2015 and No. 1466 dated 27 December 2022" No. 545 dated 30 May 2023.
[40] Resolution of the NEURC "About the establishment of tariffs for storage services (injection, selection) of natural gas in underground gas storage facilities of JSC "UKRTRANSGAZ" No. 656 dated 30 June 2022.

- UAH 253.03 (ca. EUR 6.24[41]) per day for natural gas withdrawal.

On 01 January 2023, a law was effected that regulates certification of the natural gas storage systems operator and procedures regarding control of gas storage filling. These changes are meant to strengthen security of gas supply and to allow the natural gas storage to participate in Europe's burden sharing mechanism introduced in 2023[42].

On 24 January 2023, the NEURC approved the procedure for the natural gas storage operator certification. The absence of the procedure precluded the storage operator from applying to NEURC for certification, which will be beneficial for European integration and further developing the opportunities for European suppliers and traders to store natural gas in Ukraine under a special customs regime[43].

On 07 April 2023, the NEURC approved the certification of JSC "Ukrtransgaz" as the natural gas storage system operator

3.9 Natural gas accounting units

The transfer to metering natural gas in energy units instead of cubic meters was postponed due to hostilities and is now set to take place after martial law ends[44]. The transfer was initially supposed to be effected on 01 May 2022 as a part of reforming Ukraine's natural gas market and its approximation to the European market.

IV. ELECTRICITY

4.1 Electricity supply

Certain public service obligations (PSOs) were established in the electricity market even before the full-scale invasion. Namely, the public service obligations envisaged the following block tariff scheme for households consuming:

- less than 250 kWh/month - UAH 1.44 (EUR 0.0356) per kWh (VAT included), and
- more than 250 kWh/month – UAH 1.68 (EUR 0.0415) per kWh (VAT included)[45].

These PSOs were further prolonged until 30 April 2023[46], and then until 31 May 2023[47].

[41] All values are calculated using conversion rate effective on 31 May 2023.
[42] The law of Ukraine "On the introduction of changes to some legislative acts of Ukraine regarding the certification of the gas storage operator and the continuation of measures to prevent the bankruptcy of the Chornomornaftogaz State Joint Stock Company" No. 2850-IX dated 13 December 2022.
[43] Resolution of the NEURC "On approval of the Procedure for natural gas storage operator certification" No. 110 dated 24 January 2023.
[44] The Law of Ukraine "On the introduction of changes to some laws of Ukraine regarding the introduction of accounting and calculations of volume of gas in energy units on the natural gas market regarding the date of entry into effect" No. 2372-IX dated 07 July 2022.
[45] Both values are calculated using conversion rate effective on 31 May 2023.
[46] Resolution of the CMU "On amendments to the resolution of the CMU of 05 June 2019 No. 483" No. 262 dated 24 March 2023.
[47] Resolution of the CMU "On amendments to the resolution of the CMU of 05 June 2019 No. 483" No. 384 dated 25 April 2023.

On 30 May 2023, the CMU increased electricity prices by 57-83%, abolished the block tariff scheme with the threshold of 250 kWh/month, and approved a single tariff for households at UAH 2.64 (EUR 0.07) per kWh (VAT included) from 01 June to 31 December 2023[48].

The CMU also prohibited the disconnection of households from the electricity supply or other utilities during martial law, even when there is debt, and accruing fines on such debt[49].

Disconnection of specific categories of commercial consumers also requires the approval of military administrations in the relevant regions. The categories of protected customers include government and military facilities, state-funded hospitals, transport enterprises, utility providers and any other customers related to the military sector and the well-being of Ukrainian citizens[50].

The power suppliers are not allowed to enforce collection of debts for electricity and other utilities from the households in the war zones, occupied territories or households damaged due to hostilities. Similarly, the debts for electricity and other utilities cannot be collected from certain military-related authorities and enterprises[51].

On 25 October 2022, the NEURC adopted a procedure for NEC "Ukrenergo" to restore electricity networks damaged as a result of hostilities. The procedure introduced a mechanism for NEC "Ukrenergo" to report on the damages to NEURC, schedule and perform the repairs, and report on the resources used for the repairs. It also allows NEC "Ukrenergo" to use any funding for the network restoration, including own funds, state budget funds, donations, humanitarian aid, etc[52].

On 25 November 2022, the CMU extended the function of the state-owned enterprise "Ukrinterenergo" as the supplier of last resort for one more year, which is until 31 December 2023[53].

On 29 November 2022, the CMU created the Joint-Stock Company "Ukrainian Distribution Networks" that will manage the state distribution system operators, in order to ensure the economic and energy security of the state and attract investments[54]. The company was officially registered on 23 December 2022.

On 02 December 2022, the NEURC approved the clarification on the calculation of the households' consumption for billing purposes in case of the absence of data on actual consumption and in the event of an emergency in Ukraine's energy system. The TSO announces emergencies in case of severe shortages or other threats to the system's

[48] Resolution of the CMU "On amendments to the resolution of the CMU of 05 June 2019 No. 483" No. 544 dated 30 May 2023.
[49] Resolution of the CMU "On certain matters regarding payment for utilities during martial law" No. 206 dated 05 March 2022.
[50] Provision on the peculiarities of the supply of electric energy to consumers and settlements between participants of the retail electric energy market during the period of martial law in Ukraine approved by order of the Ministry of Energy of Ukraine No. 148 dated 13 April 2022, clause 8(2).
[51] The Law of Ukraine "On the amendment of Clause 10-2 of Chapter XIII "Final and Transitional Provisions" of the Law of Ukraine "On Executive Proceedings" regarding the suspension of the execution of decisions on collection of debts for utilities from individuals during the period of martial law" No. 2456-IX dated 27 July 2022.
[52] Temporary procedure for actions of the transmission system operator to restore electrical networks and/or their components damaged as a result of hostilities during the period of martial law in Ukraine, approved by re Resolution of NEURC No. 1342 dated 25 October 2022.
[53] Order of the CMU "On amending the paragraph 1 of the CMU order of No. 1023 dated 12 December 2018" No. 1061-p dated 25 November 2022.
[54] Resolution of the CMU "On the formation of the joint-stock company "Ukrainian distribution networks" No. 1336 dated 29 November 2022.

functioning, including emergencies caused by the missile strikes on the energy system of Ukraine[55].

On 27 December 2022, the CMU approved the rules for the protection of power networks which establish additional requirements regarding the special regime of land use within the special zones of energy facilities. The rules apply to legal entities and individuals who own or operate power networks, as well as owners or users of land plots on which power networks are located[56].

4.2 Electricity-related tariffs

On 21 December 2022, the NEURC approved the transmission tariff and the dispatching tariff for year 2023 as follows:

Period	Transmission tariff[57]	Dispatching tariff[58]
	UAH per MWh, excluding VAT	
2022 Baseline	*345.64 (ca. EUR 8.5)*	*62.13 (ca. EUR 1.53)*
January – March 2023	380.28 (ca. EUR 9.39)	68.28 (ca. EUR 1.68)
April – June 2023	430.25 (ca. EUR 10.62)	80.87 (ca. EUR 2.00)
July – December 2023	485.10 (ca. EUR 11.98)	95.54 (ca. EUR 2.36)[59]

4.3 Nuclear

On 11 December 2022, a law was enacted that streamlined and regulated the procedures for obtaining a licence for a range of activities related to nuclear energy, primarily handling the nuclear fuels[60].

On 02 May 2023, the CMU adopted a decision to start the corporatization of Energoatom and created the corporatization committee[61].

4.4 Feed-in tariff

Before the full-scale military aggression, the development of renewable energy sources (RES) in Ukraine was supported via feed-in tariff (FIT) scheme, i.e. the guaranteed buyer (State Enterprise "Guaranteed Buyer") purchased all electricity produced from RES using FIT.

On 29 July 2022, the legislators introduced an alternative to FIT scheme and secured an option for RES producers to trade the produced electricity on the power market[62]. Formally this option

[55] Resolution of the NEURC "On amending the Resolution of the NEURC No. 393 dated 20 April 2022" No. 1603 dated 02 December 2022.
[56] Resolution of the CMU "On the approval of the Rules for the protection of electrical networks" No. 1455 dated 27 December 2022.
[57] Resolution of the NEURC "On setting the tariff for electric energy transmission services of NEC "UKRENERGO" No. 1788 dated 21 December 2022.
[58] Resolution of the NEURC "On setting the tariff for dispatching (operational and technological) management services of NEC "UKRENERGO"" No. 1789 dated 21 December 2022.
[59] All values are calculated using conversion rate effective on 31 May 2023.
[60] The law of Ukraine "On amendments to some laws of Ukraine regarding improvement of permitting activities in the field of nuclear energy use" No. 2755-IX dated 16 November 2022.
[61] Resolution of the CMU "The matter of the transformation of the state-owned enterprise "National Atomic Energy Generating Company "Energoatom" into a joint-stock company, 100 percent of whose shares belong to the state" No. 2394-p dated 02 May 2023.
[62] Law of Ukraine "On peculiarities of relations on the natural gas market and in the heat supply sphere during martial law and following renewal of their functioning" No. 2479-IX dated 29 July 2022, clause 6.

was made available before the new law. Yet, the new option was not regulated and it was not clear whether the RES producers could return to FIT scheme in the future after switching to direct trades in the power market. Thus, the new law clarified that the switch would not result in the amendment of FIT levels of the concerned RES producer in case they later decided to return to the FIT scheme.

As of now, RES producers are allowed to trade their electricity on any market segment, whereas other electricity producers shall trade electricity under bilateral agreements only at the electronic auctions until 01 April 2023.

On 02 August 2022, the government also improved and simplified the requirements for RES auctions[63], which were introduced in 2019 to replace FIT mechanism. The first RES auction is planned after martial law ends.

On 25 November 2022, the CMU allowed the trade of electricity produced from RES using the same conditions as for other producers participating in the electronic auctions. However, this provision does not apply to the RES producers that enjoy the feed-in tariff[64], as they are exempted from a duty to enter into the bilateral agreements via electronic auctions .

On 22 March 2023, the NEURC moved the deadline for SE "Guaranteed Buyer" to pay the outstanding debts to Energoatom and ectricity producers under the feed-in tariff from 01 April 2023 to 01 July 2023. Currently, the debt of SE "Guaranteed Buyer" to Energoatom amounts to UAH 0.14 billion (ca. EUR 3.4 million[65]), and to the electricity producers under the feed-in tariff – UAH 20.1 billion (ca. EUR 496 million[66])[67].

4.5 Contract for difference for renewables

For RES producers that do not benefit from FIT, an option was introduced to trade electricity under an electricity price stability services contract, which is effectively a contract for difference or a virtual Corporate power purchase agreement (PPA) . Such contracts may be executed between RES producers and the consumers for at least one year either before the construction of the plant or when the renewable power plant is constructed and is operational.

Contrary to EU practices, the contract for electricity price stability services is not a financial instrument. Thus, according to Ukrainian laws, a contract for difference is a service and its state control is performed by the NEURC.

The contract shall define an indicative price for the produced electricity. If the market price falls lower than the indicative price, the customer shall cover the difference, and vice-versa the RES producer pays the difference if the market price is higher than the indicative price.

[63] Resolution of the CMU "On Amendments to Resolutions of the CMU No. 420 of 23 May 2018 and No. 1175 of 27 December 2019" No. 889 dated 02 August 2022.
[64] Resolution of the CMU "On amending to the Procedure for conducting electronic auctions for the sale of electric energy under bilateral contracts" No. 1319 dated 25 November 2022.
[65] Calculated using conversion rate effective on 31 May 2023.
[66] Ibid
[67] Resolution of the NEURC "On amendments to the resolution of NEURC dated 01 September 2021 No. 1460" No. 502 dated 22 March 2023.

4.6 Feed-in tariff payments

On 28 March 2022, the Ministry of Energy of Ukraine imposed specific limits on FIT payments to RES producers[68]. The limits were further revised on 15 June 2022[69].The payment limits are now calculated as a percentage of the weighted average FIT in 2021, while the remaining payments to RES producers are accumulated as debts:

- 18% - solar & wind,
- 35% - small hydro,
- 40% - biogas, and
- 75% - biomass.

On 26 April 2022, NEURC approved the procedure of payment settlement for prosumers using FIT during martial law in Ukraine[70]. The prosumers' payments were linked with the bill collection rate in the region, e.g. if the collection rate is 90%, a prosumer receives 90% of the payment for produced electricity using FIT.

On 14 September 2022, the Ministry of Energy of Ukraine approved an order requesting NEC "Ukrenergo" to transfer the revenue from allocating cross-border capacity for electricity export to repay the debts of SE "Guaranteed Buyer" with subsequent repayment of debts to RES producers[71]. As was announced by SE "Guaranteed Buyer", they settled the debts to RES producers for ten months of 2021[72].

4.7 Electricity storage

The legislative changes allowing the functioning of the energy storage facilities came into effect on 16 July 2022[73].

Energy storage activity shall be provided based on the license, with a range of exceptions, including an exception for RES producers that will not need a license if they store only electricity produced by them. Adding an energy storage unit to a renewable power plant will not trigger any changes to the FIT rate.

Also, licensing exemptions apply to other power producers who store electricity produced by them, consumers if they do not transfer the stored energy to other consumers or the system, and the transmission system operator and the distribution system operators in certain instances allowed by NEURC. The licence shall be obtained for other market participants if the storage capacity exceeds 150 kW. On 22 July 2022, the NEURC approved licensing conditions for carrying out business activities on energy storage[74].

[68] Order of the Ministry of Energy of Ukraine "About settlements on the electricity market" No.140 dated 28 March 2022.
[69] Order of the Ministry of Energy of Ukraine "On payments under feed-in tariff" No. 206 dated 15 June 2022.
[70] Resolution of NEURC "On the peculiarities of determining the amount and carrying out calculations for the electric energy produced by the generating units of private households during the period of martial law in Ukraine" No. 396 dated 26 April 2022.
[71] Order of the Ministry of Energy of Ukraine "On taking measures in the conditions of martial law" No. 312 dated 14 September 2022.
[72] https://www.qpee.com.ua/news_item/1086
[73] Law of Ukraine "On amendments to some laws of Ukraine regarding the development of energy storage facilities" No. 2046-IX dated 15 February 2022.
[74] Resolution of NEURC "On the approval of the Licensing conditions for carrying out business activities on energy storage" No. 798 dated 22 July 2022.

On 30 September 2022, the NEURC supplemented the Transmission System Code with regulations applicable to energy storage facilities[75].On 01 November 2022, the NEURC supplemented the Distribution Systems Code with regulations applicable to energy storage facilities[76]. These include the procedure for connecting the energy storage facility to the grid, requirements to contracts applicable to the facility, a mechanism for calculating the transmission/distribution services fee, peculiarities of transmission/distribution system operators owning, using and managing the facilities, etc.

4.8 Electricity export and import

On 24 February 2022, the Ukrainian power grid was disconnected from Russia and Belarus power systems. On 16 March 2022, the Ukrainian power grid was successfully synchronised with the continental European grid (ENTSO-E).

On 28 June 2022, the TSOs of Continental Europe confirmed that the technical pre-conditions had been fulfilled and on 30 June 2022, Ukraine started commercial electricity export to the ENTSO-E countries[77].

On 07 July 2022, the CMU obliged exporters to transfer 80% of their profit from electricity export to the guaranteed buyer[78]. The collected funds are directed to the suppliers of electricity to households to reimburse the difference between their actual expenses and the revenue received from households.

On 11 October 2022, the massive attack and consequent damages to the power sector resulted in the decision of the government to stop electricity export[79].

On 27 October 2022, the state energy trader JSC "Energy Company of Ukraine" carried out the first test import of electricity from Slovakia in the volume of 1 MW. This first actual electricity import operation was done to ensure the further possibility to support the power system of Ukraine in case of a shortage of generating capacities due to damages and hostilities.

On 03 January 2023, the CMU adopted a procedure which mitigates the introduction of new limitations for consumers using imported electricity, the price of which is significantly higher compared to the Ukrainian power market, from 03 January to 30 April 2023. Emergency disconnections will still apply[80].

On 17 January 2023, NEURC approved changes to the Transmission System Code. Namely, NEURC amended Code's terminology and provisions to ensure its compliance with the requirements of the European legal framework, transmission services quality and excluded the provisions on the synchronised operation of the Ukrainian power system and the Energy System of the Russian Federation[81].

[75] Resolution of the NEURC "On amending the Transmission System Code" No. 1234 dated 30 September 2022.
[76] Resolution of the NEURC "On amending the Distribution Systems Code" No. 1369 dated 01 November 2022.
[77] https://www.entsoe.eu/news/2022/06/28/commercial-exchanges-of-electricity-with-ukraine-moldova-to-start-on-30-june/
[78] Provision on the imposition of special obligations on the participants of the electric energy market, which carry out operations on the export of electric energy, to ensure the interests of the general public in the process of functioning of the electric energy market during the period of martial law, approved by Resolution of the CMU No. 775 dated 07 July 2022.
[79] https://www.mev.gov.ua/novyna/ukrayina-prypynyaye-eksport-elektroenerhiyi-cherez-rosiyski-raketni-obstrily-enerhetychnykh
[80] Resolution of the CMU "On the approval of the Regulation on the peculiarities of the import of electric energy during the autumn-winter period of 2022/23 under the conditions of martial law in Ukraine" No. 1 dated 03 January 2023.
[81] Resolution of the NEURC " On the approval of Amendments to the Transmission System Code" No. 68 dated 17 January 2023

4.9 Electricity shortages and interruptions

The government introduced a VAT and import customs fees exemption for a range of items aimed at mitigating the electricity shortages and interruptions for consumers, which include power generators, accumulators, transformers, certain electric wiring components, etc[82]. These items may be imported and circulated in Ukraine without a declaration of conformity and marking for conformity with the technical regulations that are currently applicable to these appliances[83].

The distribution system operators are now obliged to publish on their websites the information on interruptions of electricity supply to consumers and update the information every 30 minutes. The published information shall indicate the time of the beginning and the end of interruption, the names of settlements, streets, buildings, etc. affected by the interruptions, and the type of interruptions (scheduled, emergency, or consumer restriction interruptions)[84]. And on 14 February 2023, this procedure was amended. It now reqires more detail and clarity of the announcements and recommends informing the consumers via electronic platforms and personal notifications[85].

Starting from 03 January 2023 and until 01 May 2023, import of certain goods is exempt from VAT 20%[86] and customs duties[87]. These goods include electricity generators, transformers, power storages and satellite Internet connection devices (Starlink). Also, certain energy-infrastructure repair equipment is exempt from customs duties if provided by the Energy Community.

Starting from 03 January 2023 and until six months after the end of martial law, the use of electricity generators does not require pollutants emission permit and until one month after the end of martial law – does not entail environmental tax. Also, until one month after the end of martial law, storing up to 2,000 litres of generator fuel will not require a permit[88].

Since 02 February 2023, the import of certain goods does not require providing security for the customs duties payment. This rule applies to the goods to be utilized for electricity infrastructure repair imported until 01 May 2023[89].

[82] Resolution of the CMU No. 1260 dated 09 November 2022.
[83] Resolution of the CMU "On amending certain resolutions of the CMU" No. 1288 dated 16 November 2022.
[84] Resolution of the NEURC "On amending the Resolution of the NEURC No. 349 dated 26 March 2022" No. 1408 dated 10 November 2022.
[85] Resolution of the NEURC "On amending the Resolution of the NEURC No. 349 dated 26 March 2022" No. 253 dated 14 February 2023.
[86] Law of Ukraine "On making changes to the Tax Code of Ukraine and other laws of Ukraine on promoting the restoration of the energy infrastructure of Ukraine" No. 2836-IX dated 13 December 2023.
[87] Law of Ukraine "On the amendment of Chapter XXI "Final and Transitional Provisions" of the Customs Code of Ukraine regarding the promotion of the restoration of the energy infrastructure of Ukraine" No. 2837-IX dated 13 December 2023.
[88] Law of Ukraine "On making changes to the Tax Code of Ukraine and other laws of Ukraine on promoting the restoration of the energy infrastructure of Ukraine" No. 2836-IX dated 13 December 2023.
[89] Resolution of the CMU "On amending Resolution of the CMU No. 1091 dated 27 September 2022" No. 80 dated 31 January 2023.

4.10 Access to grid

On 06 December 2022, the NEURC approved 2023 fees for standard[90] and non-standard[91] connections for power distribution system operators at the same level as in 2022.

V. PETROLEUM

5.1 Petroleum taxes

Before the full-scale military aggression, there was the following excise tax on petroleum products in Ukraine:

- petroleum EUR 213.5 per 1,000 litres,
- diesel EUR 139.5 per 1,000 litres, and
- liquified petroleum gas (LPG) EUR 52.00 per 1,000 litres.

On 15 March 2022, Ukraine introduced a zero excise tax on petroleum products for the duration of martial law and reduced the VAT for importing and selling petroleum from the usual 20% to 7%[92]. The tax-related legislative changes were aimed at addressing the fuel crisis in the country due to the damages and destructions of Ukraine's oil storage facilities and refineries.

On 28 September 2022, Ukraine increased the excise tax as follows:

- petroleum to EUR 100.00 per 1,000 litres,
- diesel to EUR 100.00 per 1,000 litres, except for diesel for military purposes, for which the excise tax remains zero,
- LPG – to EUR 52.00 per 1,000 litres, and
- bio-fuel to EUR 100.00 per 1,000 litres.

The reduced VAT 7% was not changed and will remain in place until 01 July 2023[93].

5.2 Petroleum price caps

The price caps for petrol were in place at the beginning of the invasion. On 17 May 2022, the price caps for petrol were cancelled[94].

[90] Resolution of the NEURC "On the approval of the rates of fees for standard connection for 2023 under martial law" No. 1616 dated 06 December 2022.
[91] Resolution of the NEURC "On the approval of fee rates for non-standard power connection and fee rates for the linear part of the connection for 2023 under martial law" No. 1617 dated 06 December 2022.
[92] Law of Ukraine "On introduction of amendments to the Tax Code of Ukraine and other legislative acts of Ukraine regarding the effect of norms during the period of martial law" No. 2120-IX dated 15 March 2022.
[93] The Law of Ukraine "On changes to Chapter XX "Transitional Provisions" of the Tax Code of Ukraine regarding excise tax rates for the period of the legal regime of martial law, state of emergency" No. 2618-IX dated 21 September 2022.
[94] Resolution of the CMU "On suspension of clause 41-4 of the Resolution of the CMU of 09 December 2020 No. 1236" No. 594 dated 17 May 2022.

5.3 Petroleum standards and customs procedures

Before the full-scale military aggression, the Euro 5 oil products quality standard was mandatory in Ukraine. On 16 March 2022, the CMU allowed Euro 3 and Euro 4 gasoline and diesel standards, which were previously withdrawn from circulation due to their lower quality. The Cabinet of Ministers also simplified customs procedures for importing petroleum products[95].

These changes allowed the attraction of additional fuel resources to Ukraine and are expected to last until martial law ends.

The EU also gives priority at border crossing points to petrol-transporting vehicles that are heading to Ukraine[96].

VI. COAL

The government imposed public service obligations on NEC "Ukrenergo", the transmission system operator, to extend a zero-percent loan to the State Enterprise "Ukrvuhillia" up to UAH 2.5 billion (ca. EUR 63 million[97]), which shall be used to purchase of up to one million tonnes of coal to supply it to thermal power plants. The loan shall be returned not later than 01 June 2023, and preference should be given to domestically produced coal[98].

The export of coal from the territory of Ukraine was prohibited until mid-September when the CMU allowed the export of 100 thousand tonnes of coal. This change is reportedly intended to allow delivery of this coal volume to Poland[99].

VII. MINERAL RESOURCES

On 14 February 2023, the CMU approved a list of 28 subsoil areas to be tendered for development under the production sharing agreements. The subsoil areas allow for production of uranium, titanium, lithium, and salts[100].

[95] Resolution of the CMU "On Amendments to the Technical Regulations regarding Requirements for Gasoline, Diesel, Marine and Boiler Fuels" No. 927 dated 01 August 2013.
[96] https://www.kmu.gov.ua/news/denis-shmigal-proviv-naradu-z-predstavnikami-azs-neobhidno-shchob-lyudi-mali-palne-na-rinku-ne-bulo-zlovzhivan
[97] Calculated using conversion rate effective on 31 May 2023.
[98] Resolution of the CMU "On the imposition of special obligations on transmission system operator to ensure public interests in the process of functioning of the electricity market" No. 483 dated 22 July 2022.
[99] https://www.ukrinform.ua/rubric-economy/3568604-ukraina-moze-dozvoliti-eksport-100-tisac-tonn-vugilla-do-polsi-u-veresni-smigal.html
[100] Resolution of the CMU "On the approval of the list of subsoil areas (mineral deposits) that are of strategic importance for the sustainable development of the economy and defense capability of the state, which will be made available for use through tenders for the conclusion of production sharing agreements" No. 132 dated 14 February 2023.

VIII. BIOMETHANE

The Natural Gas Transmission Code and the Natural Gas Distribution Code were amended to allow 0.2% of oxygen content in the natural gas transmission system and 1% of oxygen content in the natural gas distribution system, which was a prerequisite to allow the transportation of biomethane[101].

A procedure for registration of biomethane was approved on 22 July 2022[102]. It regulates the registration of biomethane delivered to and taken from the natural gas transmission system and the natural gas distribution system, sets provisions for issuing the guarantees of origin of biomethane, regulates audit of production facilities prior to their registration, etc. The State Agency for Energy Efficiency and Energy Saving is responsible for creating and operating the biomethane register within six months after the adoption of the procedure, that is until 22 January 2023.

Apart from transmission and distribution, the changes aim to allow and regulate biomethane export from Ukraine.

IX. WASTE-TO-ENERGY

The law of Ukraine "On waste management" which shall come into effect on 09 June 2023 introduces the legal concept of waste-to-energy incineration plants, which may produce both electric and thermal energy. More detailed requirements applicable to waste-to-energy incineration plants are expected to be approved by the Cabinet of Ministers of Ukraine in the future.

X. ENERGY EFFICIENCY

The law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Creation of Conditions for the Introduction of Comprehensive Thermal Modernisation of Buildings" came into effect on 03 August 2022, simplifies the process of implementing energy-efficient measures in buildings and structures and facilitates cooperation with the Energy Efficiency Fund. In particular, it envisages the possibility of involving the Energy Efficiency Fund in the reconstruction of damaged and destroyed buildings if approved by the CMU.

On 31 October 2022, the CMU adopted amendments to the technical regulation on the system for determining requirements for eco-design of energy-consuming products and the technical regulation on ecodesign requirements for small, medium and large power transformers[103].

On 04 November 2022, The CMU adopted the Procedure for submitting information on the

[101] Resolution of NEURC "On amendments to the Gas Transportation System Code and the Gas Distribution Systems Code" No. 847 dated 02 August 2022.
[102] Procedure for functioning of the biomethane register approved by Resolution of the CMU No. 823 dated 22 July 2022.
[103] Resolution of the CMU "On Amendments to Resolutions of the CMU No. 804 dated 03 October 2018 and No. 152 dated 27 February 2019" No. 1222 dated 31 October 2022.

certification of energy and/or environmental management systems of economic entities[104].

On 25 November 2022, the CMU adopted the Procedure for the exchange of information between the State Energy Efficiency Agency and qualification organisations, which establishes a mechanism for the provision by qualification organisations to the State Energy Efficiency Agency of information on confirmation of the qualification of energy auditors, cancellation of a qualification certificate or refusal to issue it[105].

On 07 March 2023, the CMU amended the procedure for applying for state funding of projects that are developed under the Kyoto Protocol support scheme by adding a new additional criteria for the projects, which will favour the complex projects, namely the ones that will combine thermal modernization of the buildings combined with heating facilities modernization[106].

XI. STRATEGIC DOCUMENTS

On 14 October 2022, the CMU adopted the Concept of Implementation of "Smart Grids" in Ukraine up to 2035, and a plan for its implementation. The concept sets the framework for implementing modern technologies in the Ukrainian power sector, including the process of rebuilding and restoring the energy infrastructure after the Russian military invasion. The concept also ensures that the restoration of the power sector of Ukraine should be done using smart technologies and considering the European energy efficiency standards[107].

On 09 December 2022, the CMU adopted the Water strategy of Ukraine up to 2050 and the Operational Plan for its Implementation for 2022-2024[108]. Some of the key targets are: the reduction of specific electricity costs of centralised water supply services in 2025 — up to 35%; increasing energy efficiency and saving energy costs during the design and operation of water supply and sewage systems and domestic wastewater treatment, and harmonisation of the Ukrainian regulatory framework with EU laws.

On 21 April 2023, the Cabinet of Ministers of Ukraine (CMU) approved the Energy Strategy of Ukraine until 2050[109]. The Strategy is not yet publicly available, but according to the Ministry of Energy's description[110], the document reflects the goals of the European Green Deal and is based on the principles of an integrated approach to the development and implementation of

[104] Resolution of the CMU "On the approval of the Procedure for submitting information on the certification of energy and/or environmental management systems of economic entities" No. 1238 dated 04 November 2022.
[105] Resolution of the CMU "On the approval of the Procedure for the exchange of information between the State Agency for Energy Efficiency and Energy Saving and qualification organizations" No. 1315 dated 25 November 2022.

[106] Resolution on the CMU "On amendments to the Procedure for consideration, approval and implementation of targeted environmental (green) investment projects and proposals for the implementation of measures related to the implementation of such projects and the fulfillment of the obligations of the parties to the Kyoto Protocol to the UN Framework Convention on Climate Change" No. 196 dated 07 March 2023.
[107] Order of the CMU "On the approval of the Concept of Implementation of "Smart Grids" in Ukraine up to 2035" No. 908-p dated 14 October 2022.
[108] Order of the CMU "On Approval of the Water Strategy of Ukraine up to 2050" No. 1134-p dated 09 December 2022.

[109] Resolution of the CMU "On approval of the Energy Strategy of Ukraine until 2050" No. 373-p dated 21 April 2023.
[110] https://mev.gov.ua/novyna/ukrayina-enerhetychnyy-khab-yevropy-uryad-skhvalyv-enerhetychnu-stratehiyu-do-2050-roku

energy policy, creating conditions for the sustainable development of Ukraine's economy.

Among other aspects, the Energy Strategy takes into account:

- the consequences of the full-scale war of the Russian Federation against Ukraine, strengthening the role of energy security and the stability of the energy system;
- the results of joining the Ukrainian electricity network to the European Network of Transmission System Operators for Electricity (ENTSO-E) and deepening the integration of the power system of Ukraine into the pan-European market;
- the availability of the latest technologies (in particular, the production and use of hydrogen for energy purposes, small modular nuclear reactors, energy storage facilities, etc.), technical improvements in the energy sector, world trends and innovative solutions, requirements for environmental safety in line with EU regulations and responsibilities assumed by Ukraine;
- Ukraine's international obligations regarding energy efficiency and the use of renewable energy sources, reduction of greenhouse gas emissions, etc.; decentralization of electricity generation throughout the whole country to improve the stability and reliability of the power supply[111].

On 25 April 2023, the Cabinet of Ministers (CMU) amended the list of government authorities responsible for fulfilling Ukraine's responsibilities as a member of international organisations. Namely, the CMU defined the Ministry of Energy of Ukraine (MoE) as the responsible authority for the working group on renewable energy sources (RES) instead of the State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE). The SAEE was also removed from the list of authorities responsible for the International Renewable Energy Agency (IRENA) and was replaced with the National Energy and Utilities Regulatory Commission (NEURC), while the previously appointed MoE and the Ministry of Foreign Affairs remained in the list[112].

XII. OTHER EMERGENCY MEASURES

12.1 International Treaties

On 23 August 2022, the CMU adopted the Resolution on the Termination of the Agreement between the Cabinet of Ministers of Ukraine and the Government of the Russian Federation on Measures to Ensure the Parallel Operation of the United Energy System of Ukraine and the Unified Energy System of the Russian Federation[113]. The Agreement was terminated for Ukraine on 14 September 2022.

[111] Ibid

[112] Resolution of the CMU "On amending the list of central executive authorities and other state authorities responsible for fulfilling duties arising from Ukraine's membership in international organizations" No. 289 dated 25 April 2023.

[113] Resolution of the CMU "On the Termination of the Agreement between the CMU and the Government of the Russian Federation on Measures to Ensure the Parallel Operation of the United Energy System of Ukraine and the Unified Energy System of the Russian Federation" No. 946 dated 23 August 2022.

On 27 August 2022, the CMU terminated another bilateral Agreement with the Russian Federation on Scientific, Technical and Economic Cooperation in the Field of Nuclear Energy[114].

On 29 September 2022, the Ministry of Energy of Ukraine terminated a range of international interagency agreements of Ukraine on cooperation in the field of energy with the Russian Federation and the Republic of Belarus[115].

12.2 Confiscation and limits on Russian assets

On 03 March 2022, Ukraine adopted a law on confiscation of the assets belonging to Russia or to legal entities in which Russia owns shares or otherwise participates[116].

The confiscation does not apply to Russian (or other countries') citizens, businesses or controlled businesses unless they are implicated in actions against Ukraine's security, sovereignty, territorial integrity, etc. In this case, Ukraine's government can apply sanctions, including property confiscation. The confiscation sanction, however, may be applied only during martial law and only against people or businesses that participate, assist in, support, or otherwise contribute to aggression against Ukraine, are large taxpayers in Russia, etc[117].

Apart from the sanctions mechanism, arrest and confiscation of assets are applied to persons who committed treason, financed actions aimed at the violent seizure of state power, change of territory of Ukraine, or other crimes that are punished with confiscation according to Ukrainian laws. In this case, arrest and confiscation are made in a criminal proceeding for the relevant crime.

Ukraine has arrested a range of energy assets controlled by the Russian Federation or persons mentioned above, for example:

- shares in 26 natural gas distribution system operators (DSOs) in Ukraine,
- combined heat and power plants,
- fuel stations,
- assets of Russian government-controlled companies, and
- a range of companies and assets controlled by Belarus, etc.

Russian citizens, unless they are legally residing in Ukraine, Russian companies or Ukrainian companies where Russian citizens beneficially own at least 10% cannot sell or buy real estate, securities, transport or shares and interest in companies[118].

On 29 September 2022, a new law allowed National Security and Defence Council to seize movable property that may be used for defence purposes and that is endangered by the war.

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[114] Resolution of the CMU "On the Termination of the Agreement between the Government of Ukraine and the Government of the Russian Federation Federation on Scientific, Technical and Economic Cooperation in the Field of Nuclear Energy " No. 957 dated 27 August 2022.
[115] Order of the Ministry of Energy of Ukraine "On the Termination of International Interagency Agreements of Ukraine on Cooperation in the Field of Energy with the Russian Federation and the Republic of Belarus" No. 337 dated 29 September 2022
[116] Law of Ukraine "On the main principles of forced seizure in Ukraine of objects of property rights of the Russian Federation and its residents" No. 2116-IX dated 03 March 2022.
[117] Law of Ukraine "On changes to some legislative acts of Ukraine regarding increasing the effectiveness of sanctions related to the assets of individuals" No. 2257-IX dated 12 May 2022, clause 3.
[118] Resolution of the CMU "On ensuring the protection of national interests in future lawsuits by the state of Ukraine in connection with the military aggression of the Russian Federation" No. 187 dated 03 March 2022.

This applies to the property located in regions under threat of occupation if their borders are within 30 km from the combat areas[119].

The State Budget of Ukraine for year 2022 now includes expenditures related to the Fund for Liquidation of the Consequences of Armed Aggression. The Fund is going to be sourced with funds received from foreign donors and from proceedings related to the confiscation of the Russian assets. The funds are going to be directed, among other things, to repairs of energy infrastructure damaged due to the Russian military invasion[120].

The CMU approved the list of regular reports on the operation of critical infrastructure facilities and the regulation on the exchange of information between these facilities. According to the regulation, the exchange of information between critical energy facilities should take place every day from 10 am to 11 am. In the event of a crisis situation, the exchange of information should take place within 30 minutes of such event and the exchange of information about the rectification of the consequences of the crisis should take place twice a day: before 11 am and 6 pm[121].

12.3 NEURC regulations

On 26 March 2022, NEURC adopted several resolutions regulating certain activities in the energy sector during the period of martial law:

- on the protection of information which may be considered under martial law as restricted,[122]
- on peculiarities of licensing in the energy sphere and utilities during the period of martial law in Ukraine,[123] and
- on the procedure for temporary connection of electrical installations to the distribution system during the period of martial law in Ukraine[124].

On 20 April 2022, NEURC adopted temporary order of DSOs' actions to restore electricity supply to settlements disconnected due to damages or hostilities during the period of martial law in Ukraine[125]. A similar NEURC order on actions of electricity and heat producers related to their restoration due to hostilities was adopted on 05 July 2022[126].

[119] Law of Ukraine "On the introduction of amendments to some laws of Ukraine regarding the optimization of some issues of forced alienation and confiscation of property in the conditions of the legal regime of martial law" No. 2561-IX dated 06 September 2022.
[120] The Law of Ukraine "On amending the state budget for year 2022" No. 2700-IX dated 19 November 2022.
[121] Resolution of the CMU No. 1174 dated 14 October 2022.
[122] Resolution of NEURC "On protection of information which may be considered under martial law as restricted information" No. 349 dated 26 March 2022.
[123] Resolution of NEURC "On peculiarities of licensing in the sphere of energy and utilities during the period of martial law in Ukraine" No. 350 dated 26 March 2022.
[124] Resolution of NEURC "On procedure for temporary connection of electrical installations to the distribution system during the period of martial law in Ukraine" No. 352 dated 26 March 2022.
[125] Resolution of NEURC "On temporary order of actions of DSOs to restore electricity supply to settlements cut off due to damaged objects of electrical networks or their components as a result of hostilities, during the period of martial law in Ukraine" No. 386 dated 20 April 2022.
[126] Resolution of NEURC "On temporary order of actions of entities that conduct economic activity for the production of electricity and/or for the production of thermal energy at nuclear power plants, at thermal power plants, and cogeneration plants, including using alternative energy sources, on restoration objects of electricity and/or thermal energy production, damaged (destroyed) as a result of hostilities, during the period of martial law in Ukraine" No. 689 dated 05 July 2022.

12.4 Environment

On 27 December 2022, the CMU amended the list of projects that do not require environmental impact assessment, which now includes projects that ensure energy security of the country[127].

On 10 January 2023, the CMU approved a procedure allowing citizens to exchange their household incandescent lightbulbs with LED lamps[128].

On 24 January 2023, the CMU adopted a new procedure for obtaining emissions permits. The new procedure allows to apply for the permit online, defines clearer mechanisms and terms for obtaining the permit and regulates the participation of the public in the process[129]. On 02 May 2023, the President of Ukraine signed the law amending the Budget Code and establishing the State Fund of Decarbonisation and Energy Efficient Transformation from 01 January 2024. The Fund's expenses will be used in three directions: (1) state projects for energy efficiency, development of RES and reducing CO_2 emissions; (2) state guarantees for loan and leasing agreements of individuals and legal entities for RES and CO_2 emissions reduction projects; and (3) to repay state loans received for such projects[130].

12.5 Personnel

On 27 January 2023, the CMU adopted a procedure, which allows the exemption of certain employees of a company from being drafted into the army. The new procedure allows to apply for the exemption of up to 50% of the employees for certain companies, and if the company is included in the list of vital energy companies – to exempt all employees required for the reliable functioning of the company. The vital energy companies list is approved by the Ministry of Energy of Ukraine[131].

12.6 Other Measures

On 13 January 2023, the CMU created the State Agency for Reconstruction and Development of Infrastructure of Ukraine, which will be responsible for the implementation of Ukraine recovery projects[132].

[127] Resolution of the CMU "On Amendments to Clause 2 of Appendix 1 to the Resolution of the Cabinet of Ministers of Ukraine dated 13 December 2017 No. 1010" No. 1463 dated 27 December 2022.
[128] Resolution of the CMU "On implementation of an experimental project to create favorable conditions for ensuring the effective consumption of electric energy by the population" No. 25 dated 10 January 2023.
[129] Resolution of the CMU "On amending Resolution of the CMU No. 302 dated 13 March 2002" No. 63 dated 24 January 2023.
[130] The Law of Ukraine "On amending the Budget Code of Ukraine" No. 3035-IX dated 11 April 2023.
[131] Resolution of the CMU "Regarding certain matters of applyin the Law of Ukraine on mobilisation preparedness and mobilisation" as to booking of employees during the period of mobilisation and the martial law " No. 76 dated 27 January 2023.
[132] Resolution of the CMU "Some issues of optimization of the system of central executive authorities" No. 29 dated 13 January 2023.