



Physicians for
Human Rights



TRUTHHOUNDS

Health Care in the Dark:

The Impacts of Russian Attacks on Energy in Ukraine



December 2024

ACKNOWLEDGEMENTS

This report is a joint product of Physicians for Human Rights (PHR) and Truth Hounds (TH).

It was researched and written by Houssam al-Nahhas, MD, MPH, PHR health and human rights researcher; Lindsey Green, MA, PHR deputy director of research; Evan Harary, JD, TH researcher and lawyer; Volodymyr Hryshko, LLM, PhD student, TH legal counsel; Roman Koval, MA, PhD student, TH head of research, and Uliana Poltavets, MSc, PHR Ukraine emergency response coordinator.

The report was internally reviewed by Michele Heisler, MD, MPA, PHR medical director; Thomas McHale, SM, PHR public health director; Dmytro Koval, PhD in Law, TH co-executive director; Karen Naimer, MA, JD, LLM, PHR director of programs; Michael Payne, PHR deputy director, advocacy; Payal Shah, JD, PHR director of research, legal, and advocacy; and Sam Zarifi, JD, LLM, PHR executive director.

Our organizations also acknowledge the assistance of an expert in electricity market regulations with years of experience in regulatory and consultancy support of energy projects, with whom we consulted. The expert's comments provided important details for the report and are referenced accordingly within it. The research team also consulted with Rohini Haar, MD, MPH, PHR medical advisor, for her expertise in developing the survey and interview guide for health care workers. Michael Auten, MA, PHR volunteer and medical student, also contributed to preparation of the study.

Interviews were carried out by Truth Hounds' documenters Oleksii Starynets, Nikkor, and Dido, under the coordination of Yaroslav Susoiev. Interviews were also conducted by the Media Initiative for Human Rights (MIHR) and published here with their permission.

We extend our sincere gratitude to the Ukrainian Healthcare Center (UHC), NGOs "Medical Leaders" and "Your Family Doctor" for their support in disseminating the survey for health care workers. Their contributions have been invaluable to this report.

The report received external review from Thomas D. Kirsch, MD, MPH, FACEP, director (Emeritus) of the National Center for Disaster Medicine and Public Health and professor of emergency medicine at the George Washington University; Monica Peek, MD, MPH; Ellen H. Block professor of health justice in the Department of Medicine, associate director, MacLean Center for Clinical Medical Ethics at the University of Chicago; and Leonard S. Rubenstein, JD, LLM, professor of the practice at Johns Hopkins Bloomberg School of Public Health and chair of the safeguarding health in conflict coalition. The OSINT analysis of the attacks on the Okhmatdyt Hospital received external review from Andrea Richardson, senior legal researcher for investigations, and Alexa Koenig, director of the investigations program at the human rights center, University of California, Berkeley School of Law. Our organizations greatly appreciate their important advice and support.

The report was reviewed, edited, and prepared for publication by Wacera Wathigo, MA, PHR communications and publications manager (English version), and Oksana Riabchun, TH editor (Ukrainian version).



Physicians for Human Rights (PHR) is an international human rights organization that documents and seeks accountability for violations of human rights and other international crimes. It has a particular focus on protecting health facilities, workers, and volunteers providing medical assistance and care during conflict.



Truth Hounds (TH) is a human rights organization that documents and investigates international crimes and grave human rights violations in Ukraine and other conflict affected regions. TH collects witness testimonies and other evidence to contribute to investigations by the International Criminal Court, Ukrainian authorities, and criminal justice actors in other states applying universal jurisdiction.

EXECUTIVE SUMMARY

Before the full-scale invasion by Russia in February 2022, Ukraine boasted one of the most developed power sectors in Europe, with universal access to electricity.¹ However, by June 2024, available capacity had plummeted by 85 percent due to Russia's systematic attacks on energy infrastructure.² Russia has blocked gas transit to Ukraine, seized assets, launched cyberattacks, and, since October 2022, systematically bombed Ukraine's energy infrastructure. By September 2024, Russia had allegedly destroyed all thermal power plants and nearly all large hydroelectric power plants.³

This report - a joint undertaking by Physicians for Human Rights (PHR) and Truth Hounds (TH) - documents the cumulative and reverberating impacts of these attacks on energy on health care in Ukraine. As recognized by the United Nations Human Rights Monitoring Mission in Ukraine (UN HRMMU) and the United Nations Independent International Commission of Inquiry on Ukraine, attacks on energy have had devastating impacts on the health sector in Ukraine.⁴ Despite clear protections for health and energy infrastructure in conflict under international law,⁵ both sectors have been targeted by Russia. Through research surveying over 2,200 health care workers in Ukraine and case studies, *Health Care in the Dark: The Impacts of Russian Attacks on Energy in Ukraine* establishes patterns of how energy disruptions translate into short- and long-term health harms and how these harms may be considered violations of international law.

Data collected by TH and PHR since the start of the full-scale invasion shows that the cumulative impacts of Russia's direct attacks on health facilities, as well as strikes on energy infrastructure with reported impact on health care facilities, have impeded health care delivery and endangered patients and health care workers alike. For example, since the start of the full-scale invasion, health care workers and patients at the Okhmatdyt National Specialized Children's Hospital have faced multiple attacks that have caused death and suffering. Airstrikes shattered its windows in March 2022, forcing vulnerable patients, including terminally ill and immunocompromised children, to be treated underground despite the grave health risks of doing so.⁶ On October 10, 2022 - the day that Russia began its large-scale aerial assault on Ukrainian energy infrastructure - a missile strike killed one of Okhmatdyt's doctors as she drove to work.⁷ In the months that followed, frequent power outages lasting up to several days resulted in lights shutting off in all departments but intensive care. The energy cuts jeopardized patient health by interrupting or delaying surgeries; forcing surgeons to operate in darkness illuminated only by headlamps; discontinuing flow of water to the hospital, creating unhygienic conditions; and rendering diagnostic and treatment equipment unusable.⁸

On July 8, 2024, a missile hit the hospital's toxicology building, killing two civilians, injuring 50 others, and knocking out power and water in the hospital.⁹ Dr. Anastasiia Zakharova, a pediatrician and department head at Okhmatdyt, recalls: "It was dark and dusty," she remembers, hearing "beeping devices, signaling errors [and] the screams of children."¹⁰ Her colleague, Dr. Svitlana Lukyanchuk, did not survive the impact.¹¹ The hospital was left non-functional, with temporary power generation systems taking days to restore services.¹² As Dr. Lesia Lysytsia, a pediatric ophthalmological surgeon, reflected:

"You can work in this mode for a couple of years, but not forever. [...] For me, Okhmatdyt was a fortress. I thought a children's hospital wouldn't get hit."¹³

Similarly, the Mariupol Regional Intensive Care Hospital has also faced challenges after the full-scale invasion. In February and March 2022, the hospital endured several direct attacks during the assault on Mariupol, while the siege cut off its power.¹⁴ The hospital was later occupied by Russian forces and turned into a military base.¹⁵ By December 2022, the hospital had relocated to Kyiv with the help of medical personnel who evacuated from Mariupol.¹⁶

Even in its new location, the hospital's functionality is often limited due to ongoing attacks on energy infrastructure. Dr. Olena Lazariyeva, an intensive care anesthesiologist, describes how the hospital faces frequent blackouts: "Sometimes during my 16-hour shift, the power was on for 40 minutes, sometimes for an hour and a half."¹⁷ Without electricity, surgeries are postponed, and lifesaving equipment is at risk of failing: "If there are severe patients, if they need oxygen, artificial lung ventilation, without electricity, it can be bad," says Dr. Lazariyeva.¹⁸ Another doctor at the hospital says:

"When you hear an [air raid] alarm, you immediately think what to do - whether there will be a power outage, whether the oxygen station will work, what to do next during the surgery," - An anonymous doctor from the Mariupol Regional Intensive Care Hospital in Kyiv.¹⁹

Physicians report that patients experience panic attacks and cardiac arrhythmia due to lack of power and face delays in surgery and other essential health care.

Despite the international legal prohibition on attacks on health care and attacks on civilian energy infrastructure, the Russian Federation's ongoing aggression has severely impacted Ukraine's health care system, with attacks on energy infrastructure causing widespread disruptions in many hospitals like Okhmatdyt and Mariupol.

A survey of 2,261 health care workers conducted as part of this research project indicates that the experiences of clinicians in Mariupol and Okhmatdyt hospitals are far from unique. Key findings from the survey include:

- The overwhelming majority (92.3 percent) of health care workers report experiencing power outages at their health facility as a result of attacks on energy infrastructure.
- Two-thirds of health care workers (66.3 percent) reported that power outages due to attacks on energy infrastructure affected medical procedures in their facilities.
- Specifically, 8.4 percent noted delays in elective surgeries, 1.7 percent experienced interruptions during surgery, and 1.8 percent reported failures in life support systems due to outages.
- Outages disrupted communication systems (35.7 percent), water supply (21.5 percent), heating and ventilation (19 percent), and elevators (16.5 percent).
- 7.8 percent of respondents noted malfunctions in diagnostic equipment, such as X-ray machines and MRIs due to outages.
- Medication storage issues, leading to spoilage, were reported by 13.8 percent, and 3.6 percent informed about problems with storing biological samples like blood or embryos.
- Permanent health harms (36 reports) and deaths (20 reports) were also reported.
- 82.9 percent of health workers experienced increased stress, burnout, and other challenges due to these attacks on energy infrastructure and disruption of services, with 27 percent facing these hardships daily.

Preliminary analysis suggests that these attacks may constitute violations of international law, including the laws of war and the human rights to life and health, and in some cases may give rise to criminal culpability as a matter of international criminal law. Accountability is crucial to deter future violations, uphold legal obligations, and provide justice and reparations for survivors. Immediate action is needed to investigate these attacks, support Ukraine's health care system, and ensure the long-term recovery of critical infrastructure.

“Surgeries had to be performed with flashlights in cramped conditions, which meant that instead of a conventional hour, it took about 3 hours to complete the surgery.” - Dr. Yevheniia Poliakova from the Maternity Hospital No. 3 in Zaporizhzhya

Conclusion and Recommendations:

The Russian Federation must immediately cease its aggression and stop attacking health care workers and facilities, targeting energy infrastructure essential to civilian life, and refrain from indiscriminate attacks that endanger both health and civilian energy systems.

Further, PHR and TH also make the following recommendations:

● To Prosecutors and Investigative Bodies:

- Focus investigations on attacks on energy and health infrastructure as war crimes and crimes against humanity, ensuring integration of cases and collaboration between national and international teams.
- Dedicate resources to building cases of harm to the health care system and preserving evidence for future legal use.

● To the Government of Ukraine:

- Implement legal and policy measures to ensure that attacks on energy and health care are fully documented and investigated.
- Fully document health impacts and support affected patients and health care facilities, including providing mental health assistance.

● To the International Community:

- Increase the support to Ukrainian health care facilities to respond to their critical needs.
- Publicly denounce attacks on health and energy infrastructure and advocate for their immediate cessation.
- Enhance enforcement of international norms protecting health care and civilian infrastructure, support accountability mechanisms, and condemn arms sales violating UN resolutions.
- Improve data collection and sharing on attacks impacting health and energy services.
- Strengthen cooperation with non-governmental organizations (NGOs) and national health agencies to improve documentation as well as resilience of health care facilities affected by prolonged power outages.

I. INTRODUCTION

Despite the well-established protections of hospitals under international law²⁰ that have existed for decades and the more recent adoption of the United Nations Security Council Resolution 2286 in 2016, which calls for protection and prevention of acts of violence, attacks and threats against medical personnel, transport, equipment, and facilities,²¹ there has been persistent impunity for these violations. This impunity has emboldened further attacks on health care facilities and health workers and contributed to widespread civilian suffering and harm.²²

This research shows how Russia's attacks on Ukraine's energy infrastructure effectively amount to attacks on health care and violates international law. By illustrating how power cuts severely disrupt health services and result in health harms, this study aims to support efforts to end impunity while strengthening the evidence base for future protection and advocacy strategies.

In Ukraine, attacks on health are a notable feature of Russian warfare. Since Russia's full-scale invasion of Ukraine in February 2022, health care facilities have been damaged and destroyed,²³ occupied and repurposed, while health care workers have been captured, detained, tortured, or forced to work under duress.²⁴ From the start of the full-scale invasion to August 2024, the health care workforce in Ukraine has shrunk by an estimated 20 percent as many health professionals sought safety abroad, volunteered, or relocated to overwhelmed frontline hospitals.²⁵

Despite these challenges, Ukraine's health care system has remained relatively resilient. In most territories controlled by the Ukrainian government, health care services and medications are still delivered to the civilian population though access varies in different regions.²⁶

With the start of a campaign of attacks on energy infrastructure in the fall of 2022,²⁷ the country has faced waves of massive, repeated power outages, particularly during the winter months. In 2024, the International Criminal Court (ICC) issued arrest warrants for four high-ranking Russian military officials: Sergey Kobylash, former Commander of the Long-Range Aviation of the Aerospace Force; Viktor Sokolov, former Commander of the Black Sea Fleet; Sergei Shoigu, then Minister of Defense; and Valery Gerasimov, Chief of the General Staff and First Deputy Minister of Defense.²⁸ These individuals are accused of directing attacks on Ukraine's civilian infrastructure, specifically targeting electric power plants and substations from at least October 10, 2022 until at least March 9, 2023. They are charged with war crimes and crimes against humanity for intentionally inflicting great suffering or serious injury through a coordinated campaign against Ukraine's critical energy infrastructure.²⁹

The United Nations Human Rights Monitoring Mission in Ukraine (UN HRMMU) notes that Russia's attacks have "reverberating effects causing harm to the civilian population and the country's electricity supply, water distribution, sewage and sanitation systems, heating and hot water, public health, education, and the economy."³⁰ The Mission underlines the interconnectedness of systems and how their disruption "affects public health in numerous ways. Hospitals and health care clinics rely on electricity for lifesaving medical equipment and procedures and cold storage of medication."³¹

The Independent International Commission of Inquiry on Ukraine spotlights the devastating impacts of Russia's assault on Ukraine's energy grid and the impact on health care: "Repeated large-scale waves of attacks on Ukraine's energy infrastructure have resulted in power outages sometimes affecting millions of civilians. The blackouts have particularly affected the health and well-being of certain categories of the population."³²

Electricity is the lifeblood of the health sector, powering lifesaving devices and enabling basic medical services. Unreliable access to electricity supply accounts for up to one third of failures of medical devices globally.³³ Electricity is crucial for supporting diagnostics, emergency response, vaccinations and medication distribution, and daily functionality of health facilities. The interconnectedness of energy and health care means that disruption of energy has cascading and deleterious effects, and results in disruption of interconnected services³⁴ - water, heating, sanitation, waste disposal, and the distribution of medication and medical supplies all depend on electricity.

The analysis of effects of attacks on energy infrastructure presented below demonstrates that the assault on health care extends beyond physical destruction, obstructing access to essential services and endangering health care workers and patients. As health care relies on electricity for lifesaving equipment and maintaining basic hospital functions to provide essential services, Russia's attacks on energy infrastructure compound the damage to the health care system. Cascading effects further impede the functioning of health care facilities.



Doctors operate with phone flashlights after power outages due to conflicts within the Russian-Ukrainian war in Kyiv, Ukraine on November 30, 2022. Photo by Abdullah Unver/Anadolu Agency via Getty Images

II. METHODOLOGY

This research employed a mixed-methods approach to document the impact of power cuts resulting from Russia's attacks on energy infrastructure on Ukraine's health care system. The methodology combined data collection through: (i) a quantitative survey of health care workers; (ii) analysis of a monitoring database of attacks on health; and (iii) qualitative interviews with health care workers in affected health care facilities and witnesses to attacks. Researchers then undertook a legal analysis of the violations observed and how they pertain to protections under international law. This approach aims to establish patterns of how energy disruptions translate into immediate and permanent health harms and how these harms may be considered violations under international law.

The research was approved by PHR's Ethics Review Board, and all data collection conducted also followed TH Code of Ethical Conduct for Field Researchers.³⁵

Below, we provide a detailed description of some of the methods employed.

Analysis of Ukraine's Energy Infrastructure: The analysis of Ukraine's energy infrastructure³⁶ is based on desk research of publicly available information about Ukrainian energy infrastructure, including reports from several international fact-finding bodies, non-governmental organizations (NGOs), as well as relevant Ukrainian state bodies. Analysis was conducted by an expert with extensive experience in the field and in-depth knowledge of Ukraine's energy system. The analysis is meant to assist in interpretation of elements of the energy infrastructure and

how attacks against energy impact them. The team also reviewed data about incidents of attacks on energy infrastructure as verified by the Humanitarian Research Lab at Yale School of Public Health.³⁷

Survey of Health Care Workers: An online survey was distributed to health care workers across Ukraine to better understand how attacks on health and energy infrastructure affect the health of Ukraine's population, the working conditions of health care workers, and the experiences of patients.³⁸ Inclusion criteria to participate in the survey were that health care workers were over the age of 18 and were either (a) currently employed or (b) were working during the full-scale invasion at a health care facility in Ukraine. The survey was distributed digitally through a network of partners including the UHC, NGOs "Medical Leaders" and "Your Family Doctor." The survey was available in Ukrainian and English and was distributed for completion from July 21 to September 18, 2024. The main sections of the survey asked respondents about their previous experiences of direct attacks on health facilities and the frequency and timing of such attacks; it also posed questions on power cuts that affected health care facilities through direct attacks on hospitals or indirectly through attacks on energy infrastructure, impacts of such attacks on health services, facility operations, medical staff, and health outcomes.

A total of 2,395 surveys were received, of which 5.6 percent were excluded due to incomplete data, resulting in 2,261 responses being included in the analysis. The demographics of the survey respondents are outlined below.

Survey Participant Demographic Information³⁹

Gender of respondents⁴⁰



Male
630
(28.1%)



Female
1,606
(71.7%)



Other
5
(0.2%)

Age of respondents



Profession of respondent



Physician
841
(37.3%)



Nurse
229
(10.2%)



Administrative staff
1,001
(44.4%)



Other health care professionals
184
(8.2%)

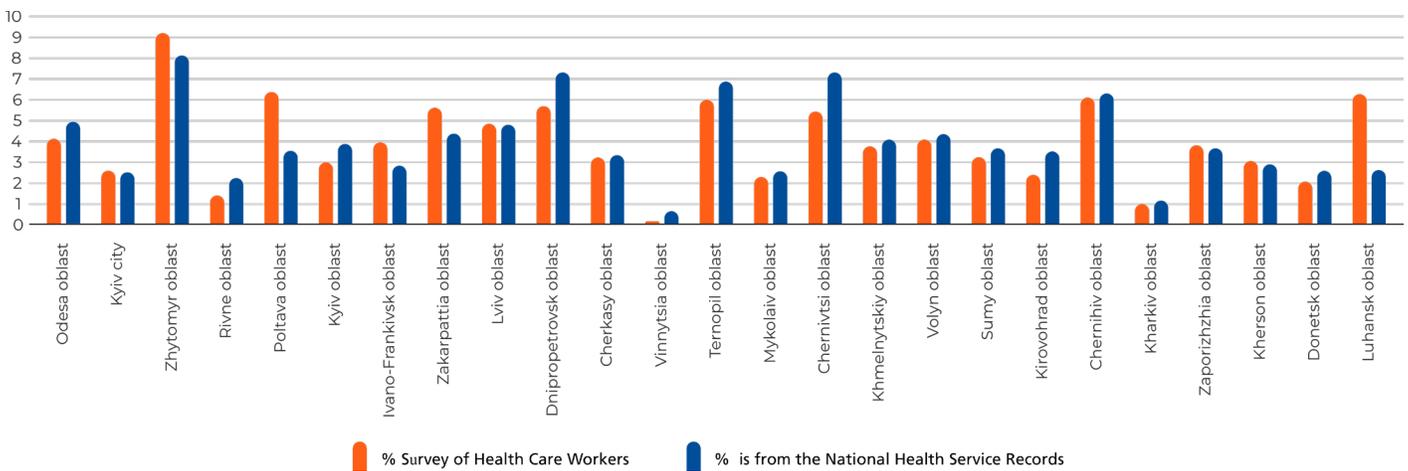
Geographic location respondent data

Respondents from 24 oblasts and Kyiv completed the survey and submitted responses (none of the respondents came from Crimea). The highest number of responses were from:



Demographic data was compared to the data extracted from the National Health Service of Ukraine (NHSU) as at September 25, 2024.⁴¹ NHSU's database of concluded contracts on medical care contains information on the total number of facilities that have signed an agreement with the NHSU to provide primary, specialized, and emergency medical care. By integrating the data from the NHSU's database, the research team was able to compare survey

distributions to the national health care system and crosscheck the data, without generalizing (see example for regional distribution in *Graph 1*). While there are outliers in several instances, the data from survey findings seems to be consistent with the data from the NHSU in terms of the general distribution of health care workers across the country.



Graph 1. Comparing the Survey Data with the National Health Service Records. Source: Survey of Health Care workers, Data from the National Health Service of Ukraine

Data from Ukraine's Medical Statistics show that the majority of health care workers in Ukraine in 2023 are female (82.5 percent); thus, the survey demonstrates the same general gender distribution of the national health care system.⁴²

Dataset of Attacks on Health: Researchers analyzed an incident dataset developed by partner organizations eyeWitness to Atrocities, Insecurity Insight, MIHR, PHR, and the UHC. This dataset has 1,521 verified incidents of attacks on Ukraine's health care system⁴³ since Russia's full-scale invasion of Ukraine in February 2022.⁴⁴ The incidents in the database are collected through open-source research, the eyeWitness app,⁴⁵ witness accounts, insights from hospital administrators, site visits, and contributions from partner networks. Each incident is assigned an incident number and reviewed based on a range of verification criteria following Insecurity Insight's ethical guidelines for data collection. The verification protocol is based on Insecurity Insight's standard data collection, verification and coding procedures and an adapted protocol from the Berkeley Protocol on Digital Open-Source Investigations. The data is analyzed to identify patterns of violence, geographic distribution, and the scale of harm to Ukraine's health

care system. The documented incidents create an interactive map of attacks on Ukraine's health care system which is accessible online at www.attacksonhealthukraine.org.

For the purpose of our monitoring, two categories of Russian attacks have been considered to have impacted Ukraine's health care infrastructure and are included for analysis; (a) attacks on Ukraine's energy infrastructure⁴⁶ with reported impact on health facilities; and (b) direct attacks on a health care facility causing damage that disrupted its energy and/or water supplies.⁴⁷

Semi-structured interviews: Six semi-structured interviews were conducted with Ukrainian health care workers in four health care facilities affected by power outages: two interviews with representatives of Mariupol Regional Intensive Care Hospital (Mariupol/Kyiv), two interviews with representatives of Okhmatdyt National Specialized Children's Hospital (Kyiv), one representative of a network of emergency stations in the Sumy oblast, and one from maternity hospital No. 3 in Zaporizhzhia. These interviews were specifically conducted for this research, providing firsthand accounts of the challenges faced by health care professionals to provide

medical care and treatment for their patients as a result of attacks on energy infrastructure. Additionally, four interviews conducted prior to this research by Truth Hounds and MIHR detailing the direct attacks on the Mariupol Regional Intensive Care Hospital between February and March 2022 were included.

Interviews were conducted based on the interview guide developed by PHR and performed in accordance with the documentation methodology employed by TH since 2014.⁴⁸ The interview guide covered the following topics: work as a health care professional, attacks on energy infrastructure and their effects on hospital functions and patient outcomes, attacks on health care facilities (shelling, captured hospitals, looting), attacks on health care workers, community-level and personal impact of conflict. Written informed consent was collected from each participant after reviewing the consent information with the interviewer. Interviews were conducted in Ukrainian, transcripts were analyzed in Ukrainian and coded for analysis, and data was stored on a password-protected server accessible only to the research team. Identities of interviewees have been anonymized where requested to ensure their safety. Quotations were translated into English by a researcher fluent in Ukrainian and English once they were selected for inclusion in the report.

The research team developed detailed case studies based on witness interviews with supporting information from open-source materials.

Legal Analysis: A legal analysis was conducted examining violations outlined in this study, including attacks on energy infrastructure, attacks on health, and their nexus, pursuant to international humanitarian, human rights, and criminal law. The legal analysis was used to contextualize findings. The legal analysis was drafted by legal experts with knowledge of international criminal law, international human rights law (IHRL), and international humanitarian law (IHL), as well as with particular expertise in the conflict in Ukraine. The legal analysis was reviewed by legal experts from both TH and PHR as well as external legal experts on attacks on health.

Limitations

The study and its findings have several limitations. First, the analysis of attacks against Ukraine's energy infrastructure only includes direct attacks on the generating plants and grids. Attacks on enabling and related infrastructure, such as natural gas storage or heating sector infrastructure, and cyber-attacks, are not included in the analysis. Similarly, attacks on short-term energy generation solutions, such as diesel generators and household solar panels

are outside the scope of review. Additionally, after the full-scale invasion, some data about the location of power infrastructure was classified as confidential and removed from public access. Nonetheless, the analysis relied on data that was still publicly available and might not be fully up to date but is still useful to analyze trends and impact. Lastly, information relating to the maximum projected vs actual installed capacity of traditional generation is not available so the information provided on the capacity of specific plants may not be fully precise.

The voluntary nature of the survey and the absence of probability sampling mean that the findings cannot be generalized to the entire health care system in Ukraine. The lack of participation from all health care facilities may have led to under-reporting, potentially resulting in missing data on incidents and an underestimation of the true scale of attacks and their health impact. Conversely, the potential for double counting exists, as multiple respondents from the same facility may have reported the same incident, leading to possible over-counting of events. However, medical complications or deaths reported from the same facility are unlikely to indicate a double count, because any incident with multiple cases reported from the same facility is flagged and highlighted accordingly to ensure proper evaluation. Data accuracy has not been independently verified by PHR or TH. As all information related to incidents and their impacts were self-reported, there may be recall bias or reporting inconsistencies due to the challenging conditions in conflict zones. Additionally, although the survey specifically aimed to assess the impact of attacks on energy infrastructure on medical services, there is a risk that respondents may have interpreted the questions more broadly, reflecting the overall impact of power outages on health outcomes and medical services. This potential variation in interpretation introduces measurement variance, which, while somewhat mitigated by a large sample size, still represents a limitation in accurately isolating the specific effects of energy infrastructure attacks alone.

Due to ongoing conflict and the presence of Russian forces in the occupied areas of Ukraine, the research team was unable to document and verify incidents directly in those areas; this could result in underreporting of attacks on health in certain high-risk areas. All information in the dataset of attacks was carefully reviewed based on established verification criteria. The dataset of attacks on health care may suffer from "reporting bias" where incidents may be included or excluded for a range of reasons, including lack of access, lack of knowledge, editorial choices, security reasons, communication disruptions, errors and omissions. Verification of attacks on health has a lag of at least several weeks which might result in underreporting of recent events.

III. THE GENERAL CONTEXT OF RUSSIA'S ATTACKS ON ENERGY INFRASTRUCTURE IN UKRAINE

a. Overview of the Ukrainian Energy Infrastructure: Power Plants, Grids and the Connectedness of the Energy Systems

Access to power and functional infrastructure to generate, transport, and facilitate its consumption is crucial for the health and well-being of populations. Attacking generation capacities and grid infrastructure hampers access to electricity and utilities and worsens energy poverty.⁴⁹ Because of the significant capital required to develop functional energy infrastructure, when that infrastructure is

targeted and damaged during conflict, the immediate impacts and long-term harm is substantial.

Ukraine's power sector is made up of interconnected generating capacities, transmission and dispatch grid infrastructure, all moving energy to the end consumers (see *Image 1*).

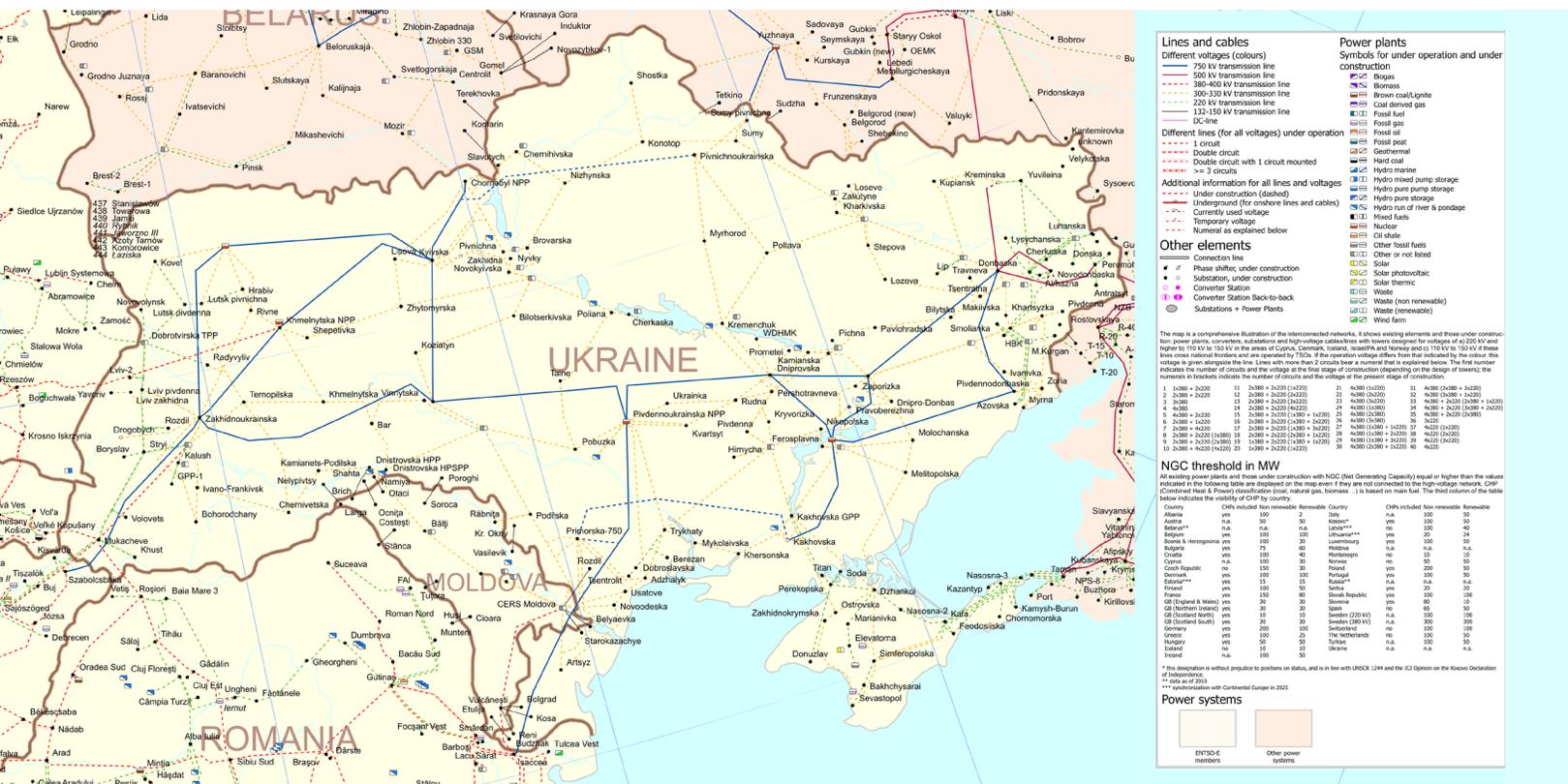


Image 1. Ukraine's energy infrastructure. Source: ENTSO-E, 2023⁵⁰

Before the full-scale invasion, Ukraine energy sector was one of Europe's most developed with a peak installed electricity generation capacity of around 60 gigawatts (GW).⁵¹ It played a key role in Ukraine's economic growth with the entire population having access to electricity.⁵²

A 2019 assessment predicted that traditional power generation would meet demand until at least 2025.⁵³ However, by June 2024, Ukraine's available capacity had dropped by 85 percent to just 9 GW, well below the required 13.8 GW.⁵⁴

Ukraine's energy infrastructure was diversified with electricity produced from thermal, nuclear and hydropower plants as well as

renewable resources like biomass, biogas, solar, wind and small hydropower.⁵⁵ Russian aggression has damaged or destroyed nearly all forms of production: some facilities have been occupied, others have suffered damage from combat operations along the front line, and many have been deliberately targeted in precise Russian attacks. A comprehensive analysis of the Ukrainian energy infrastructure and the effects of Russian aggression on it is presented in Annex I.

Grids and Connectedness

For electricity to reach the end consumers safely, energy must be generated and transported as well as transformed and distributed. Electricity is usually consumed the moment it is produced, meaning

that the amount of electricity generated matches the demand at any given moment. Operational grid infrastructure is a prerequisite for connecting various types of generating plants to the end consumers, who are often located hundreds or thousands of kilometers away.⁵⁶

Ukrainian power grid infrastructure is broadly divided into transmission (long-distance, high-voltage electricity transportation) and distribution (shorter distances and lower voltage electricity transportation) grids. The transmission power system connects all power infrastructure in Ukraine nationwide. The dispatch grids, on the other hand, are local, usually specific to oblasts in Ukraine and several smaller systems.

In Ukrainian transmission lines,⁵⁷ there are more than 100 high-voltage substations and 445 transformers operated by the transmission system operator (TSO).⁵⁸ The distribution systems include over 800 thousand km of overhead and cable lines, more than 100 high voltage substations, and about 200,000 transformer substations operated by more than 30 distribution system operators (DSOs).

Power Transformation

Between the power plant where the energy is generated and the end use point where the consumer receives the energy, there are usually several substations with transformers that change the voltage of the energy between high transmission voltages (necessary to move the energy across long distances while reducing energy loss) and lower distribution voltages (to allow for the energy to be used by the consumer).

Damage to the substation often results in reduced capability for the electricity system at large. Transformers are the frequent targets of attacks and are difficult to replace.⁵⁹ Those substations located near a generating plant and converting the electricity are especially vulnerable.⁶⁰

Power lines, including cables and poles, are relatively inexpensive and easier to replace,⁶¹ but they also become targets of attack. Besides attacks on substations, one attack targeted a TSO dispatch center, threatening the operation of the entire grid.⁶²

Connectedness

Until 2022, the Ukrainian power system was synchronized with power systems of Belarus and Russian Federation, trying to fully integrate into the European Network of Transmission System Operators for Electricity (ENTSO-E).

At the time of the full-scale invasion, TSO was running test operation in island mode (without connectedness to Belarus and Russian Federation) as a part of the grid integration process that started in 2017.⁶³ Because of the full-scale invasion, Ukraine continued to operate in the island mode with the ENTSO-E providing emergency support.⁶⁴ In November 2023, ENTSO-E enabled a permanent interconnection between the power systems of Continental Europe and Ukraine.⁶⁵

The massive attacks and consequential damage to the power sector also created the need for electricity imports. With joining ENTSO-E, Ukraine's power grid became more stable but limits to the capacity of interstate connectors means that electricity imports are currently not sufficient to fully cover the demand.⁶⁶

b. Timeline of Energy Warfare

Beginnings: Gas Wars, Energy Appropriation, and the Lead-up to the Full-Scale Invasion

Russia has long weaponized energy against Ukraine. In 2005, Russia cut off the natural gas supply to Ukraine amid a dispute over gas usage.⁶⁷ After an agreement to resume transit in 2007, Russia again reduced supplies in 2008, and later cut them in 2009.⁶⁸ Restrictions in gas supply led to heating outages and industrial disruptions.⁶⁹

From 2014 to 2022, as Russia illegally annexed Crimea, backed militias in Luhansk and Donetsk, and later invaded Ukraine, it damaged and seized Ukraine's coal mines and power plants⁷⁰ forcing Ukraine to import energy resources it had previously extracted.⁷¹

Russia also initiated a campaign of cyber-attacks against the Ukrainian energy grid. In December 2015, one such attack caused a six-hour blackout that left hundreds of thousands of customers in and around Kyiv without power.⁷²

Later, destruction of Ukrainian energy resources portended the full-scale invasion itself. On February 21, 2022, Russian forces shelled Luhanska TPP in Shchastia, at the time on the line of contact between Russian and Ukrainian forces, resulting in the TPP being disconnected from the power grid.⁷³ Within days, Russian forces had crossed the frontline and seized the plant itself.⁷⁴

Full-Scale Invasion: The First Months

Soon after crossing state borders and the former line of contact, Russian forces began occupying power plants. On March 3, 2022, they placed military objects within the Zaporizka NPP complex,⁷⁵ leading to the intermittent damage and shutdown of the plant's intricate and potentially volatile generation system.⁷⁶ In addition, during the first weeks of invasion, Russian forces also took over the Vuhlehirska, Zaporizka, and Luhanska TPPs as well as the Kakhovka HPP⁷⁷ resulting in a loss of 14 GW of generation capacity.⁷⁸

The full-scale invasion also disrupted Ukraine's transition to renewable energy, shelling of power lines in Zaporizhzhia stopped electrical generation from wind farms on day one.⁷⁹ In the first eight months of the full-scale invasion, Ukraine lost 80 percent of its wind-powered generation and 20 percent of solar power generation.⁸⁰

In Autumn 2022, direct attacks on energy infrastructure were at the forefront of the Russian strategy to undermine Ukrainian resistance. On September 11, 2022, Russian forces carried out the first aerial attacks specifically targeting energy infrastructure.⁸¹ These attacks damaged two TPPs and two substations, leaving over a million customers in the Poltavaska, Dnipropetrovska, Kharkivska, Sumska, and Donetska oblasts without power.⁸² Days later, Russian President Vladimir Putin appeared to threaten further attacks on civilian infrastructure, implying that the recent wave of attacks had been "warning shots."⁸³

The attacks soon escalated on September 19, 2022, when Russian missiles shut down Oleksandrivska HPP and damaged three high-voltage power lines⁸⁴ and landed just 300 meters from the reactor of the Pivdenoukrainska NPP.⁸⁵

Autumn 2022: Total War on Ukrainian Energy Infrastructure

September 11, 2022:	First coordinated aerial attacks on energy infrastructure.
October 10-11, 2022:	Facilities in Kyiv and 11 regions damaged; 30% of infrastructure affected. The massive targeted campaign started.
End of October 2022:	40% of energy infrastructure damaged by Russian strikes.
Cyber-attacks:	From October 25 - November 24 , over 10 daily cyber-attacks on energy infrastructure.
Pre-October 2022:	Focus of attacks shifted to fuel installations and railway-related electric infrastructure.
Post-October 2022:	Focus of attacks shifted to power plants and critical electricity/heat transmission infrastructure.

On October 10, 2022, Russian forces launched 80 missiles at Ukrainian energy infrastructure, damaging facilities in Kyiv and 11 regions across Ukraine.⁸⁶ Approximately 30 percent of the infrastructure was damaged leaving millions without heating, power, or water, for varying durations. Ukrainian energy authorities suspended energy exports indefinitely.

Also, on October 10, 2022, President Putin stated the following: "This morning, at the proposal of the Defense Ministry and in accordance with the plan of Russia's General Staff, a massive strike was launched with long-range precision air, sea and land-based weapons against Ukrainian energy, military and communications facilities."⁸⁷

In October 2022, Russian forces attacked Ukrainian energy infrastructure almost daily⁸⁸ damaging approximately 40 percent of the energy infrastructure by end of the month.⁸⁹ These strikes triggered regular blackouts and cuts to heating and water.⁹⁰ The situation forced Ukrenerg, a state-owned electricity TSO, to introduce restriction schedules that continue at varying intensities to this day.⁹¹ Russian forces continued targeting Ukrainian energy infrastructure with a major assault on November 15, 2022 involving 100 missiles and suicide drones that damaged 15 production facilities, including TPPs and transmission substations, and leaving ten million consumers without electricity.⁹²

Russian forces also attacked Ukrainian infrastructure through ground troops and cyber warfare. While retreating to the right bank of the Dnipro River ahead of the advance of Ukrainian forces in Kherson, the Russian military forces destroyed almost all critical energy infrastructure in districts where Ukraine was retaking control.⁹³ Russian forces also looted parts of renewable energy generating facilities, rendering them unusable without significant repairs.⁹⁴ On average, from October 25 to November 24, 2022, Russia carried out more than ten cyber-attacks on energy infrastructure daily.⁹⁵

Russia's strategy to destroy Ukrainian energy infrastructure as winter approached was clear from both official statements and patterns of attacks. The UN Commission of Inquiry on Ukraine found that "the attacks on energy infrastructure since October 10, 2022 were widespread and systematic and...the objective was to disrupt the energy system of the entire country, with the predictable effects on the heating system."⁹⁶ Whereas attacks before October 2022, focused mainly on fuel installations and electric infrastructure related to the railway system, after October 2022, attacks targeted power plants and other infrastructure critical for the transmission of electricity and the generation of heat across Ukraine.⁹⁷

These attacks on energy infrastructure also worsened the refugee crisis: reports show that attacks on energy fueled a 17 percent rise in departures from Ukraine in November 2022 compared to the previous month, soaring to 39 percent in December.⁹⁸

Winter 2022-2023: Ongoing Attacks and Adjusting Tactics

Expanded Scope:	Attacks spread to 20 of 24 regions , hitting Kyiv, Kharkiv, Kherson, Dnipropetrovsk, and Zaporizhzhia hardest.
December 16, 2022:	A countrywide attack disrupted 50% of customers , affecting heat, water, railways, and even power supply to Moldova .
As of February, 2023:	Over 100 energy workers killed, 200+ injured ; Ukraine lost approximately 50% of production capacity .
February 2023:	12.5 million homes and 400,000 businesses without power for 10 hours/day .

The winter of 2022 to 2023 saw constant bombardment. Attacks further expanded in geographic scope, striking with greatest frequency Kyiv and Kharkivska, Dnipropetrovska, Khersonska, and Zaporizka oblasts in the South and East of the country, eventually affecting 20 of the 24 administrative units of Ukraine.⁹⁹ On December 16, 2022, a countrywide attack disconnected approximately 50 percent of customers throughout Ukraine, caused heat, water, and railway disruptions, and even disrupted power supply to neighboring Moldova.¹⁰⁰

Moreover, Russian forces changed their approach, indicating an intention to maximize long-term damage to energy infrastructure by targeting repair workers seeking to undo the damage that Russian munitions had done.¹⁰¹

The destruction was substantial: from October 2022 to February 2023, there were at least 13 waves of drone and missile attacks coming in quick succession.¹⁰² As of February 24, 2023 - one year after the full invasion began - over 100 energy workers in Ukraine had been killed and more than 200 injured.¹⁰³ By April 2023, the Ukrainian system had reportedly lost about half of its production capacity.¹⁰⁴ Damages were estimated to amount to approximately US\$8.3 billion or higher.¹⁰⁵

By the end of February 2023, around 12.5 million residential and 400,000 commercial consumers did not have access to power for ten hours a day.¹⁰⁶ Power, heating, and water cuts contributed to new flows of displacement.¹⁰⁷ The average Ukrainian household had spent the equivalent of five weeks without electricity amid freezing temperatures.¹⁰⁸

Spring 2023 - Present: Targeting Generation, Cumulative Destruction, and Looking to the Future

March 22, 2024:	Russia launched 88 missiles and 63 drones across 9 oblasts , causing power outages for 1.5 million consumers .
March-August 2024:	Regular strikes hit 20 of 24 regions in 9 major waves , severely damaging energy infrastructure.
2024 strikes:	Damaged 3x more thermal power plants (TPPs) than in 2022-2023, with repeated targeting of key facilities.
March 5, 2024:	ICC issued arrest warrants for missile strikes against energy infrastructure.
June 24, 2024:	Warrants issued for Russia's Defense Minister Sergei Shoigu and Chief of Staff Valery Gerasimov.

After the devastating winter from 2022 to 2023, Ukrainian energy producers scrambled to repair lost generation and distribution networks - incurring major expenses - and make up for power shortfalls.¹⁰⁹ Going into winter from 2023 to 2024, Ukraine could only generate 17.8 GW of electricity per hour. Peak consumption reached 18.6 GW per hour.¹¹⁰ Formerly a net energy exporter, Ukraine began importing electricity from neighboring countries to fill deficits.¹¹¹ Occasional Russian strikes still damaged Ukrainian energy infrastructure.¹¹²

Then, in March 2024, Russian forces resumed their large-scale, systematic attacks on Ukrainian energy infrastructure.¹¹³ On March 22, 2024, the Russian Federation launched 88 cruise, ballistic, and repurposed surface-to-air missiles, and 63 loitering munitions and drones, firing from the air, ground, and sea. The munitions destroyed or damaged energy infrastructure in, at least, Odesa, Ivano-Frankivsk, Lviv, Vinnytsia, Dnipropetrovsk, Khmelnytskyi, Kirovohrad, Kharkiv, and Zaporizhzhia oblasts. Immediate power outages disrupted heating and water and disconnected 1.5 million consumers.

Strikes continued at regular intervals, with at least nine waves of major aerial attack between March and August 2024. The UN HRMMU - drawing from statements by Russian and Ukrainian authorities, information from private and government energy companies, open-source videos and photos assessed as credible and reliable, and UN HRMMU observations during site visits - stated that:

"[E]ach wave involved numerous high-precision, high-yield cruise and ballistic missiles, loitering munitions, and reconnaissance drones and targeted multiple electricity facilities across the country in a well-coordinated and synchronized

manner. The munitions were launched simultaneously from multiple locations utilizing land, aerial, and sea-based delivery platforms, requiring high-level planning and coordination of several branches of the Russian armed forces."¹¹⁷

While previous waves primarily targeted energy transmission, and to a lesser extent generation facilities, these strikes heavily targeted energy generation facilities.¹¹⁸ Indeed, the 2024 strikes damaged three times as many TPPs as did those in 2022 to 2023, in some instances targeting the same facilities multiple times so as to render them completely inoperable.¹¹⁹ UN HRMMU also found that by June 2024, 73 percent of the power-generating units of TPPs, as well as 20 HPP units, were already rendered inoperative due to severe damage.¹²⁰ By September 2024, Russia had allegedly destroyed all TPPs, and nearly all hydroelectric capacity in Ukraine.¹²¹ The human cost of these strikes has been immense and cumulative, directly killing at least 18 and injured 84 civilians.¹²² Data on indirect harm from these attacks that could result in excessive deaths has yet to be gathered.

The attacks, moreover, caused immediate power outages at times lasting days in major cities like Kharkiv and Odesa, disrupting water, heating, public transit and communication.¹²³ In Kharkiv, the strikes took out the air raid alarm system for several days.¹²⁴ City employees had to physically circulate the city to warn residents of imminent risks to their lives and health.¹²⁵

Russia has employed a diverse array of weaponry in its attacks on Ukraine's energy infrastructure. While open-source data is insufficient to conclusively identify the specific weapons used in each individual strike, there is enough available information to confirm that high-precision missiles, designed for targeting ground targets, have been predominantly employed in these operations.¹²⁶ The use of these high-precision weapons suggests that Russia is specifically targeting the energy infrastructure, and that the damage is not incidental to other attacks targeting military objectives.

The future of Ukraine's energy infrastructure is uncertain. A Ukrainian electricity transmission company in June 2024 stated that they expect deficits of 3 to 6 GW during peak hours this winter.¹²⁷ At the same time, 25 percent of Ukrainian citizens interviewed at the Ukrainian border stated they were leaving due to lack of access to electricity, water, and heating; by July, that had jumped to 49 percent.¹²⁸ Meanwhile, all along the frontline, ongoing conflict continues to deprive hundreds of thousands of consumers from power daily.¹²⁹ The Russian assault on Ukrainian energy infrastructure is ongoing, comprehensive, and threatens to undermine Ukrainian civilian life.



A destroyed power transformer from Burshtynska thermal power plant displayed on a square in Kyiv, Ukraine no longer produces such transformers making them difficult to replace. Photo captured by Physicians for Human Rights in September 2024.

IV. ATTACKS ON ENERGY AS ATTACKS ON HEALTH

Case study: Okhmatdyt Hospital

The Okhmatdyt National Specialized Children's Hospital exemplifies the multifaceted assault on Ukraine's health care facilities since the full-scale invasion; enduring shelling, shooting, blackouts, and staff deaths due to continued aerial attacks on the city.¹³⁰ On July 8, 2024, a missile directly struck the roof of Okhmatdyt's toxicology building which houses the chronic and acute intoxication unit, killing two civilians and wounding 30 more, knocking out power and water, and damaging or destroying large parts of the hospital campus.¹³¹

Okhmatdyt Hospital's Patient Population

With a 600-patient capacity, Okhmatdyt is Ukraine's largest children's hospital providing vital pediatric care for over 130 years.¹³² Before the full-scale invasion, it treated approximately 20,000 patients from all over Ukraine, bringing patients from remote regions via aerial evacuation, and performed 10,000 surgeries annually.¹³³ Its doctors, working in over 80 departments, treated children suffering from cancer, severe injuries, and rare diseases.¹³⁴ Okhmatdyt received cases of dangerous pregnancy complications, helped pregnant people develop postnatal care plans and tended to premature babies.¹³⁵

Impact of Direct Attacks on Okhmatdyt Hospital

From the start of the full-scale invasion, Okhmatdyt's operations were disrupted. In March 2022, the effects of an aerial attack blew out the hospital's windows¹³⁶ and amid crossfire during the first days of the invasion, bullets hit one of the wards.¹³⁷ As the battle for Kyiv escalated, Okhmatdyt saw an influx of wounded children and adults.¹³⁸ The hospital delayed all but lifesaving surgeries, and staff evacuated patients with non-life-threatening conditions.¹³⁹ Evacuation itself posed a danger to immunocompromised pediatric oncology patients by increasing the risk of sterility breaches during transfers; in one case - according to an Okhmatdyt doctor - the need to transfer led to a secondary infection that killed a pediatric oncology patient.¹⁴⁰

In Kyiv, the constant risk of air and ground assault forced Okhmatdyt's most vulnerable patients - children with terminal diseases - underground¹⁴¹ where sheltering from air raids disrupted delicate cycles of treatment. Dr. Lesia Lysytsia, a pediatric ophthalmological surgeon at Okhmatdyt, said: "Cancer treatment is structured cyclically. ...and when we introduce the drug, we have a small time-window when we can influence cell division. If the patient reschedules the visit due to an attack, if this cycle is lost - we just fill the patient with chemicals, do not treat the disease and cause harm to the patient."¹⁴²

Relocating patients underground further complicated treatment, and the long-term health effects from missed and inadequate care will only become clear as they accumulate.¹⁴³ Staff were forced to operate ventilators by hand for patients needing oxygen.¹⁴⁴ Pediatric cancer patients had, during that time, access to only a basic form of chemotherapy, increasing their risk of relapsing or becoming sicker.¹⁴⁵ Patients with autoimmune diseases and diabetes had limited access to medication.¹⁴⁶

Impact of Attacks on Energy on Okhmatdyt Hospital and Patients

The retreat of Russian forces from Kyiv oblast in April 2022 brought only partial relief. On October 10, 2022, Russia began its large-scale aerial assault on Ukraine's energy infrastructure, fire from a missile strike killed Oksana Leontieva, one of Okhmatdyt's doctors, as she was driving to work.¹⁴⁷ The hospital lost more staff to displacement, emigration, and being enlisted in military service as combat medics.¹⁴⁸ Power outages due to attacks on energy infrastructure also occurred.¹⁴⁹ For periods of 13 hours to several days, the power outages resulted in lights shutting off in all departments but intensive care, interrupted or delayed surgeries affecting patient outcomes; stopped the flow of water to the hospital, creating unhygienic conditions; and rendered diagnostic and treatment equipment unusable.¹⁵⁰ Where surgery could not wait, Okhmatdyt's surgeons conducted operations in the half-dark, headlamps illuminating their work.¹⁵¹

Power outages increase the burden on already overburdened doctors. Dr. Lysytsia recounts the rush of activity in the wake of a blackout:

"The hematology department must ensure that the refrigerators work, the surgeon must ensure that the operation does not end with blood flowing from the patient, and the anesthesiologist must ensure that the patient breathes... The anesthesiologist begins to 'breathe' the patient with a 'manual resuscitator', the nurse responsible for the medicine begins to look for where to find batteries for refrigerators. If these are blood products, then there is a system that keeps the desired temperature for a certain time. If the doctor understands that the electricity will not appear in the near future, he begins to find out where to transport the drugs so that they do not spoil."¹⁵²

July 8, 2024 - Attack on Okhmatdyt Hospital: Devastation, Power Loss, Death, and Suffering

With patients and staff enduring constant air raids, blackouts, and exhaustion, the missile attack shattered the already fragile ecosystem. On July 8, 2024, the air raid alarms sounded first without prior warning about the attack from Russian forces.¹⁵³ Soon after, cell service cut out.¹⁵⁴ Staff hurried to transport patients down to shelter.¹⁵⁵ Then, the first explosion rang out nearby.¹⁵⁶ Dr. Anastasiia Zakharova, a pediatrician and department head at Okhmatdyt, recalls how she rushed with her colleague to disconnect her five patients on dialysis, a process that can take half an hour for each patient. As she was working, the second explosion came: a powerful munition had struck the roof of Okhmatdyt's toxicology building amid a massive aerial attack across Ukraine.¹⁵⁷ Analysis of the appearance, trajectory, speed, and destructive impact of the munition has established with high confidence that it was a highly accurate Russian Kh-101 missile.¹⁵⁸ Detailed analysis of the attack and evidence of Russia's involvement are provided in Annex II of this report.



Okhmatdyt Hospital after the attack on July 8, 2024.
Photo by Masi Nayyem.

At the moment of impact, Dr. Zakharova saw her colleague, Dr. Svitlana Lukyanchyk, thrown by a blast wave to the wall. Then she saw only chaos.

“It was dark and dusty,” she remembers, and I heard “beeping devices, signaling errors, [and] the screams of children.”

Dr. Zakharova rushed to help her patients and found one of her colleague’s unconscious under rubble, her arm badly injured.¹⁵⁹ Some men ran in to help Dr. Zakharova transport the terrified children, some of whom could not walk, downstairs.¹⁶⁰ Dr. Zakharova searched for Dr. Lukyanchyk and saw her feet against the window; Dr. Lukyanchyk died from the impact.¹⁶¹

Dr. Lysytsia, who was working just opposite the toxicology department where the missile hit, also recalls total darkness, shockwaves, falling debris, and wounded colleagues, some wearing surgical gowns and covered in blood from their own wounds, rushing to save patients.¹⁶² She notes, also, how things could have been much worse: “if the first missiles had not fallen on Lukyanivka [a district nearby], we would not have started to lower everyone very quickly into cover - if we had not urgently finished operations, then everything would have been much worse... I know about a case where the doctor performed an operation, put down the scissors and did not yet have time to pierce the child’s eye with a needle during the operation [because] the explosion occurred the moment before. [Had the explosion occurred a moment later], [t]hat would be a lost eye.”

Two adults, including a doctor, died on impact because of the missile attack and at least 30 people were wounded, among them eight children, one of whom later died of his wounds.¹⁶³ There were no military personnel among the casualties, nor any stationed at or near the hospital.¹⁶⁴ The strike completely destroyed the toxicology and trauma surgery departments, and severely damaged countless pieces of specialized equipment, as well as the intensive care unit, surgery, and oncology departments, among others.¹⁶⁵ The attack happened on Monday in broad daylight, during regularly scheduled patient intakes, a time when the hospital would be more crowded with patients than usual.¹⁶⁶ There were surgeries in progress.¹⁶⁷

The strike knocked out power and water for two days.¹⁶⁸ It



Okhmatdyt Hospital after the attack on July 8, 2024.
Photo by Masi Nayyem.

destroyed two energy substations that powered all Okhmatdyt’s infrastructure, requiring the installation of mobile transformer substations for temporary power generation, representing an additional and substantial expense.¹⁶⁹ The campus was all but non-functional for days.¹⁷⁰

There had been 627 patients admitted at the time of the attack; staff temporarily discharged 450, transferred 94 to other hospitals in Ukraine, and kept 68 in their care on the now rubble-strewn campus.¹⁷¹ The attack caused patients in delicate health to regress, erasing months of careful treatment.¹⁷² It deterred new patients from seeking treatment for fear of attack, causing conditions to worsen.¹⁷³

By July 16, 2024, the hospital reopened several departments, but it may take years to restore its highly specialized functions.¹⁷⁴ Experts estimate it will cost US\$19 to 22 million to repair the damage.¹⁷⁵ In the meantime, Ukraine’s most vulnerable pediatric patients now have limited access to the care they desperately need, like pediatric hemodialysis or other specialized treatments.¹⁷⁶

These are only the immediate physical effects. Though doctors continued to work, even on the day after the attack, the psychological strain is immense and, for many, unbearable. There has been attrition among staff, with some choosing to leave or stay abroad for their safety and the good of their families.¹⁷⁷ Dr. Lysytsia states that “you can work in this mode for a couple of years, but not forever.”¹⁷⁸ The attack left doctor and patient alike in shock, uncertain of the future. “For me,” Dr. Lysytsia states,

“Okhmatdyt was a fortress. I thought a children’s hospital wouldn’t get hit.”¹⁷⁹

Dr. Zakharova recounts the same feeling among staff. But “now there is no such impression.”¹⁸⁰

Attacks such as those on Okhmatdyt Hospital do not just damage medical capacity in the near-term by causing death and destruction. They undermine patients’ access to specialized medical care in the long-term, as for doctors whose calling is saving children’s lives, persistent attacks on health care impose a stark choice: “either you work, or you are safe.”¹⁸¹

Attacks on Health as Part of a Broader Strategy to Attack Civilian Infrastructure

Protection for health care in conflict is a universally recognized norm that is increasingly threatened.¹⁸² There are numerous recent examples of this brutal but persistent trend,¹⁸³ including many attacks specifically perpetrated by Russia. In Syria, the assault on health care facilities has been relentless since the start of the conflict and particularly after Russia entered the conflict.¹⁸⁴ Since the start of the Russian invasion of Ukraine, health care facilities and workers have faced relentless attacks that have endangered patients and medical staff.

In 2023, there was a 25 percent annual increase of global attacks on health.¹⁸⁵ Attacks on health care in armed conflict can threaten an entire civilian population’s ability to sustain itself in the long-term. Routine illnesses become fatal; cancer rates increase as patients face limited access to life-saving treatment.¹⁸⁶ Patients must weigh the need to seek necessary medical attention against the risks of attack at their place of treatment.¹⁸⁷ Pregnancy and birth complications become more common and fraught.¹⁸⁸ Chronic conditions become unmanageable, and communicable diseases rage.¹⁸⁹ The longer the attacks continue, the more severe their effects: comprehensive campaigns of attacks on health care infrastructure may set a population’s health back by decades and produce excess deaths and reduced quality of life for years to come.¹⁹⁰

PHR, together with eyeWitness to Atrocities, Insecurity Insight, MIHR, and the UHC have documented a total of 1,521 attacks on Ukraine’s health care system since Russia’s full-scale invasion in Ukraine in February 2022.¹⁹¹ PHR and partners have documented both the devastating effects of attacks on hospitals, ambulances, and health care workers¹⁹² as well as Russia’s more implicit methods of misusing and weaponizing health care in the occupied territories,¹⁹³ indicating the centrality of health care as a target in the war.

TH has also focused on Russia’s intentional targeting of health care facilities. A collaborative study with Human Rights Watch and SITU

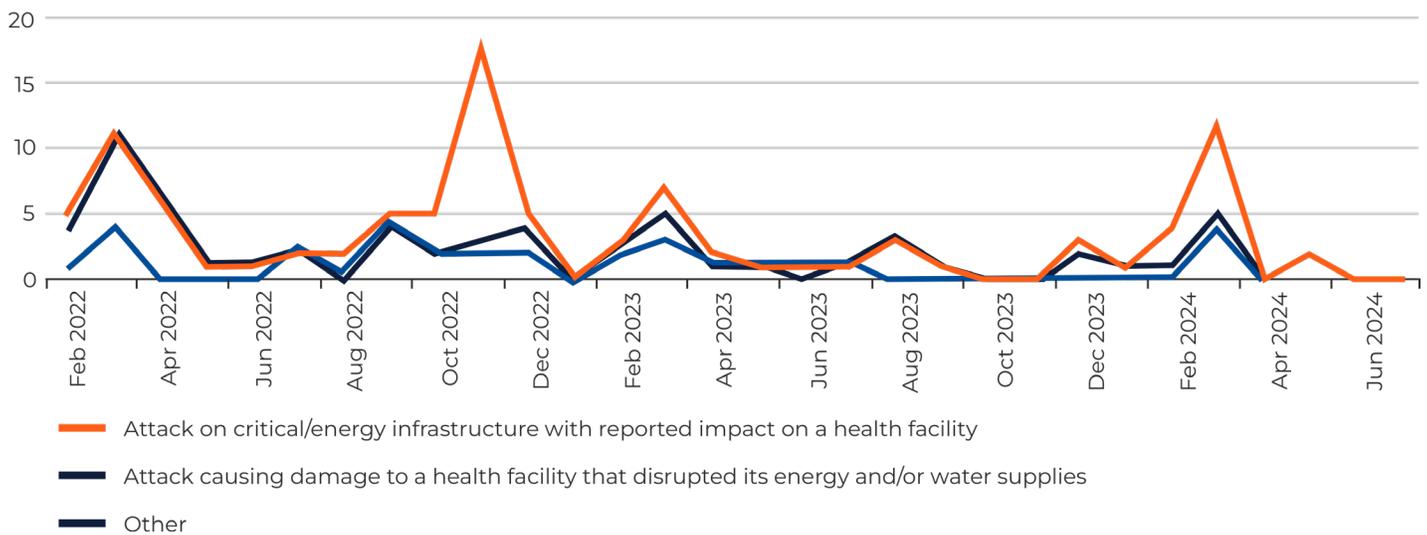
Research analyzed the destruction of Mariupol and underscored the deliberate and targeted nature of Russian attacks on hospitals and the systematic approach taken against health care infrastructure.¹⁹⁴

Attacking health care, as evidenced by the numerous violations since the start of the Russian invasion in Ukraine, extends far beyond using explosive weapons to destroy health care facilities for military or other advantages. As defined by the World Health Organization (WHO), an attack on health, apart from verbal or physical violence, is also “obstruction or threat of violence that interferes with the availability, access and delivery of curative and/or preventive health services during emergencies.”¹⁹⁵ When a hospital is not able to provide medical services due to such obstruction, it is essential to document the resulting impact on patients and health care workers.

Beyond the immediate loss of life, the impact of attacks on health can be felt through how threats to health care providers in fragile health care systems have a ripple effect throughout communities they work in and also in the mid to long-term impact on the population’s health.¹⁹⁶

In Ukraine, attacks on energy infrastructure have become a key component of Russia’s war effort with the apparent intent to advance its military objectives, retaliate against Ukraine, and inflict harm on civilian populations.¹⁹⁷ In the first six months following Russia’s full-scale invasion, attacks on Ukraine’s energy infrastructure left 12 million people with limited or no access to energy,¹⁹⁸ and put almost seven million children at risk of worsening physical and mental health.¹⁹⁹ These attacks not only represent efforts to destroy Ukraine’s energy infrastructure, but also impact essential services that are critical for the well-being and survival of the Ukraine’s population. According to the WHO Regional Director for Europe, attacks on energy in Ukraine have had “knock-on effects on the health system and on people’s health.”²⁰⁰

Data collected by PHR and partners on how attacks on energy have impacted health care indicate that since the start of the full-scale invasion there have been at least 101 attacks that disrupted the functioning of hospital utilities.²⁰¹

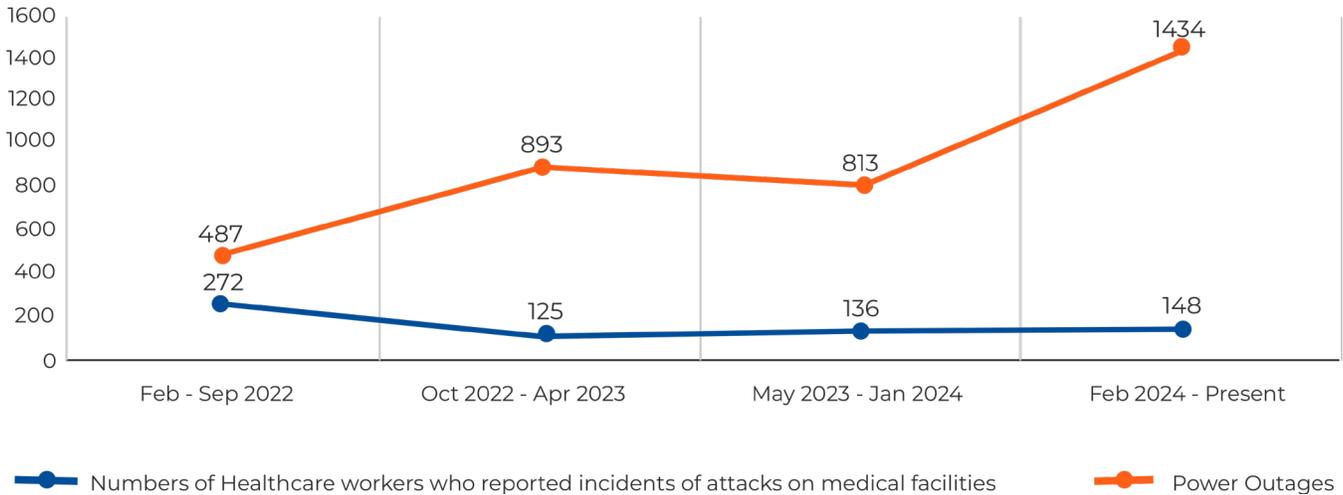


Graph 2. Timeline of attacks with reported impact on health facilities’ utilities, February 24, 2022, to July 31, 2024. Source: *Attacks on Health Care in Ukraine, as of July 31, 2024*²⁰²

A timeline based on data collected from the monitoring of attacks shows attacks with an impact on health care facilities' utilities corresponding to the timeline of the campaign of attacks on energy infrastructure (see Graph 2).

Data from the survey of health care workers²⁰³ also reveals a shift in the types of attacks experienced by health care workers. While

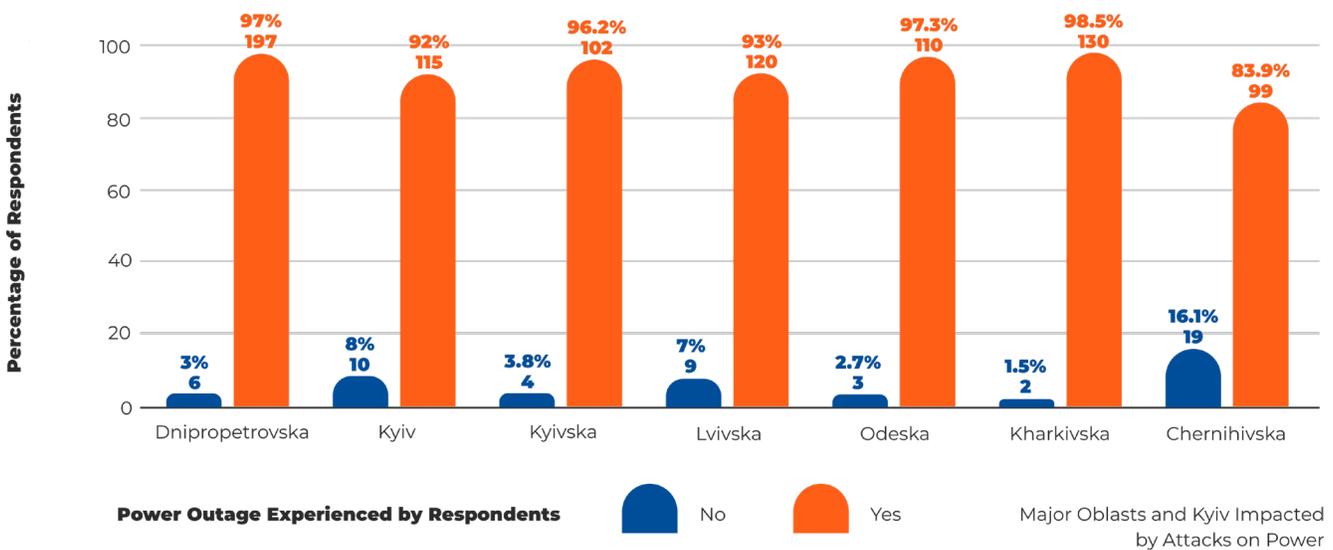
attacks directly hitting hospitals and their utilities were more common from February to September 2022, data shows more widespread attacks against energy infrastructure since October 2022, with reports of power outages surging between February and April 2024, including those impacting on health care facilities' access to energy (see Graphs 2 and 3).



Graph 3. Data from the survey of health care workers shows that while numbers of direct attacks against health care were consistent over time, with a slight increase in 2023 and 2024, power outages due to attacks on energy infrastructure continued to increase significantly during the same period of time. Source: Survey of Health Care Workers in Ukraine

Among the 2,261 health care workers surveyed, 20.9 percent reported experiencing direct attacks on their health care facility; the overwhelming majority of health care workers surveyed (see Graph 4) also reported experiencing power outage incidents specifically due to attacks on energy infrastructure across major oblasts (97 percent in Dnipropetrovska oblast, 96.2 percent in Kyivska, 93 percent in Lvivska, 97.4 percent in Odeska, 98.5 percent in Kharkivska, and 83.9 percent in Chernihivska) and Kyiv (92 percent). These multiple attacks targeting health care facilities infrastructure and utilities as well as attacks on broader energy infrastructure with impact on health care facilities access to power are indicative of the compounded nature of infrastructure destruction experienced by health care workers and health systems in Ukraine.

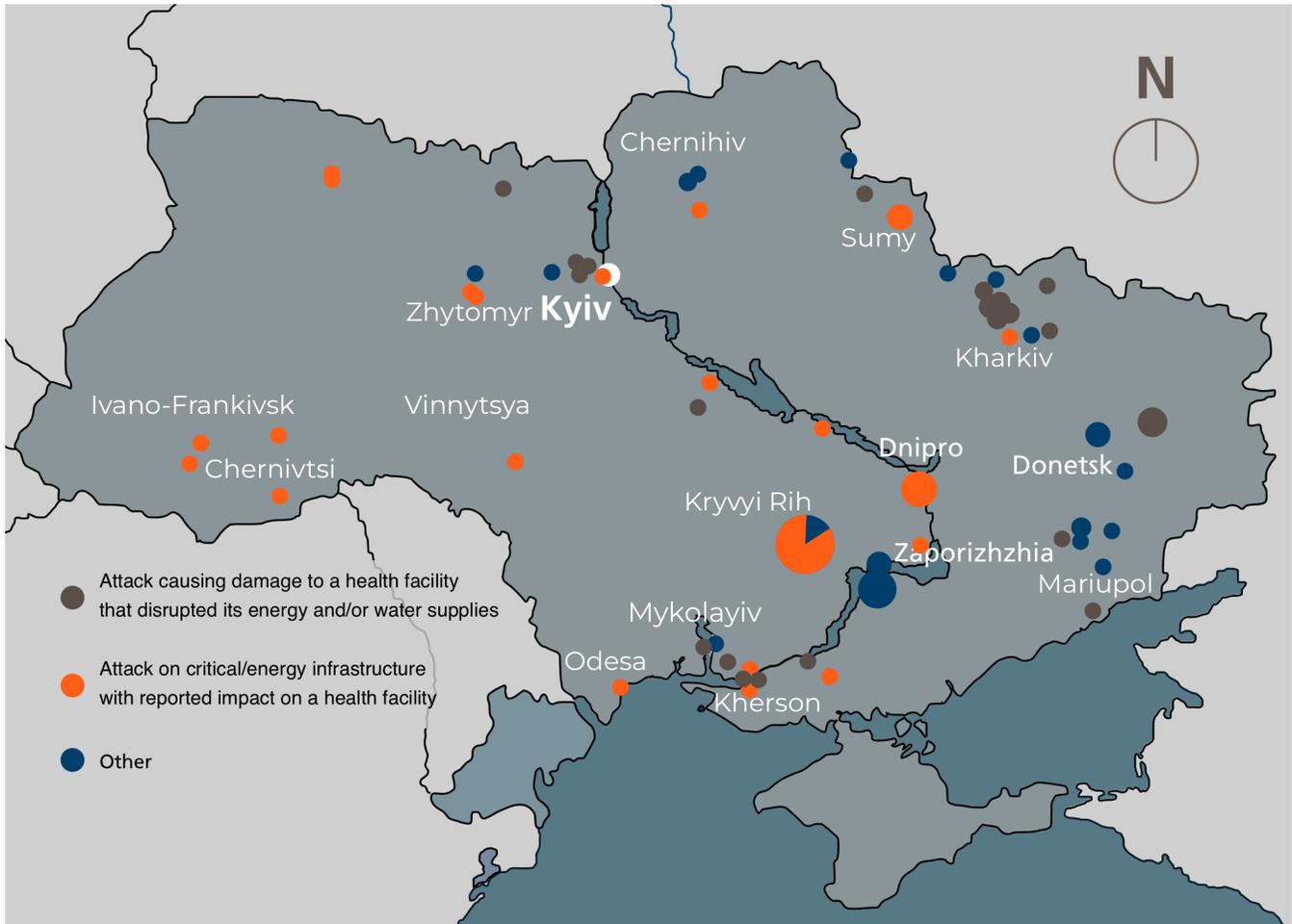
in Kharkivska, and 83.9 percent in Chernihivska) and Kyiv (92 percent). These multiple attacks targeting health care facilities infrastructure and utilities as well as attacks on broader energy infrastructure with impact on health care facilities access to power are indicative of the compounded nature of infrastructure destruction experienced by health care workers and health systems in Ukraine.



Graph 4. Distribution of power outage incidents due to attacks on energy infrastructure reported by health care workers across major oblasts and Kyiv (percent of total surveyed health care workers in major oblasts and Kyiv). Source: Survey of Health Care Workers in Ukraine

Graph 5 shows the geographical distribution of the attacks, based on the monitoring data. While the majority of direct attacks on facilities that led to loss of power occurred closer to the frontline, attacks

on energy infrastructure that affected hospital utilities happened across the areas of Ukraine under government control. In most such incidents, an air-launched weapon was reported to be used.²⁰⁴



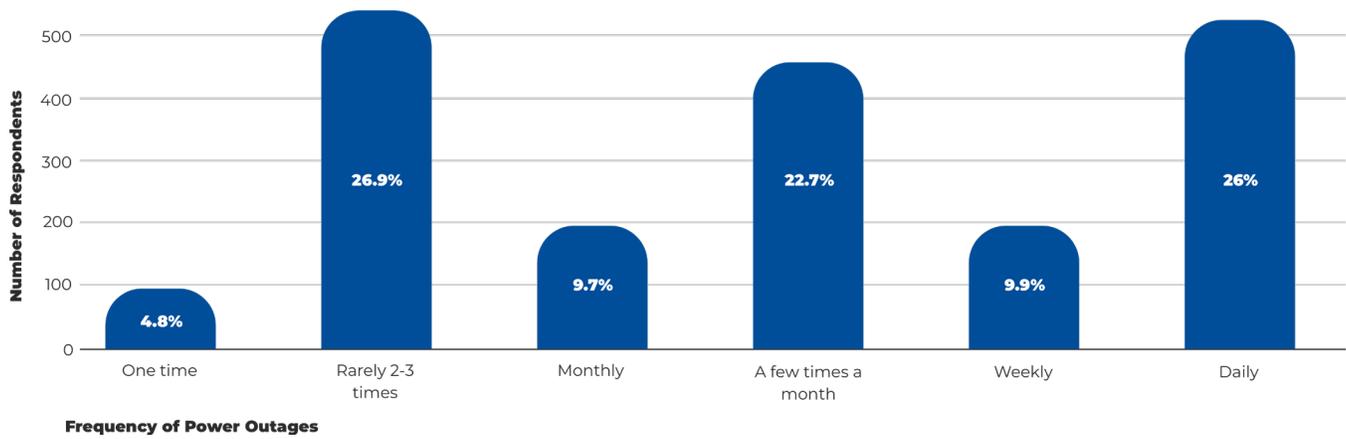
Graph 5. Map of attacks with reported impact on health facilities' energy and water supplies, February 24, 2022 – July 31, 2024. Source: *Attacks on Health Care in Ukraine, as of July 31, 2024*²⁰⁵

Our monitoring showed at least 31.7 percent of these incidents were direct strikes on hospitals that led to loss of power²⁰⁶ causing significant damage to facilities infrastructure and interconnected utilities such as power, water, and heating, causing immediate impact to the ability to provide care to patients, implicating costly repairs, and increasing vulnerability to future attacks. The safety of patients is compromised both during the attacks and because of a loss of power causing disruptions of oxygen supply, water, and access to lifesaving equipment.

The analysis of the monitoring data showed 37.8 percent were attacks on critical energy infrastructure that impacted a health facility.

The majority of these reported incidents occurred in the coldest months of 2022 to 2023 (October to April) and there was another peak in incidents in the spring of 2024.

Survey data showed 92.3 percent of health care workers reported experiencing power outages at their health facility as a result of attacks on energy with 26 percent of those who reported experiencing power outages as a result of attacks on energy, experienced these power outages on a daily basis (Graph 6).



Graph 6. “To your knowledge, how often has your health care facility experienced power outages due to Russian attacks on energy infrastructure specifically?” (Percent of surveyed health care workers who experienced a power outage due to Russian attacks on energy infrastructure specifically). Source: Survey of Health Care Workers in Ukraine

A stark example of the breadth of harm caused by attacks against energy is seen in the cases of health facilities who lose heat because of a loss of power. For health facilities already damaged by direct attacks, often missing windows, losing power, and no longer being able to provide sufficient heat compounds existing difficulties in providing care. But even for those facilities that may remain structurally intact, losing power during critical moments, such as cold winter months, can cripple a facility’s ability to function for prolonged periods, forcing patient evacuations and halting critical treatments. While temporary repairs can be made to windows and other superficial destruction, restoring electricity and subsequently heating, water, and sanitation systems can be more complex. For example, in February 2024, in Dnipro,²⁰⁷ three health care facilities were reportedly left without heating after a large-scale drone attack on the city and energy infrastructure. The inpatient facility with over 100 patients had to be evacuated. In March 2024, in Ivano-Frankivsk in the west of Ukraine, a health care facility had to reportedly turn to alternative power generation after a missile attack on the critical energy infrastructure left the hospital without heating.²⁰⁸

Reliable power which is essential for every aspect of health care, and as shown on Graph 6, power outages caused by attacks on energy infrastructure can cripple a hospital’s ability to function, even if the facility may remain structurally intact, forcing patient evacuations and halting critical treatments.²⁰⁹ Therefore,

Any attack on energy that disrupts power to health facilities constitutes an attack on health. Such attacks obstruct the availability, accessibility, and quality of care

bringing them within the WHO’s definition of an “attack on health.” As the timelines presented above show, the deliberate shift in the Russian forces’ strategy from direct attacks on health care facilities to targeting broader critical infrastructure, which affects hospitals, effectively weaponizes energy to indirectly disrupt access to critical services like health care.

V. HOW ATTACKS ON ENERGY INFRASTRUCTURE IMPACT HEALTH AND HEALTH CARE

Case Study: Mariupol Regional Intensive Care Hospital

Mariupol Regional Intensive Care Hospital exemplifies the many ways the Ukrainian health care has been targeted and how direct and indirect attacks on hospitals' energy supply have hindered health care. Bombarded, besieged, occupied, relocated, and enduring the challenges of providing care while facing attacks on energy in a new city, the hospital and its staff have suffered severe and ongoing hardships since the start of Russia's full-scale invasion.

Mariupol, a strategic Azov Sea port, was among the first cities to be attacked by Russia in early 2022. It was barraged by a wide range of weapons that damaged or destroyed up to 90 percent of the city's residential infrastructure.²¹⁰ By mid-March, the city was encircled, and on May 16, Russia fully occupied Mariupol.²¹¹

As they advanced on the city, Russian forces cut off its communications, while intense fighting damaged the city's access to electricity, sanitation, and water.²¹² According to a witness, on March 2, 2022, "water, electricity and Kyivstar [cellphone provider] communications disappeared. The next day the gas disappeared."²¹³ Another witness confirms that by March 8, 2022,

"There was no gas, no electricity, no water. Water was brought in barrels."²¹⁴

The attacks left at least 450,000 residents in complete isolation while continuous injuries from shelling, unsanitary conditions, and cold weather created a critical need for health care.²¹⁵ By the end of March, with up to 80 percent of the city's health care infrastructure critically damaged or destroyed, the UN High Commissioner stated that, "the damage and destruction coupled with the lack of electricity and medical supplies meant that hospitals had effectively ceased to function."²¹⁶

One of the remaining functioning hospitals was Mariupol Regional Intensive Care Hospital, the largest in the region with 23 departments, including a 550-bed inpatient department, and 300,000 out-patient visits per year.²¹⁷

In February and March 2022, the hospital experienced several direct attacks. On February 28, a missile hit the hospital yard,²¹⁸ and around March 10 to 13, another missile also hit the hospital.²¹⁹ The first attack damaged the intensive care ward, and the latter hit the neurosurgery department, causing one floor to collapse onto another and resulting in patients being crushed to death.²²⁰ Dr. Oksana Kyrsanova, who worked as an anesthesiologist at the hospital in February and March 2022, recalls: "It was snowing and freezing outside, and we had no windows, and the temperature in the hospital was below zero. These patients need to be warmed up, there needs to be a thermal regime to prevent hypothermia after surgery. We did not have such conditions. We covered ourselves with blankets or something else, found an old fireplace and turned it on, but it could not heat up because there were no windows. Although we covered these windows with films and bedspreads, it was useless, because the

*new air strikes just blew everything away.*²²¹ The attacks and siege also cut power. Another anesthesiologist said that "on February 25 to 26, 2022, it seems, there was no more electricity or gas in the hospital or nearby."²²²

Russian forces then turned the hospital into a military base.²²³ One of the doctors says: "Our hospital was occupied by the Russian military on March 12. It happened around lunchtime."²²⁴ The witness, whose son was a patient at the hospital, recounts: "Approximately around March 13, the hospital had already been captured by the troops of the Russian Federation, and the hospital was already running out of medicines, but some medical services were provided. However, the centralized water supply had long been cut off and the generators were running out of fuel and gradually failing."²²⁵ The witness explains that the hospital turned into a hub for civilians seeking shelter, some came on their own, but some were brought by the Russian military: "They [Russian troops] were shooting from the hospital hiding behind civilians. [...] That is, they were making a human shield out of civilians."²²⁶

This echoes in Dr. Kyrsanova's testimony: "They were on the roof of our hospital. We have a very large building, and they had a very good view. And indeed, we saw it all, they set up their equipment and shot from these hospital buildings." She says: "The hospital was a human shield for them. They knew that no one would shoot at the hospital."²²⁷

In Mariupol, the hospital continued its operation under Russian occupation, with a newly appointed administrator from the so-called "Donetsk People's Republic."²²⁸

In December 2022, the hospital was relocated and began providing health care in a new building in Kyiv with the help of medical personnel who had evacuated from Mariupol and with equipment from other cities within the Donetsk oblast.²²⁹ As of April 2023, 90 out of the hospital's 1000 health care workers evacuated to the capital.²³⁰

Even after the bombardment and occupation faced in Mariupol and relocation to Kyiv, ongoing attacks on energy infrastructure continue to limit the hospital's ability to provide the desired level of medical services in its new location.

Dr. Olena Lazariyeva, a health care worker from the Mariupol Regional Intensive Care Hospital who has worked as an intensive care anesthesiologist in the stroke department in the new hospital building in Kyiv since March 2023, says that the relocated hospital operates on one floor of a private medical center rather than the eight floors of the Mariupol facility.²³¹ This has impacted the functionality and capacity of the hospital, as only planned surgeries are performed in this hospital. Another doctor, who continued working in the Mariupol Hospital in Kyiv, adds that planned surgeries are postponed during blackouts due to greater risk for patients during surgery.²³²

Dr. Lazariyeva told the research team that the relocated hospital is not on the list of "critical infrastructure" and is thus subject to blackouts. The hospital purchased a power generator. However,

during the summer 2024 attacks, it stopped working. The outages were long:

"I am on duty for 16 hours a day. Sometimes during this time, the power was on for 40 minutes, sometimes for an hour and a half."²³³

Another doctor says: *"This summer of 2024, it was very hot and there was rarely any electricity, so the generators also failed and overheated. Some patients who couldn't wait were transferred to the Amosov [the Amosov National Institute of Cardiovascular Surgery] and other cardiac centers. Others were waiting for a stable situation with electricity."*²³⁴

"If there are severe patients, if they need oxygen, artificial lung ventilation, without electricity, it can be bad. [...] While the generator was being repaired, some patients had panic attacks, and cardiac patients sometimes had rhythm disturbances. I do not know whether this led to the deaths of patients, but it definitely harmed their health," said Dr. Lazarieva. Even when the generator was repaired, its capacity might not have been enough to supply the entire hospital. *"Almost all devices require electricity to operate. That's why the blackouts had a big impact on our work,"* she said.²³⁵

Doctors stated that electronic medical records system is also affected by the power outages: *"You need to enter data about the patient, about his or her course of illness, and without electricity and the Internet, this is impossible."*²³⁶ Dr. Lazarieva also said: *"Because the system sometimes did not store information about the actions taken with the patient, wages were sometimes not paid."*²³⁷

As illustrated in the Mariupol Regional Intensive Care Hospital case study, power outages caused by attacks on Ukraine's energy infrastructure threaten the already weakened health system. Understanding their impact on health care functions and health outcomes is essential for ensuring the right to health accountability for the full breadth of harm resulting from attacks on energy in Ukraine and informing efforts to provide remedies and restore capacity for health care provision. This can be considered through a disaster preparedness framework, using the "four Ss" framework - "space (physical structures, beds), staff (clinicians and support staff), stuff (supplies and equipment), and systems (critical infrastructure, administration and coordination)" - to explore impact on health systems and linkages to health service delivery.²⁴²

Without power, elevators do not work, and the transportation of patient became difficult and dangerous: *"For employees, it is hard physical labor if they have to transfer patients who are unconscious."*²³⁸ Air conditioning becomes non-functional as well, which is a problem during extreme heat. According to Dr. Lazarieva, the outages also cause problems with the water supply and, as a result, only one bathroom is available for the whole floor. Security systems are also affected by blackouts, jamming electronic lock for the operating room and intensive care unit.²³⁹

With all that the staff of the hospital have endured, from attacks and occupation in Mariupol, and an increased burden of power outages in Kyiv, there is an acute need to support mental health among health care workers, Dr. Lazarieva says. *"When discussing some questions, we get irritated, someone gets hysterical, panic attacks happen."*²⁴⁰

"Doctors, like all other people, suffer from blackouts," says another doctor, *"Now,*

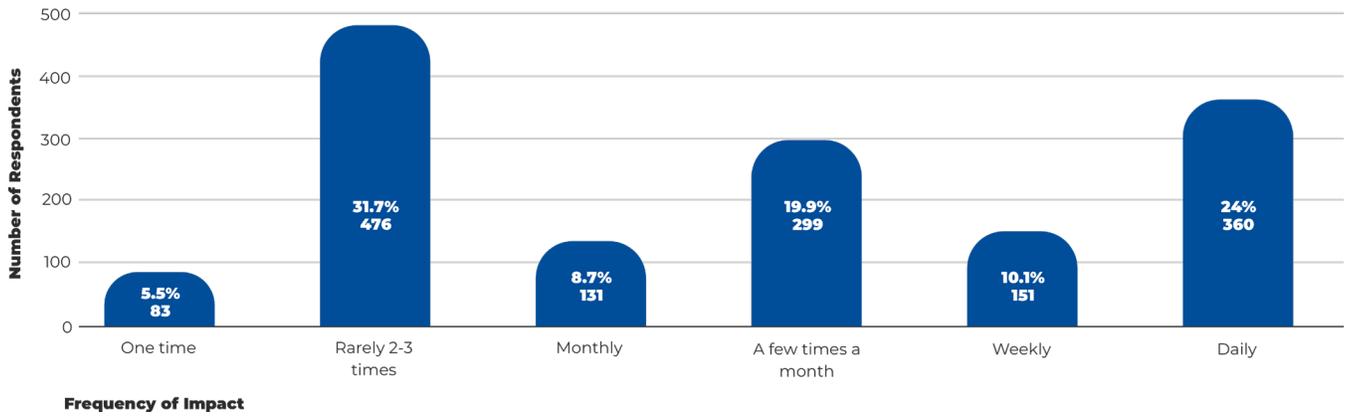
When you hear an [air raid] alarm, you immediately think what to do. Whether there will be a power outage, whether the oxygen station will work, what to do next during the surgery.

*You try to calculate everything in your head, to calculate all the options."*²⁴¹

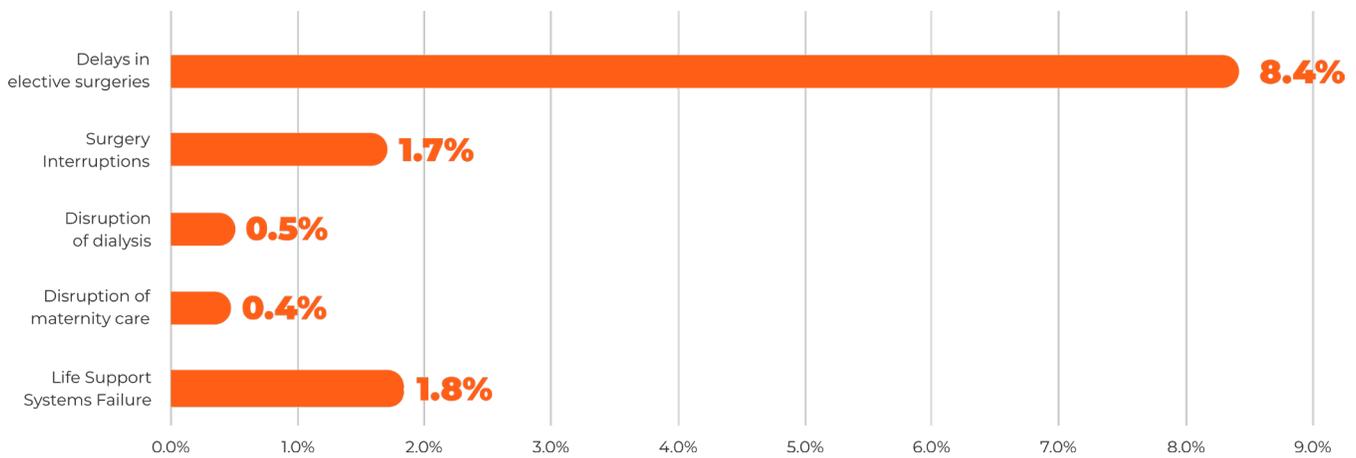
Health Care Service Delivery (Space, Systems and Stuff)

There is little research exploring the connection between access to reliable power and health care delivery, particularly about repeated outages and their long-term impact amidst conflict.²⁴³

Power outages interrupted medical procedures for 66.3 percent of the surveyed health care workers at least once between February 2022 and July 2024 (see *Graph 7*). Delays in elective surgeries were reported by 8.4 percent of surveyed health care workers, and 1.7 percent experienced interruptions during a procedure due to power outages. In addition, 1.8 percent of respondents reported failures in life support systems (like ventilators, heart monitors and other life support machines) due to power outages. Service disruptions from power outages also caused disruptions to dialysis (0.5 percent) and maternity care (0.4 percent) (See *Graph 8*).



Graph 7. “How often do power outages affect medical procedures in your facility?” (percent of health care workers who experienced a power outage due to attacks on energy infrastructure). Source: Survey of Health Care Workers in Ukraine

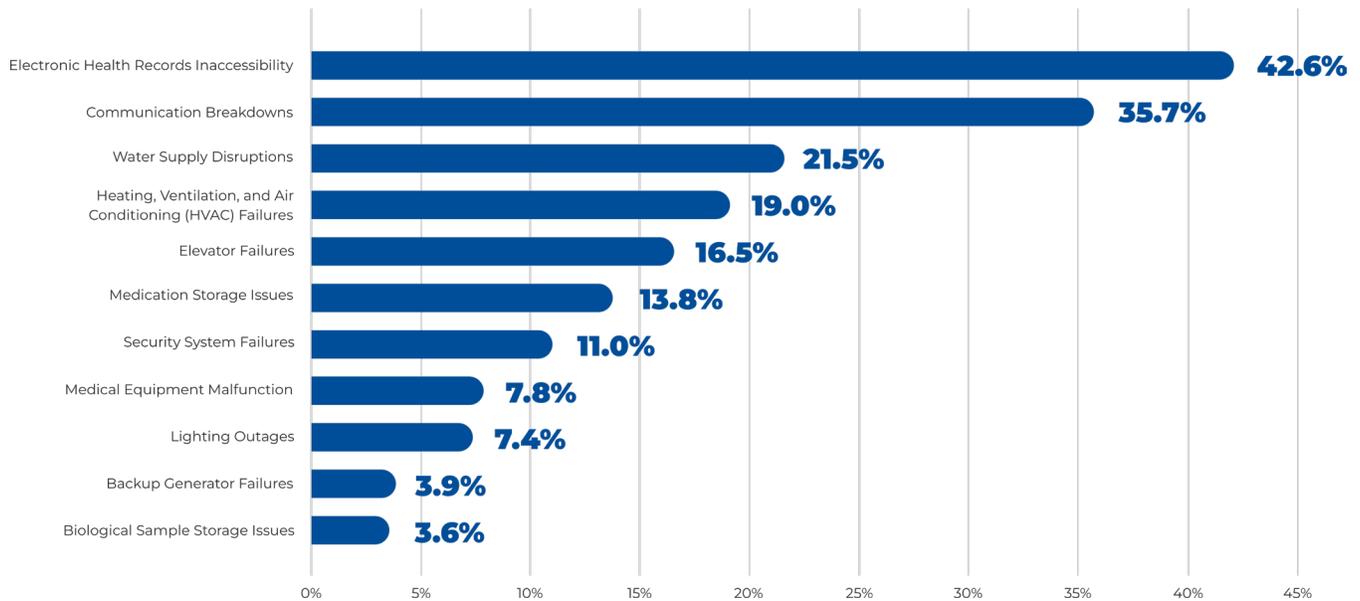


Graph 8. Reported impacts of the disruption of power on the facility’s health service delivery (percent of total surveyed health care workers). Source: Survey of Health Care Workers in Ukraine

A doctor working at an emergency station in Sumy oblast says: “Power outages caused by attacks by the Russian Armed Forces on energy infrastructure, particularly during calls from residents of apartment buildings, have resulted in problems with staff access to patients, delivery of equipment to patients, on-site examination of patients, transportation of patients to ambulances, and violations of protocols for providing specialized advice for certain types of diseases due to lack of communication.”²⁴⁴

Among the negative impacts from attacks identified by the surveyed health care workers (see Graph 9), hospital functions that facilitate medical service delivery were the most impacted. According to respondents, outages primarily disrupted communication systems (35.7 percent), as well as water supply (21.5 percent), heating and ventilation (19 percent), and elevators (16.5 percent). Additionally, 7.8 percent reported malfunctions in diagnostic equipment, such as X-ray machines and MRIs. Medication storage issues, where refrigeration for certain medications and vaccines was compromised leading to spoilage, were reported by 13.8 percent and 3.6 percent reported issues with storing biological samples, like blood or embryos.

Unreliable power has been tied to the reduced availability of essential medical equipment needed for basic health services, including autoclaves, lighting, ultrasounds, water pumps, and microscopes, as hospitals might become less likely to rely on equipment that requires reliable electricity to operate.²⁴⁵ Non-electronic alternatives may not be readily available, and staff may not be trained in using these older technologies.²⁴⁶ Medication and vaccine storage also become problematic when power is lost or unstable as temperature control via refrigeration and freezers is crucial for the “cold chain.” Blood samples and embryos require similar care during storage.²⁴⁷



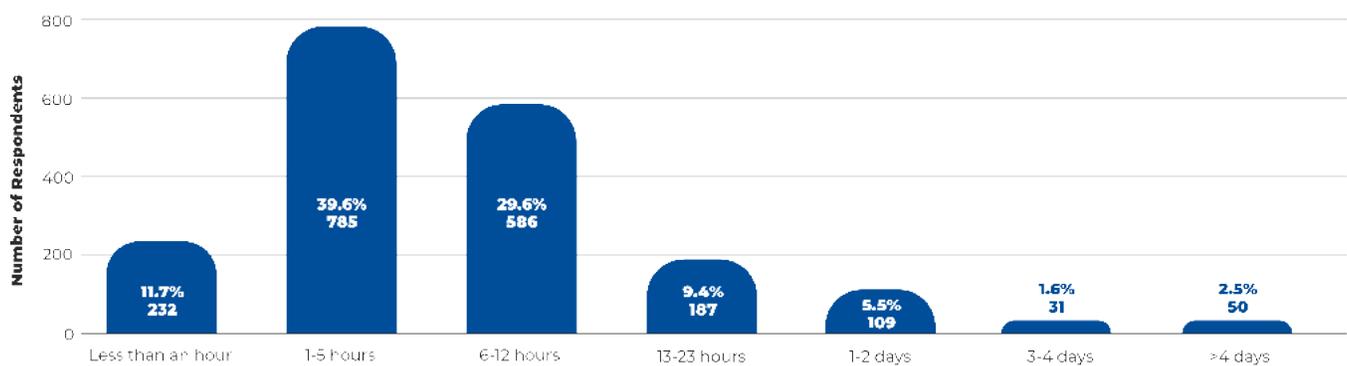
Graph 9. Reported impacts of the disruption of power on the facility's ability to provide care (percent of total surveyed health care workers). Source: Survey of Health Care Workers in Ukraine

Modern health care systems increasingly depend on technology and electronic systems for record keeping, telehealth, and remote patient monitoring.²⁴⁸ Electronic medical records systems are used for patient records, referrals, and prescriptions, and require the use of internet and computers, all relying on power.²⁴⁹ Ukraine's Electronic Health Care Records System digitizes medical records and connects over 35 million patients and hundreds of thousands of health care workers. It supports various services, including electronic doctor-patient declarations, referrals, prescriptions, birth certificates, sick leave documentation, and COVID certificates.²⁵⁰

However, 42.6 percent indicated that access to the Electronic Health Records Systems was hindered by an attack on energy (See Graph 9).

Back-up Power

Health care workers surveyed reported that the majority of outages lasted from one hour to a day (see Graph 10). Among those who experienced power outages, 2.5 percent reported outages lasting more than four days. Despite 78.4 percent of respondents noting that back-up power sources were always available and 16.6 percent noting that they were partially available, 40.9 percent reported delays in activating these systems, ranging from a delay of one hour to several days.



Graph 10. "If you have experienced power outages, what was the longest time period of the power outage?" (percent of health care workers who experienced a power outage due to attacks on energy infrastructure). Source: Survey of Health Care Workers in Ukraine

Delays in activating back-up power sources and the reliability of these systems are both areas of concern when thinking about the impacts of power outages on health care delivery. The U.S. Department of Homeland Security found globally a “67 to 99 percent degradation of core hospital functions after five minutes without back-up electricity sources, after ten minutes without information technology, and after two hours without water and wastewater.”²⁵¹ Furthermore, back-up power systems, such as generators, are often temporary and are not equivalent to an electrical grid as they do not provide the same capacity of energy and can only supply power to a limited set of critical hospital functions. Additionally, voltage interruptions produced within the system while switching to back-up power can damage sensitive medical equipment.²⁵² Fuel-based generators also emit harmful pollution and noise, which can negatively affect health.²⁵³

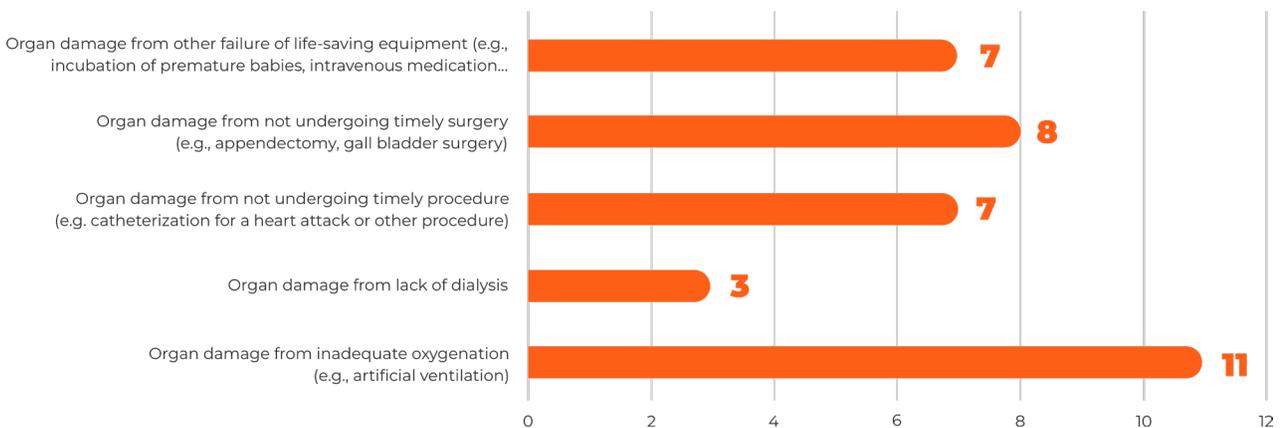
As of June 2024, the Ministry of Health of Ukraine has supplied 643 health care facilities (100 percent) that are “part of a functioning network” with back-up power generators to ensure uninterrupted functionality.²⁵⁴ It also continues to work on supplying hospitals with alternative sources of back-up power, like solar panels.²⁵⁵ However, survey results indicate that these stop-gap measures are not sufficient to mitigate all impacts of power losses.

Health Outcomes Linked to Power Outages

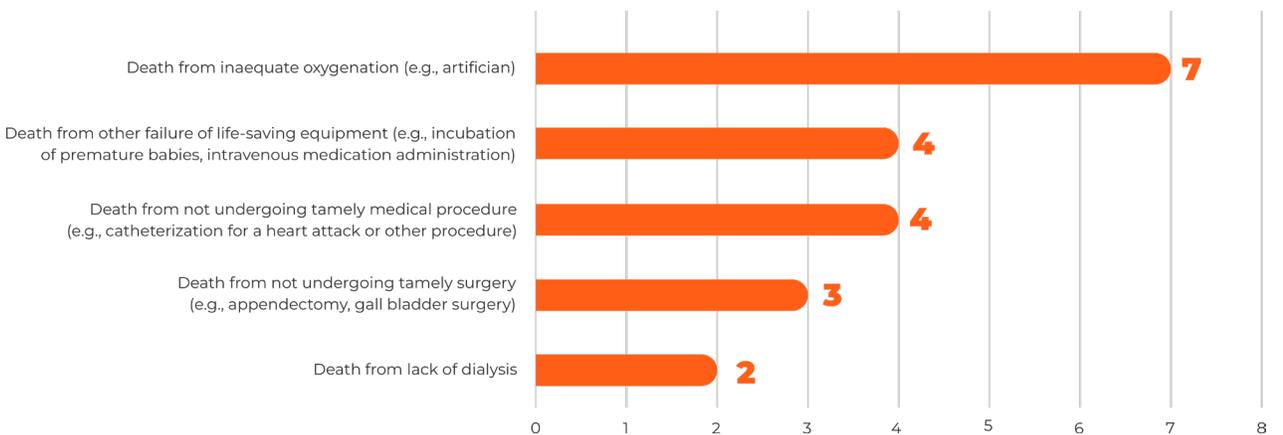
Studies indicate that power outages could impact patient care, health outcomes, and community health.²⁵⁶ Ukrainian health care workers reported serious health-related harms and deaths linked to power outages. The majority of permanent health harms (11 reports out of 36) and deaths (7 out of a reported 20) were attributed to organ damage due to inadequate oxygenation (see *Graph 11* and *Graph 12*). This occurs when patients who are unable to breathe on their own lose access to their mechanical breathing support. In such situations, health care workers must step in to manually provide oxygen in lieu of a machine (a process called manual ventilation). If manual ventilation is needed for an extended period, it can cause complications or even lead to death if it isn't performed correctly or promptly.²⁵⁷

Other reported permanent health-related harms from power outages included patients experiencing organ damage from not undergoing timely surgery (8 reports), not undergoing timely medical procedures (7), other failures of life-saving equipment (7), and from lack of dialysis (3).²⁵⁸

Additional reported deaths due to power outages include those from not undergoing timely medical procedures (4), other failures of life-saving equipment (4), not undergoing timely surgery (3), and from lack of dialysis (2).²⁵⁹



Graph 11. Reported permanent health harms due to power outages. Source: Survey of Health Care Workers in Ukraine



Graph 12. Reported deaths due to power outages. Source: Survey of Health Care Workers in Ukraine

A doctor from the emergency station in Ukraine's Sumy oblast attests that "power cuts due to the attacks of the Russian forces [...] worsen the quality and accessibility of medical services for the population. This particularly creates problems during emergency hospitalization in cases of CPR, clinical death, etc."²⁶⁰

These findings related to mortality and morbidity stemming from loss of power at health facilities are aligned with other reports, primarily from non-conflict contexts, which show that isolated incidents of power outages can lead to both direct and indirect increases in morbidity and mortality through accidental deaths and injuries, straining emergency services, limiting access to primary care, carbon monoxide poisoning, hospitalization for chronic diseases (for example, cardiovascular, respiratory, and renal diseases), and death for those reliant on electricity-dependent medical devices.²⁶¹

Data from the National Health Service of Ukraine also shows a decline in procedures (defined as performed medical interventions) in health care facilities nationwide aligned with the timing of increasing attacks on energy infrastructure (see Graph 13). There was a 5.1 percent decrease in procedures in October 2022, when the first wave of attacks on energy started, marking a decline in the number of procedures after six months of increasing numbers of procedures following the start of the full-scale invasion. A more significant drop accompanied a renewed wave of attacks on energy in spring 2024, with a 15.7 percent decline in procedures from May to June.²⁶²



Graph 13. Dynamics of procedures (performed medical interventions) nationwide in 2022-2024, millions.
Source: National Health Service of Ukraine

Impact on Vulnerable Populations

Limited access to electricity in conflict and non-conflict settings disproportionately affects vulnerable groups, particularly women and children.²⁶³ One study showed that "the duration of power outages is a significant predictor of skilled birth attendance."²⁶⁴ The perceived threat of danger from delivery at a health care facility may encourage home delivery which increases the risk of maternal and infant complications.²⁶⁵ Conversely, improved access to reliable electricity has been shown to improve prenatal care and childhood vaccinations.²⁶⁶

The Maternity Hospital No. 3 in Zaporizhzhya, which attended 3,000 deliveries per year prior to the full-scale invasion was affected by attacks on energy.²⁶⁷ According to the former director, Dr. Yevheniia Poliakova, around August 2022, "large-scale blackouts began in the city, and the facility also experienced serious problems with the power supply, with only one low-power generator, which was not enough

to maintain the operation of ventilators, ultrasound machines, and patient monitors."²⁶⁸ As a result of the outages, says Dr. Poliakova,

"Surgeries had to be performed with flashlights in cramped conditions,

*which meant that instead of a conventional hour, it took about 3 hours to complete the surgery, and the quality of sutures was sometimes lower."*²⁶⁹ Despite purchasing a generator in December 2022, it was not possible to provide the entire building with power, which "created certain difficulties for patients, such as feeding their children at night."²⁷⁰ With no proper bomb shelter, the patients went down to the basement understanding that they would be "without medical care during their stay there."²⁷¹

Older populations are also at higher risk as they are more likely to depend on electronic medical devices.²⁷² Outside of the hospital system, patients receiving outpatient care, such as dialysis or at-home

treatments, are vulnerable to the effects of power cuts on the medical equipment they rely on.²⁷³ In Ukraine, there have been “patients who have spent hours hooked up to their cars to charge their medical devices through the vehicles’ cigarette lighters,” according to a non-profit foundation providing lifesaving at-home care.²⁷⁴

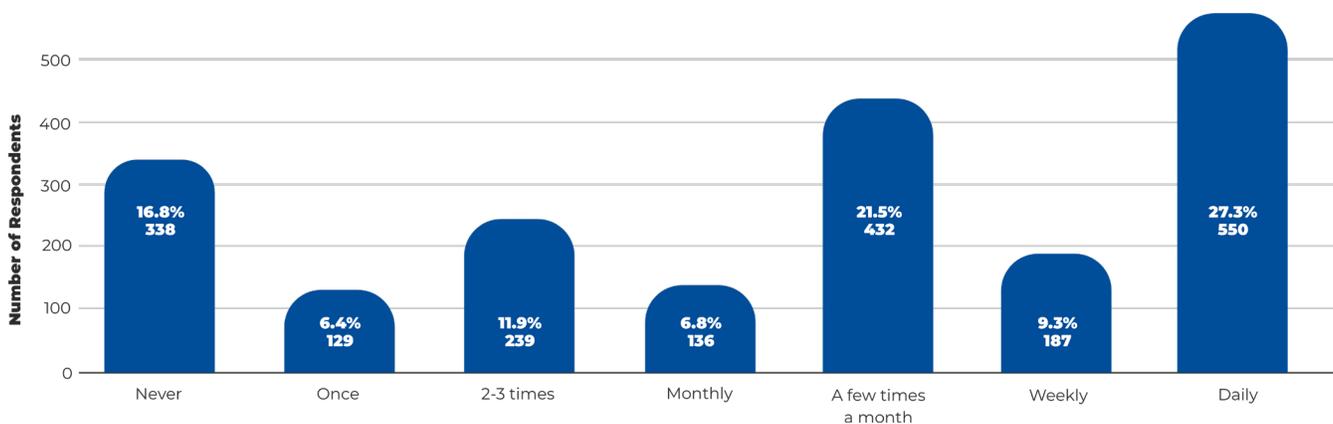
Health Care Workers and Mental Health (Staff)

The health care workforce is also affected by power cuts on a personal level. Patients pour into hospital during and after attacks, forcing health care workers to work overtime again and again.²⁷⁵ Faced with power outages, hospitals tend to develop workaround solutions and coping strategies, and the burden of implementing these solutions falls on staff.²⁷⁶ Doctors perform surgeries in the dark, using headlights.²⁷⁷ Procedures and surgeries are timed to when electricity is more stable, affecting health care workers’ schedules.²⁷⁸ Health care personnel are also faced with additional administrative challenges, as delayed data entry into electronic

medical records systems due to blackouts affects payment processing.²⁷⁹ All of these issues add stress to the already strained health care workforce in Ukraine.²⁸⁰

Even more impactful is the unrelenting toll of so many traumatic events and deaths, day after day, on the mental health of health care workers. Depression and post-traumatic stress disorder are common among responders working in disasters.²⁸¹ Ukrainian health care workers have been working in disaster conditions for over two years. In addition to their workload is the stress of caring for their families, living with limited power at home, and concerns about their own safety and the safety of their loved ones.

Among the survey respondents, 82.9 percent reported increased stress, burnout, and other challenges due to these attacks on energy infrastructure and service disruptions, with 27.3 percent facing these hardships daily (see *Graph 14*).



Graph 14. Frequency of stress and burnout reported by health care workers (percent of total surveyed health care workers). Source: Survey of Health Care Workers in Ukraine

These findings are consistent with studies that have shown that individuals who experience power outages are prone to “worry, anxiety, stress, and reduced wellbeing” related to concerns about “disrupted heating, food, water supplies, and health care.”²⁸² As the physician from the Sumy region said, “the lack of electricity leads to certain everyday problems for [medical] staff, which affects their ability to recuperate.” With the accumulated effects of the war, “there is a problem of emotional burnout and psychological pressure among them.”²⁸³ Dr. Poliakova from Zaporizhzhia concurs: “Due to the lack of stable power supply, frequent shelling and air raids in Zaporizhzhia, the staff is clearly experiencing emotional burnout, excessive stress, and sharp reactions to loud noises. All this directly affects the performance of medical staff.”²⁸⁴

These findings are particularly acute in Ukraine where the WHO estimates 10 million people to be at risk of mild to severe mental health problems in Ukraine.²⁸⁵ Ongoing conflict and persistent attacks on energy infrastructure, especially around colder winter months, may exacerbate mental health problems.

VI. THE LEGAL FRAMEWORK AND ANALYSIS

International Humanitarian Law: Principles and Protections

IHL binds both Russia and Ukraine, as parties to an international armed conflict,²⁸⁶ to restrict their means and methods of warfare so as to protect those who are not participating in combat. IHL derives from the four Geneva Conventions of 1949 and their Additional Protocol I of 1977,²⁸⁷ the Hague Conventions of 1899 and 1907,²⁸⁸ and the body of customary international law²⁸⁹ - general practice accepted as law by states.

The three governing principles of IHL are that of distinction, proportionality, and precaution.

Principle of Distinction

The principle of distinction is a “cardinal” and “intransgressible” tenet that holds that combatants must at all times distinguish between military and civilian targets.²⁹⁰ Concretely, this amounts to the IHL mandate that combatants must only direct attacks against combatants and military objects; attacks against civilian objects are therefore prohibited, except when civilians are participating directly in hostilities, or civilian objects are being used for military purposes.²⁹¹

Indiscriminate attacks, those that fail to distinguish between civilian and military targets, are in all cases IHL violations.²⁹² An attack is indiscriminate where it a) is not directed at a military object; b) employs “a method or means of combat which cannot be directed at a specific military object”; or c) employs “a method or means of combat the effects of which cannot be limited.”²⁹³ Parties to Additional Protocol I of the Geneva Conventions, including Russia and Ukraine, must ensure they have the capability to distinguish between civilian and military objects, and exercise that capability at all times.²⁹⁴ That a state could not distinguish between civilian and military objects when launching an indiscriminate attack would not render the attack lawful.²⁹⁵

Ample evidence suggests that Russia has failed to distinguish between civilian and military targets in attacking Ukrainian energy infrastructure and as discussed in previous sections, health care facilities. Attacks on energy facilities have killed hundreds of civilians.²⁹⁶ They have deprived civilians of heat, water, and, in some instances, proper medical care.²⁹⁷ As the UN HRMMU observed, the attacks may have been launched not for military gain, but “to intimidate and create panic among the population by depriving civilians of critical services” and to create displacement.²⁹⁸ Indeed, the widespread deleterious effects on the civilian population strongly support the inference that Russian forces failed to distinguish between civilian and military targets in attacking energy infrastructure.

Principle of Proportionality

IHL also prohibits, in accordance with the principle of proportionality, attacks that are directed at military objectives but still “may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.”²⁹⁹ These disproportionate attacks

are, by nature, indiscriminate.³⁰⁰ Combined with the principle of precaution discussed below, the prohibition of disproportionate attacks requires that - when faced with multiple options as to how to accomplish a military object - a commander choose that which will result in less incidental harm to civilians.³⁰¹

Notably, harm to civilians and civilian objects does not only include direct physical harm. In its first report assessing the legality of Russian strikes in Ukraine, the Organization for Security and Co-operation in Europe (OSCE) Moscow Mechanism stated, “Russia should consider not only incidental harm to civilians or civilian objects,” but also “reverberating effects” such as “interruptions of electricity, gas, heating and water supplies ... including their impact on the health system.”³⁰²

In fact, the anticipated military advantage may not include harm to civilian objects that may weaken the civilian economy and thus, in the long-term, the enemy’s military.³⁰³ Following this logic, demoralizing the Ukrainian population or undermining the Ukrainian economy by attacking the energy infrastructure would not constitute a permissible military advantage.

Though definitive analysis requires more information about the anticipated military advantage as weighed against incidental civilian harm, there are grounds for a preliminary conclusion that even Russian attacks on energy infrastructure that may qualify as a military objective are disproportionate. The ICC arrest warrants for disproportionate attacks, discussed in more detail below, corroborate this conclusion.³⁰⁴ Generally, military plants or installations in Ukraine operate with autonomous sources of energy supply so that their tasks continue in the event of grid power outages or ongoing combat in their vicinity.³⁰⁵ A substantial number of military installations that do not have autonomous sources - for example, private military-industrial enterprises - receive top priority in the event of shortages in energy supply.³⁰⁶ Military installations that are neither autonomous from the grid nor receiving energy priority have independent generators that serve them in the case of a blackout.³⁰⁷ As a consequence, though deficits in the energy grid may impose challenges on some segments of the Ukrainian defense sector, there are likely to be few instances in which they would affect a military installation in a way that provides a direct and immediate military advantage.

International Committee of the Red Cross (ICRC) commentators have concurred in general terms, stating that “the long-term strategic and operational military advantages [of attacks on energy infrastructure] remain questionable and, in any event, are likely outweighed by the serious reverberating effects of such attacks on the civilian population...[t]his is especially the case when militaries are generally priority users during armed conflict and, as such, are likely to be allocated any residual electricity capacity for their operations when pieces of energy infrastructure are subject to attack.”³⁰⁸

More broadly, the UN HRMMU has noted that “a military campaign to damage or destroy the entire electricity system of a country appears to entail remote, hypothetical, or speculative military gains, rather than the substantial and relatively close advantage

required to justify the attacks.³⁰⁹ Hence, the civilian harm caused by the Russian campaign to destroy Ukrainian energy infrastructure - leading to the destruction or occupation of half of Ukrainian generation and transmission by April 2023, and causing civilian death, rolling blackouts and interruptions in essential services - likely outweighs any potential military advantage.

Principle of Precaution

The principle of precaution holds that parties must take all feasible precautions to avoid, and in any event minimize, incidental loss of civilian life, injury to civilians, and damage to civilian objects.³¹⁰

In particular, they must: (1) verify that the objects to be attacked are neither civilians nor civilian objects and are not subject to special protection; (2) give advance warning of attacks that may affect the civilian population, if possible; 3) cancel or suspend an attack if it becomes apparent that the principles of distinction or proportionality may be violated; and (4) chose means and methods of warfare to at least minimize incidental death of, or injury to, civilians and damage to civilian objects.³¹¹

There is ample evidence that Russia has not abided by the precautionary principle. Assessing only the strikes on energy from March to August 2024, the UN HRMMU has noted that “[t]he Russian Federation’s attacks on electricity infrastructure continued unabated... despite public information about the reverberating effects on the civilian population and interconnected civilian systems.”³¹² In fact, “previously damaged locations were struck repeatedly until they became nonoperational.”³¹³ Based on this, the UN HRMMU concluded “that adequate precautionary measures were not taken to mitigate civilian harm... in violation of international law.”³¹⁴

Protection of Health Care Facilities

IHL grants health care facilities broad and durable protection.³¹⁵ The Fourth Geneva Convention, Article 19, states that “civilian hospitals... may in no circumstances be the object of attack but shall at all times be respected and protected by the Parties to the conflict.”³¹⁶ The term “attack” means “acts of violence against the adversary, whether in offence or in defense.”³¹⁷ The obligation to “respect” medical facilities is broad and encompasses not only refraining from attack, but also from conduct that interferes with medical facilities’ abilities to properly discharge their functions - including the transportation, diagnosis, and treatment of the wounded and sick.³¹⁸

There are grounds to conclude that Russia has violated its IHL obligations to refrain from attacking health care infrastructure. The UN Commission of Inquiry on Ukraine and the OSCE Moscow Mechanism have both concluded that Russia attacked protected health care facilities in respective attacks on a clinic in Dnipro on May 26, 2023 and on the Mariupol Maternity House and Children’s Hospital on March 9, 2022.³¹⁹ Testimony taken by the authors of this report provides further evidence of a series of direct attacks on the Mariupol Regional Intensive Care Hospital from February to March 2022, on hospitals in Sumy oblast, and on Okhmatdyt National Specialized Children’s Hospital on July 8, 2024.³²⁰

There is, moreover, a wealth of evidence suggesting that the direct and reverberating effects on health care resulting from Russia’s assault on Ukrainian energy infrastructure amount to violations of the principles of proportionality and precaution. Okhmatdyt Hospital experienced blackouts, both before and during

the missile attack, threatening to degrade hygienic conditions, spoil vital medicine, and destroy vital medical equipment, and forcing surgeons to operate by lamplight.³²¹ A maternity hospital in Zaporizhzhia experienced acute problems with power supply, delaying and reducing the quality of surgery.³²² In Sumy oblast, blackouts caused acute problems for patients attempting to access medical care amid failures in telecommunications.³²³

In Okhmatdyt and Mariupol, Russian attacks in the vicinities forced doctors and patients to shelter in hospitals full-time for weeks, operating at times in cramped basements.³²⁴ Russian military actions left Mariupol Regional Intensive Care Hospital in Mariupol without heating, power, or water by March 12, 2022, they occupied the hospital later turning it into a military base.³²⁵ Even after Mariupol Regional Intensive Care Hospital relocated to Kyiv, Russian attacks on the energy grid led to blackouts that delayed surgeries and affected life-sustaining equipment, ultimately causing patients’ health to suffer.³²⁶

The harm to health care has already been widespread, and it portends damage that will persist and compound further. The majority of health care workers surveyed for this report have experienced blackouts as a result of Russian military action - these disrupted and delayed surgeries, harmed vital infrastructure, and placed immense strain on Ukraine’s already overburdened medical personnel.³²⁷ In all testimonies taken by the authors of this report, doctors reported working with insufficient and still diminishing staff in an environment of constant, mounting stress.³²⁸ All recount having to repeatedly transport vulnerable and ailing patients to shelters whenever the air raid siren sounds, in some cases to insufficient shelter.³²⁹

The deleterious effects on health care of Russian attacks on energy infrastructure entail both direct damage to health facilities, and cumulative “reverberating effects” that threaten to undermine the health care system in the long-term. As discussed in the preceding section on proportionality, the anticipated military advantage from these attacks is likely minimal, because military installations in Ukraine generally have autonomous sources of energy or generators, or receive top priority for energy distribution.³³⁰ Accumulating damage to health care as a result of these attacks, on the other hand, is an eminently foreseeable result of a campaign that has damaged or destroyed nearly all energy-producing infrastructure in Ukraine.³³¹ Because attacks on energy infrastructure resulted in foreseeable damage to health care and can only have had minimal anticipated military advantage, in cumulative form they likely violate the principle of proportionality.

Russian leadership is likely aware that its attacks on energy infrastructure violate the principle of proportionality - information about damage to health care and the minimal military advantage to be gained is publicly available. The principle of precaution holds that combatants must cancel or suspend an attack if it becomes apparent that the attack will violate the principle of proportionality.³³² Despite having notice that its attacks likely violate the principle of proportionality, Russian commanders did not suspend attacks rather, they continued their campaign against energy infrastructure at increased intensity.³³³ In fact, given the interconnectedness of health care facilities and Ukrainian energy sources, the importance of regular power for effective health care in Ukraine, and the apparent compounding effects on health care from loss of power, it is likely that there are no means by which Russian commanders could at once launch regular, massive aerial assaults on energy infrastructure, and minimize harm to civilians as the

principle of precaution requires. As such, Russian attacks on energy infrastructure and their resultant harm to health care likely violate the principle of precaution.

Protection of Energy Infrastructure

Under IHL, energy infrastructure is only a valid target when it qualifies as a military object; otherwise, IHL prohibits attacks on energy infrastructure as civilian objects.³³⁴ An energy target qualifies as a military object when, “by [its] nature, location, purpose or use make[s] an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military of advantage.”³³⁵ The attacker must have reliable indications that the energy infrastructure is making effective contribution to military action: the mere possibility of its use for military objectives would not render it a valid military target.³³⁶ Rather, there must be a close connection between the targeted infrastructure and the fighting itself.³³⁷ This will typically relate to tactical-level activities, such as where an energy object powers a military barracks or command-and-control communications.³³⁸ It may, in certain circumstances, include strategic targets that produce direct military effects - like a piece of energy infrastructure that powers an enemy’s air defense radar.³³⁹

Even when an energy object qualifies as a military target, customary international law holds combatants must still refrain from attack when such infrastructure is indispensable to the survival of the civilian population, or it contains dangerous forces.³⁴⁰ The former category includes energy infrastructure that is essential to the maintenance of agriculture, drinking water, heating, and health care, among other things.³⁴¹ The latter includes dams, dikes, and nuclear generation facilities.³⁴² The attacker must also, of course, abide by the principle of proportionality described in the preceding sections.

Given a lack of specific information, it is not possible for this report to assess in each instance which energy objects qualified as military objects. But experts agree that given the scale of attacks - ultimately destroying every TPP in Ukraine - it is highly unlikely that Russia has abided by its IHL obligation to refrain from attacking civilian energy objects.³⁴³

But even assuming that there are some energy facilities that qualify as military objects - a fact that, again, would require individualized analysis - Russian attacks have destroyed energy infrastructure that supports the maintenance of drinking water, heating, and health.³⁴⁴ As noted above, health care facilities have borne a heavy burden of the attacks on energy infrastructure, with blackouts impacting communications, heating, water, elevators, and diagnostic equipment.³⁴⁵ Russian munitions have landed on the campuses of nuclear generation facilities and brought nuclear facilities to the brink of blackout.³⁴⁶ Because of this, one may conclude that, even if certain energy objects are military objects, Russia has likely violated the principle of proportionality, and its obligation to refrain from attacks on energy objects that are indispensable to civilian life, or contain hazardous forces.

International Criminal Law: Assessing Responsibility

While IHL sets the standards of lawful combat, the body of international criminal law (ICL) provides for individual criminal responsibility for concrete acts. ICL derives from treaties like the Rome Statute, customary international law, and the Geneva Conventions and Additional Protocol I, which describes a number

of “grave breaches” of IHL as offenses that contracting parties must prosecute.³⁴⁷ Generally, for an adjudicating body to find an act to be criminal, they will need to find proof of certain conduct, consequences, and circumstances, as well as the existence of the intent and knowledge to commit the act - also known as *mens rea* - in the accused.

Intentional Attacks against Civilian Objects (Rome Statute Article 8(2)(b)(i)), Medical Objects and Personnel Bearing the Distinctive Emblems (Rome Statute Article 8(2)(b)(xxiv))

Launching direct attacks against civilian populations or civilian objects is a war crime.³⁴⁸ Health care facilities are civilian objects.³⁴⁹ Separately - underscoring the vital importance of protecting medical objects - the Rome Statute criminalizes “[i]ntentionally directing attacks against buildings, material, medical units and transport, and personnel using the distinctive emblems of the Geneva Conventions in conformity with international law.”³⁵⁰ The distinctive emblems of the Geneva Conventions are the Red Cross, Red Crescent, and Red Crystal.³⁵¹ For this crime, no damage to the targeted objects is necessary - the simple launching of an attack triggers criminal liability.³⁵² As stated above, energy objects may qualify as military targets depending on their use; where their destruction offers no definite military advantage, they retain protection as civilian objects.³⁵³

A body prosecuting the war crime of directly targeting civilian objects must establish that the charged actor launched the attack willfully - either deliberately or recklessly.³⁵⁴ Mere negligence is not enough to trigger criminal liability.³⁵⁵ Direct evidence is not necessary to establish the requisite *mens rea*; adjudicators can infer willfulness from “the means and methods used during the attack, the number and status of the victims, the discriminatory nature of the attack or, as the case may be, the nature of the act constituting the attack.”³⁵⁶ International criminal tribunals have held, moreover that the indiscriminate nature of attack may support an inference that an attack was intentional when the damage to civilians is so severe so as to make it clear that civilians were the primary target.³⁵⁷ Evidence supports an inference that Russia has launched direct attacks against both health care and energy facilities, and, generally, that these facilities had not lost their status as protected civilian objects.

Intentional Attacks: Health Care Facilities

There is a reasonable basis to conclude that Russian forces have launched intentional attacks on health care facilities in Ukraine, and that these health care facilities had not lost their protection. Okhmatdyt provides a salient example. There, direct and circumstantial evidence supports the notion that Russian forces were responsible for the strike, and that they launched the attack deliberately using precision weapons.

The attack on Okhmatdyt happened amid a large-scale combined missile attack on Ukraine launched from Russian territory.³⁵⁸ Analysis of video footage captured of the missile that hit Okhmatdyt - annexed to this report - notes that the missile in the footage resembles most closely a Kh-101 cruise missile, among the munitions that Russia launched at Ukraine that day. Bellingcat investigators came to the same conclusion.³⁵⁹ Photos of missile fragments from the blast site further support the notion that it was a Kh-101 cruise missile.³⁶⁰ The likely use of a Kh-101 would support the notion that the attack was deliberate, because such missiles are highly accurate and extremely difficult to intercept, and therefore

likely to be launched at a particular target with the intention of hitting that target.³⁶¹

The day after the strike, Russian representative to the UN Vasily Nebenzya suggested that a Ukrainian air defense missile had hit the hospital: Russian Foreign Minister Sergey Lavrov offered a different, contradictory explanation, stating that an intercepted Russian missile had landed on Okhmatdyt.³⁶² But the missile's speed, lack of fiery exhaust, and radius of impact appear to exclude that explanation.³⁶³

No Russian governmental explanation advanced any claim that Okhmatdyt - a children's hospital, and therefore a protected civilian object - had become the site of acts "harmful to the enemy," nor is there any evidence to that effect.³⁶⁴ In fact, at the time of the attack, Okhmatdyt was conducting patient intake, and therefore exceptionally crowded with pediatric patients.³⁶⁵ Witness interviews and analysis of open sources confirm there were no combatants or military installations present, and all of the dozens of victims of the attack were civilians.³⁶⁶ Furthermore, Okhmatdyt bore the Red Cross, used by medical facilities and personnel as a marker of their protected status, and any Russian attack on a building bearing the emblem of the Red Cross is in violation of 8(b)(2)(xxiv).³⁶⁷

The Prosecutor General's Office of Ukraine has alleged that Russian Lieutenant General Sergey Kobylash was responsible for the attack on Okhmatdyt.³⁶⁸ Prior to that attack, on March 5, 2024, the ICC had already issued an arrest warrant against Kobylash who in Summer 2024 was promoted to Commander of the Russian Air Forces as the Commander of the Long-Range Aviation of the Aerospace Force.³⁶⁹ He is suspected of being responsible for the "campaign of strikes against numerous electric power plants and sub-stations, which were carried out by the Russian armed forces in multiple locations in Ukraine."³⁷⁰

Okhmatdyt, moreover, is just one of many health care facilities for which there is possible evidence of an intentional attack.³⁷¹ Testimonies taken by the authors of this report provide possible evidence of intentional attacks on health care facilities in Zaporizhzhia, Sumy, and Mariupol.³⁷² Establishing criminal culpability for each of these instances - and indeed for all of the 1,521 attacks on health that PHR and partners have recorded as occurring between February 24, 2022 and July 31, 2024 - requires analysis of the status of the facility, the damage inflicted, and the intent of the attacker. But, if the attack on Okhmatdyt is any indication, there are likely grounds to conclude that Russian forces conducted intentional attacks on health care facilities in Ukraine.

Intentional Attacks: Energy Infrastructure

Some Russian attacks on energy infrastructure likely constitute intentional attacks on civilian objects. Pointedly, the ICC has issued four arrest warrants, the contents of which are secret, for former Russian Minister of Defense Sergei Shoigu, Russian Chief of the General Staff of the Armed Forces of the Russian Federation and First Deputy Minister of Defence Valery Vasilyevich Gerasimov, Russian Lieutenant General and Commander of the Long-Range Aviation of the Aerospace Force Sergei Ivanovich Kobylash, Russian Admiral and Black Sea Fleet Commander Viktor Nikolayevich Sokolov for, in part, directing attacks at civilian objects under Article 8(2)(b)(ii) of the Rome Statute.³⁷³

More investigation is required regarding the weapons used in individual strikes, the potential military use of each site, and the damage resulting from each strike, available information provides reasonable grounds for supporting these charges. Indeed, the scale of individual attacks and the resultant extent of civilian harm

suggest that Russia has launched intentional attacks on civilian objects. According to the UN HRMMU, from October 2022 to September 2024, Russia launched 22 waves of large-scale attacks against Ukrainian energy infrastructure, hitting over 200 targets.³⁷⁴ These strikes killed hundreds of civilians - and Russian officials have acknowledged the launching of these attacks, if not their aims.³⁷⁵ On August 26, 2024 - just one of many of such attacks - Russia launched 236 long-range explosive munitions at targets throughout Ukraine, killing seven civilians and injuring 51, damaging substations, power lines, gas infrastructure, and generation facilities and leaving almost four million consumers without power.³⁷⁶ As of the drafting of this report, there was no publicly available information on damaged military targets.³⁷⁷

Disproportionate Attacks – Rome Statute Article 8(2)(b)(iv)

The Rome Statute criminalizes disproportionate attacks when combatants launch them intentionally and in "the knowledge that such attack will cause incidental loss of life or injury to civilians or damage to civilian objects or widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to the concrete and direct overall military advantage anticipated."³⁷⁸ To determine what constitutes clearly excessive harm under the Rome Statute, adjudicators must balance the civilian harm and military advantage on a case-by-case basis, viewing factors, at the time of the attack's execution, from the perspective of a "reasonable military commander."³⁷⁹ Notably, under this formulation the crime's commission occurs at the moment the perpetrator launches the attack, regardless of whether the knowable damage happens or not.³⁸⁰

The anticipated military advantage must be definite, substantial, and relatively close, and emanate from the attack itself.³⁸¹ It may not include political or economic motives.³⁸² An attack targeting, for example, the power supply of a logistics facility, and in this seeking to deprive the Ukrainian military of re-supply efforts during the duration of the outage may offer a concrete military advantage; an attack seeking to terrorize civilians so as to undermine their support for a war effort would not.³⁸³

The same ICC arrest warrants alleging intentional attacks against civilian objects found that, in the context of attacks on Ukrainian energy infrastructure, "for those installations that may have qualified as military objects at the relevant time, the expected incidental civilian harm and damage would have been clearly excessive to the anticipated military advantage."³⁸⁴ The International Independent Commission of Inquiry on Ukraine, for its part, concluded that "[the attacks on Ukrainian energy infrastructure from October 10, 2022 to February 1, 2023] constituted the war crime of excessive incidental death, injury, or damage."³⁸⁵

To draw an independent conclusion on proportionality, information is necessary to determine which energy objects were permissible military targets, and what military advantage Russian commanders anticipated in attacking specific energy objects. But available information suggests that Russian objectives in launching devastating attacks on Ukrainian infrastructure were not "immediate" or "tactical" advantages, but a long-term desire to undermine the Ukrainian economy and make conditions unbearable for Ukrainian civilians. To this point, Russian officials have stated that Ukrainians facing a winter without heating could "rot and freeze," and that the Russian strike campaign was necessary to destroy the Ukrainian state's capacity to survive.³⁸⁶ With respect to the attacks from October 10, 2022 to February 1, 2023, the Commission of Inquiry on Ukraine stated that "the objective was to disrupt the

energy system of the entire country, with the predictable effects on the heating system.³⁸⁷ Indeed, as stated in preceding sections, Ukrainian military installations generally have independent energy reserves, so there are likely to be few instances in which an attack on the public energy grid would yield any military advantage.

Moreover, the Russian campaign against Ukrainian energy infrastructure has now continued at varying intensity for two years - the massive cost to civilian life of these attacks in the form of outages to essential services has long been clear from publicly available information.³⁸⁸ In this context, it seems that, at the outset of each attack, clearly excessive civilian harm would be apparent to a "reasonable military commander." Russian commanders, surely aware of the harm caused by past attacks, continued to launch massive, multi-wave aerial assaults on Ukrainian energy infrastructure. This analysis applies doubly in cases in which Russian munitions landed directly on civilian targets.³⁸⁹

The most devastating consequences, moreover, were only averted due to the efforts of Ukrainian electricity workers, who are constantly repairing the damaged equipment and restoring power lines damage.³⁹⁰ And importantly, the effects of the attacks on energy that could have taken place, but did not in fact materialize due to circumstances independent from the perpetrator's will, must also be taken into account when analyzing the crime of excessive harm.³⁹¹ Considering this, the conclusions of the Commission of Inquiry on Ukraine, and outstanding arrest warrants for the Russian leadership, there are reasonable grounds to conclude that Russian commanders have launched disproportionate attacks under the Rome Statute 8(2)(b)(iv).

Terror Against the Civilian Population

IHL prohibits "[a]cts or threats of violence the primary purpose of which is to spread terror among the civilian population."³⁹² International criminal tribunals, but not the ICC, have also recognized the crime of "terror" as a "serious" violation of Additional Protocol I, Article 51(2).³⁹³ This crime consists of "attacks or threats of attacks against the civilian population," resulting in grave consequences, undertaken with "the intent to make the civilian population or individual civilians not taking direct part in hostilities the object of the acts of violence or threats thereof, and of the specific intent to spread terror among the civilian population."³⁹⁴ Grave consequences include, but are not limited to, serious injury or death.³⁹⁵

Both individual attacks and their cumulative effect have had the foreseeable result of terrorizing the Ukrainian population - so much so that attacks on energy infrastructure now serve as the primary motive for half of Ukrainians leaving the country.³⁹⁶ More information is necessary to establish the specific intent to terrorize; but international bodies assessing the situation have inferred from the pattern and effects of an attack that a possible intent is to demoralize civilians and spread fear for the future.³⁹⁷ National jurisdictions may investigate and prosecute such conduct under universal jurisdiction as a serious violation of Additional Protocol I, Article 51(2). The ICC, for its part, may take evidence that Russian authorities engaged in "[a]cts or threats of violence the primary purpose of which is to spread terror among the civilian population" into account when assessing culpability for other crimes.³⁹⁸

Crimes against Humanity in the Form of Other Inhumane Acts - Rome Statute Article 7(1)(k)

It is a crime against humanity to commit inhumane acts "as part of a widespread or systematic attack directed against any civilian

population, with knowledge of the attack," that intentionally cause "great suffering, or serious injury to body or to mental or physical health."³⁹⁹ The term "widespread" signals that the attack must "be massive, frequent, carried out collectively with considerable seriousness and directed against a multiplicity of victims."⁴⁰⁰ That an attack is systematic means that it is subject to organization, and improbably the result of random or sporadic acts.⁴⁰¹ The perpetrator must commit them in furtherance of state or organizational policy.⁴⁰² The perpetrator's simple intent to commit the act, with knowledge that the attack is on civilians, and the perpetrator's participation in the attack, is sufficient to establish elements of the crime.⁴⁰³

There is a reasonable basis to conclude that Russian commanders have committed crimes against humanity in their campaign against Ukrainian energy infrastructure. The Russian strike campaign has been nothing if not "widespread affecting 20 of 24 regions of Ukraine, involving the use of thousands of munitions in regular waves of attack, often launched in a coordinated fashion so as to overwhelm air defenses, and repeatedly targeting the same generation and transmission facilities to render them inoperable."⁴⁰⁴ These attacks appear to be systematic; it is improbable that Russian forces would launch these thousands of munitions at random, at energy facilities, in at least 22 orchestrated waves.⁴⁰⁵ The UN Commission of Inquiry has stated as much, concluding succinctly that "[t]he large-scale attacks between October 10, 2022 and January 26, 2023...were widespread and systematic."⁴⁰⁶

This systemic assault has produced great physical and mental suffering. Physically, it has deprived millions of Ukrainians of heat, water, telecommunications, and means to prepare and preserve food in the midst of sub-zero temperatures causing, in the estimation of the UN Commission of Inquiry "great harm and suffering."⁴⁰⁷ It has undermined the quality of medical care on an ongoing and cumulative basis, subjecting health facilities to persistent blackouts, as suggested by the results of the survey of health care workers undertaken by the research team.⁴⁰⁸ This has placed a particular burden on the elderly and disabled, who often depend on powered mobility and medical devices.⁴⁰⁹ Mentally, it has demoralized large segments of the Ukrainian public - becoming a significant factor causing displacement - and brutalized health workers working under extreme stress and in challenging, shifting conditions.⁴¹⁰ As such, the attacks may entail "serious violations of international customary law and the basic rights pertaining to human beings" that caused great suffering, and therefore be of a similar character to the other acts listed in Rome Statute 7(1).

Russian forces appear, moreover, to have undertaken this assault pursuant to a state policy. Russian officials have seemingly acknowledged the existence of a policy to attack Ukrainian energy infrastructure, although while claiming that the purpose of this policy is to "weaken and destroy [Ukrainian] military potential."⁴¹¹ But the available evidence of the impacts of these strikes belies this claimed purpose, if not the existence of a policy to destroy Ukrainian infrastructure. As described at length throughout this report, civilians have borne the brunt of reported damage from this strike campaign, with basic services like health care being affected, while the close, concrete military advantage derived from them appears to be minimal. Russian officials may not state their policy as one that, by massive aerial assault, seeks to deprive Ukrainian civilians of essential services. But one may infer such a policy by the "totality of the circumstances," which, in its long-term, cumulative destruction of Ukrainian civilian energy infrastructure and the degradation of health care, does just such a thing.

Appropriately, then, the ICC mentioned in the arrest warrants for Shoigu, Gerasimov, Kobylash and Sokolov that “the alleged campaign of strikes constitutes a course of conduct involving the multiple commission of acts against a civilian population, carried out pursuant to a State policy, within the meaning of article 7 of the Statute. Therefore, there are reasonable grounds to believe that the suspects intentionally caused great suffering or serious injury to body or to mental or physical health, thus bearing criminal responsibility for the crime against humanity of other inhumane acts, as defined in Article 7(1)(k) of the Rome Statute.”⁴¹² The ICC’s accused have links to Russia’s devastating legacy from other conflicts where attacks on health have been a hallmark of its war strategy. Kobylash was promoted to the rank of lieutenant-general in Syria, where Long Range Aviation bombers carried out repeated attacks that, among other things, devastated health care infrastructure.⁴¹³ Sokolov led a detachment of Russia’s Northern Fleet engaged in operations off the Syrian coast in 2016.⁴¹⁴ Gerasimov was Russian General Staff chief during Russian operations in Syria.⁴¹⁵

International Human Rights Law: Violations of Obligations

Finally, Russian attacks on energy infrastructure in Ukraine and their effects on health care entail violations of its obligations to respect International Human Rights instruments to which it is a party. Article 6 of the International Covenant on Civil and Political Rights (ICCPR), enshrining the right to life, imposes on signatories an obligation to ensure proper access to “basic lifesaving services” such as health care, food, water, and sanitation.⁴¹⁶ Ensuring access to

essential services includes both “a positive obligation to ... facilitate such services and a negative obligation not to impede the offer and provision of humanitarian services to individuals and populations in need.”⁴¹⁷ The right to life also produces a prohibition on acts of violence that cause death, or may be expected to cause death even when death does not result.⁴¹⁸

Notably, the obligation to respect the right to life applies extraterritorially and at all times, including during armed conflict where IHRL complements and supports the application of IHL.⁴¹⁹ Indeed, states engaged in wars of aggression violate ipso facto the right to life.⁴²⁰ The right to health, also - as contained in the International Covenant on Economic, Social and Cultural Rights (ICESR) and other instruments - requires at its core that states refrain from restricting access to essential health care in territory under their control, in particular to marginalized groups, and to sanitation and safe drinking water.⁴²¹

Russia’s attacks on energy infrastructure are acts of violence that have taken lives and threatened to take even more.⁴²² They have rendered hospitals non-functional, left health facilities short-staffed, and deterred patients from seeking treatment.⁴²³ They have cut off water and threaten now to degrade sanitation conditions.⁴²⁴ Where Russian actions have restricted access to health care in territory under occupation, they amount to violations of the right to health.⁴²⁵ Unquestionably, Russian attacks on energy infrastructure entail violations of the right to life and raises questions about possible violations of the right to health as contained in the ICCPR, ICESR, and other instruments.

VII. CONCLUSION AND RECOMMENDATIONS

The findings of this report underscore the gravity of Russia's campaign of attacks against Ukraine's energy infrastructure, which has disrupted the health care system and endangered the lives and well-being of millions. The damage to power facilities and resulting blackouts have limited hospitals' capacity to provide essential services, interrupted medical procedures, and compromised patient care. These attacks on energy infrastructure have, in effect, become attacks on health. The true extent of harm to health and health care from these assaults will only become fully known over time but the immediate and midterm consequences are already apparent from the data, reported health impacts, and testimonies of affected health care workers.

Preliminary analysis suggests that Russian attacks on energy infrastructure and health care facilities in many cases amount to violations of international humanitarian and human rights law, and in some cases may give rise to criminal culpability as a matter of international criminal law. Ensuring accountability for these attacks is crucial to upholding international humanitarian and human rights law, protecting health care and health in conflict, and putting an end to these attacks. Perpetrators must be held to account not only to deter future violations but also to provide justice, redress, and reparations for survivors of these attacks. The energy and health care system of Ukraine require immediate support as well as strategic support for long-term recovery. Among surveyed health care workers, the most suggested resources needed to improve the response to power cuts include solar panels, radiocommunication systems, fuel for generators, hybrid energy systems, and reliable internet access.

The recommendations below outline urgent actions needed by international and national actors to strengthen the response and accountability mechanisms for protecting Ukraine's health care system.

Recommendations

The Russian Federation must immediately cease its aggression and stop attacking health care workers and facilities, targeting energy infrastructure essential to civilian life, and refrain from indiscriminate attacks that endanger both health and civilian energy systems.

To the Prosecutor General's Office of Ukraine, the International Criminal Court, and Other Investigative Bodies at the National and International Levels:

1. Prioritize investigations of attacks on energy infrastructure and health as war crimes and crimes against humanity while integrating existing cases and ensuring cooperation between national and international prosecution teams.
2. Allocate sufficient resources to build cases focused specifically on the harm to the health care system.
3. Collect and preserve evidence of these attacks for use in future proceedings and trials.

To the Government of Ukraine:

1. Implement legal and policy measures to ensure that attacks on energy and health are fully documented and investigated.
2. Ensure that health impacts from these attacks are fully documented and patients are supported to address such impacts.
3. Provide the necessary support to the affected health care facilities to respond to ongoing attacks on energy infrastructure, as well as health care workers, including mental health support.

To the International Community:

1. Increase the support to Ukrainian health care facilities to respond to their critical needs.
2. Publicly condemn attacks on health and energy infrastructure and call for immediate cessation of hostilities against civilians and civilian objects, including health care facilities and personnel.
3. Strengthen and enforce international norms against attacks on health care facilities and civilian infrastructure in conflict.
4. Advocate for the protection of health care workers in conflict, including those in detention as well as their safe release.
5. Increase political and financial support for accountability mechanisms documenting violations in Ukraine, particularly against health and health care.
6. Condemn Iran and Democratic People's Republic of Korea as well as other weapons sellers to the Russian Federation for violating United Nations Security Council resolutions, namely resolution 1718 (2006), resolution 1874 (2009), and resolution 2270 (2016) and urge to cease sale of missiles and drones that have been used to damage health care facilities and civilian energy infrastructure.

To the United Nations and the World Health Organizations:

1. Enhance data collection and sharing on attacks on energy and health and ensure reporting of impacts on health services.
2. Consider appointing a Special Rapporteur on Violence against Health Care to address systematic targeting of health care systems in Ukraine and other conflict settings.
3. Strengthen cooperation with NGOs and national health agencies to improve documentation as well as resilience of health care facilities affected by prolonged power outages.

ANNEX I. Overview of Ukrainian Power Stations and the Impact of Russian Aggression

This appendix highlights key types of power stations and their operational status. Special attention is given to the impact of Russian aggression on them, including damage and destruction of facilities.

Thermal Power Plants

TPPs operate on several types of fossil fuels, including coal, which is used most often by Ukrainian TPPs, along with natural gas, and heavy fuel oil (mazut).⁴²⁶ The total capacity of coal-fired power plants in Ukraine is approximately 27,980 megawatts (MW),⁴²⁷ with Dniproenergo being the largest operating conglomerate of three power plants at approximately 8,400 MW.⁴²⁸

That total number of TPPs decreased after 2014 with the occupation of Crimea⁴²⁹ and the occupied territories in Donetsk and Luhanska oblasts in the east of Ukraine.⁴³⁰ At the beginning of 2022, there were 12 TPPs in Ukraine with a total installed power capacity of approximately 22 GW (excluding the plants located in the territories temporarily occupied by Russia before February 24, 2022).⁴³¹ Thereafter, Russian military forces occupied three TPPs (Zaporizka, Luhanska, and Vuhlehirska) with a total installed capacity of 7.7 GW.⁴³²

Attacks on TPPs are more frequent compared to other generation types and are ongoing. Information on attacks on TPPs is usually restricted, particularly regarding which exact facilities were targeted and the precise consequences of these attacks. However, generalized data on the overall impact is sufficient to convey the severity of the situation and highlight the scale of destruction caused by ongoing strikes against Ukraine's energy infrastructure. In March 2024, DTEK, the largest TPP's operator in Ukraine, reported a loss of 50 percent of its generation capacity, but has not provided specifics whether the said estimate relate to thermal plants or the whole generation portfolio that includes about 1 GW of renewables.⁴³³ Centrenergo, one of the largest power generating company⁴³⁴ marked April 11, 2024 as "a black day in the company's history": it lost its third asset, a 1,800 MW Trypilka TPP in the massive missile and drone attack on the plant powering Kyiv's more than 3 million of population in addition to supplying power to Cherkasy and Zhytomyr oblasts.⁴³⁵ Two remaining TPPs were lost earlier: 2,200 MW Zmiivska TPP was fully destroyed on March 22, 2024⁴³⁶ and a 3,600 MW Vuhlehirska TPP was occupied on July 25, 2022.⁴³⁷ The general estimate of lost capacity as of June 2024 is around 9.2 GW, or around 73 percent of TPPs that are damaged or destroyed.⁴³⁸ According to Ukraine's Prime Minister Denys Shmyhal, Ukraine made it through the 2023 to 2024 heating season with about 18 GW of generating capacities. The share of the electricity produced by the TPPs has fallen dramatically: according to a member of the Supervisory Board of NEC Ukrenergo, as of May 2024, the share of energy generated by the TPPs is around almost 5 percent only, not accounting for the latest attacks.⁴³⁹

Combined Heat and Power

Before the full-scale invasion, the total installed power capacity of combined heat and power plants (CHPs), which mostly use

natural gas for both electricity and heating, slightly exceeded 6 GW (excluding the plants located in the territories temporarily occupied by Russia before February 24, 2022).⁴⁴⁰ Though often merged with the TPPs, estimates are that in 2021, the share of CHPs and cogeneration units in electricity production was 5.5 percent; in 2023, around 8 percent of CHPs installed capacity was under occupation and approximately 45 percent of CHPs were destroyed or damaged as a result of Russian attacks.⁴⁴¹

CHPs are typically located near settlements requiring additional power, because of operating mostly on natural gas where output can be more flexible. CHPs usually allow for more maneuvering, meaning that the output from such co-generating plants can be controlled to address elevated demand during peak hours and dropping the electricity generation during the off-peak hours; such plants are important in balancing of the power system.⁴⁴²

Compared to nuclear or TPPs, CHPs are not usually big, with three big exemptions – 500 Kyiv CHP 5, 750 Kyiv MW CHP 6, and 740 MW Kharkiv CHP. However, the proximity to the end consumers and heating makes them crucial for uninterrupted supply of power and heating, especially among the urban areas where it is not possible to find alternative fuel (such as wood) for heating or other sources of power. While the heating sector is outside the scope of this report, it is important to refer to the 2006 case of Alchevsk to illustrate the potential damage: in case of no-heating during the severe frosts, the heating pipes might be damaged severely and require months to be repaired.⁴⁴³

Nuclear Power

Nuclear energy production became dominant following the invasion of Ukraine in 2014; by 2021, four NPPs covered 55.5 percent of demand.⁴⁴⁴

Nuclear power typically covers the minimum demand but cannot provide sufficient, steady supply due to daily usage fluctuations and occupation of the largest NPP. To meet peak demand or deficits, additional power from more flexible generation sources or imports is needed. All nuclear power is state-owned and operated by the Energoatom State Enterprise, that jointly owns 15 reactors.⁴⁴⁵

Zaporizhzhia NPP (ZNPP) was occupied in early 2022 and allegedly used as an ammunition warehouse and disconnected from the Ukrainian grid for supply while Ukrainian grid provides power for NPP's own needs.⁴⁴⁶ Provision of the electricity for ZNPP is essential to maintain nuclear safety. The ZNPP stopped generating power for the Ukrainian grid in September 2022. According to the International Atomic Energy Association (IAEA), it has kept at least one of its six units in hot shutdown since October 2022 to provide district heating as well as process steam for liquid waste treatment at the site, and since April 2024 all six reactor units are in cold shutdown.⁴⁴⁷

Without ZNPP, other plants can power up to 7,657 MW for the baseload capacity (meaning the minimum level of constant power supply that a utility or power grid must produce to meet the continuous and consistent demand for electricity).⁴⁴⁸ The availability of these units depends on scheduled maintenance, usually done during warmer months to ensure NPPs are ready during the heating season when over 50 percent of Ukraine's energy comes from nuclear power. From October to December 2023, the share of nuclear power reached 55 percent.⁴⁴⁹

While the NPPs remain vital for supplying electricity to households, communities and businesses, they are not immune from the risks associated with armed conflict. The Russian forces used the ZNPP and Chernobyl nuclear facility to gain military advantage. Shelling and direct attacks on NPP facilities are less common compared to other generation facilities, and yet some attacks were reported by IAEA, including artillery fire,⁴⁵⁰ sometimes leading to temporary loss of back-up power lines,⁴⁵¹ drone strikes or drone-carried explosion damage,⁴⁵² intense shelling,⁴⁵³ putting down dozens of radiation detectors,⁴⁵⁴ disconnection from the grid as a result of attacks on Ukraine power infrastructure,⁴⁵⁵ and other. Drones crossing nearby the nuclear plant facilities (see, for example, KhNPP)⁴⁵⁶ also pose the risks of disconnection, other damage or disruption. Ongoing attacks violate the IAEA pillars for safety and security of nuclear facilities.⁴⁵⁷

As more attacks on Ukrainian grid and generating capacities undermine its resilience leading to blackouts and disruptions in the power supply, there is a growing risk for loss of continued generation capacity by the NPPs. The attacks of August 26, 2024, for example, caused major fluctuations in the power supply and led to the temporary shutdown or disconnection of reactor units at Rivne NPP and Pivdennoukrainska NPP;⁴⁵⁸ ZNPP has suffered eight complete loss of power events since 2022.⁴⁵⁹

Large Hydroelectric Power Plants

Ukraine has two types of large hydropower plants - HPPs and pumped-storage power plant (PSPP) in addition to smaller hydropower plants. Both HPPs and PSPPs generate electricity using the power of water falling from some height from the upper water basin to the lower one and thus rotating the water turbines connected to the generator.⁴⁶⁰

Before the full-scale invasion, there were ten large HPPs with a total installed power capacity of about 4.7 GW and PSPPs with an installed capacity of 1.5 GW.⁴⁶¹ Almost 10 percent of electricity was generated from large HPPs in 2021.⁴⁶² In August 2024, General Director of Ukrhydroenergo, Ukraine's largest hydropower generation company, reported that every major hydroelectric power plant in the country had been targeted by Russian forces, enduring over 130 missile strikes in total. As a result, Ukrainian hydroelectric power stations have suffered a loss of approximately 40 percent of their generation capacity.⁴⁶³

Unlike nuclear power that is useful for baseload capacity provision, the large HPP is used mainly for covering deficit in the peak hours and storing it for low demand hours. It plays an important role in balancing Ukraine's renewable energy from those sources that rely on weather conditions (solar, wind) and thus have high fluctuations in forecasted and generated amounts. Large HPP is critical for enabling balance in the power system to keep Ukrainian system balanced and operating, especially in the times of high demand, along with thermal energy and import.

Renewable energy⁴⁶⁴

Renewable energy in Ukraine is presented by solar and wind power plants and also includes small HPPs, biomass and biogas stations, and at least one geothermal energy project in the occupied territory.⁴⁶⁵

As of the end of 2021, almost 10 GW of renewable energy was installed, of which 8,450.8 megawatt-peak (MWp) are industrial generation, and 1,205.1 MWp represents capacity of households both generating and consuming the generated power.⁴⁶⁶

As of early 2024, it is estimated that Ukraine has around 1,000 renewable energy producers (RES producers) that operate more than 1,500 energy installations, with a total available capacity (excluding damaged, occupied or destroyed plants) of 8.7 GW.⁴⁶⁷ Other estimates of available capacity are more pessimistic and refer to approximately 3 GW of the available capacities.⁴⁶⁸

ANNEX II. The Attack on the Okhmatdyt Hospital: OSINT Analysis

This appendix examines the July 8, 2024 attack on the Okhmatdyt Hospital, offering information and analysis to identify the perpetrator.

On the morning of July 8, 2024, Russia launched a large-scale combined missile attack on Ukrainian territory. According to official data from the Ukrainian Air Force, the assault involved 38 missiles of various types, including: Kh-47M2 aerial ballistic missile; 9M723 ballistic missiles; Kh-59/Kh-69 cruise missiles, and cruise missiles such as the 3M22 Zircon, 3M14, Kalibr and Kh-101.⁴⁶⁹ Most of these missiles were aimed at the Ukrainian capital, Kyiv. According to the Kyiv City Military Administration, the attack resulted in a significant toll, with at least 33 people killed and 121 others injured in Kyiv alone.⁴⁷⁰

Around 10:30 a.m., a sequence of explosions with brief intervals between them was reported in Kyiv.⁴⁷¹ Eyewitness videos from that period document multiple missile strikes targeting the city's central areas. One of the missiles hit the toxicology building with the chronic and acute intoxication unit of the Okhmatdyt National Children's Hospital⁴⁷² - Ukraine's largest pediatric hospital.⁴⁷³

The moment of this impact was captured on video by an eyewitness located in a nearby residential complex (50°26'52.7"N 30°28'47.8"E).⁴⁷⁴ The footage shows a missile approaching the surface at an acute angle, characteristic of cruise missiles during their final phase of flight. (see *Image 2*) This trajectory, along with the absence of visible damage to the missile, indicates that it was not intercepted by a missile defense system.

The next day after the attack, the Permanent Representative of Russia to the United Nations, Vasily Nebenzya stated that the Okhmatdyt hospital had been struck by a Ukrainian air defense missile.⁴⁷⁶ He asserted that the missile was launched from the NASAMS air defense system and called on the Norwegian government, which he alleged had supplied Ukraine with the system, to address the incident.



Image 2. The image shows the missile without visible damage approaching the surface at an acute angle. Source: TSAPLIENKO_UKRAINE FIGHTS⁴⁷⁵



Image 3. The image displays three panels: on the left and right are 3D models of the Kh-101 and AIM-120 missiles created by Bellingcat, respectively. The center panel shows a screenshot from a video of the missile that struck the hospital. Source: Bellingcat

Nebenzya further suggested that the attack might have been a deliberate action by the Ukrainian government, as it occurred on the eve of the NATO summit. In his official statement, he implied that the timing was intended to strengthen arguments to increase military assistance to Ukraine.⁴⁷⁷

To assess what weapon was used, which may shed light on who was responsible for the strike, Bellingcat investigators compared the missile from the video of the hospital strike with a 3D model of the Russian Kh-101 missile, which according to Ukrainian officials was used in the attack (see *Image 3*).⁴⁷⁸ Bellingcat's analysis reveals structural similarities between the Kh-101 missile, used by Russia, and the 3D model, including the distinctive outboard turbojet engine and mid-body wings. In contrast, the 3D profile of the AIM-120 AMRAAM missile, which is used with the NASAMS system, differs significantly from the missile observed in the video.⁴⁷⁹

In addition to Nebenzya's assertion, Russian military observers published an alternative theory suggesting that the hospital was struck by a MIM-104 Patriot missile system used by Ukraine to

The missile that hit the hospital



PAC-2



PAC-3

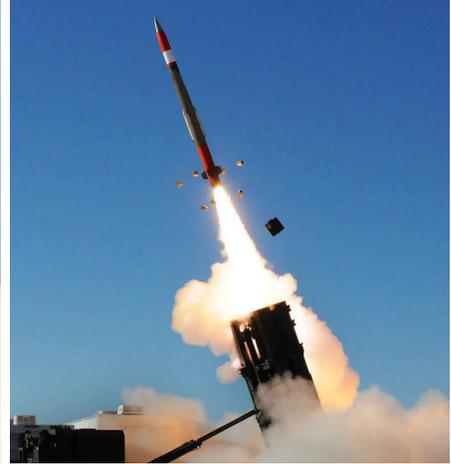


Image 4. Comparing the image of the incoming missile that struck the hospital (on the left) with the images of PAC-2 (in the center) and PAC-3 (on the right)

intercept Russian missiles.⁴⁸⁰ However, the PAC-2 and PAC-3 missiles fired from this system are completely visually distinct from the missile that struck the hospital (see *Image 4*).

A crucial point against the missile in the video being from any of the listed air defense systems is the missile's clear subsonic flight speed. The Kh-101 missile has a speed of approximately 700 km/h (Mach 0.58),⁴⁸¹ allowing the missile to be recorded on video during its flight. In contrast, missiles launched from NASAMS or Patriot systems typically travel at speeds around 5,000 km/h with a fiery exhaust following the missile.⁴⁸² Fiery exhaust is not visible in the video.

The strike resulted in the destruction of two floors in the southern wing of the hospital's toxicology building (see *Image 5*).⁴⁸³

Such extensive damage would have been unattainable with surface-to-air missiles such as the AIM-120, PAC-2, or PAC-3, which are not intended for ground targets. These missiles have warhead weights of approximately 20 kg for the AIM-120 and 90 kg for the PAC-2, which are insufficient to cause the observed level of devastation. Furthermore, the PAC-3 uses "hit-to-kill" technology to destroy agile targets, the technology that destroys a target through the impact of kinetic energy, rather than through shrapnel.⁴⁸⁵ In contrast, the warhead of the Kh-101 missile weighs approximately 450 kg, which is sufficient to cause the level of destruction seen at the Okhmatdyt hospital.⁴⁸⁶

The photos of the missile debris released by the Security Service of Ukraine provide further confirmation that the Kh-101 missile was employed in the attack on the hospital.⁴⁸⁷ These photos include imagery of specific components of the missile, including fragments of the TD-50A engine casing, the wing deployment mechanism, and other related parts.

Thus, all the analyzed evidence holds that the attack was carried out using a Kh-101 cruise missile, a weapon exclusively used by the Russian military.⁴⁸⁸

The type of weapon employed further suggests that the attack on the hospital was deliberate. The Kh-101 missiles have a circular probable error of approximately 6 to 20 meters, indicating high accuracy.⁴⁸⁹ Intercepting these missiles with air defense systems is particularly challenging due to their capability to fly at extremely low altitudes and their specific shape and coating, which hinder radar detection.⁴⁹⁰ Additionally, the Kh-101 is equipped with decoys that can deflect surface-to-air missiles, further complicating interception efforts.⁴⁹¹

The fact that the attack occurred during the morning rush hour when the hospital was receiving patients and conducting scheduled surgeries strongly suggests that the attacker aimed to maximize the number of casualties. According to the Ministry of Health, there were 627 children receiving treatment at the hospital at the time of the strike.⁴⁹²



Image 5. The destroyed toxicology building at the Okhmatdyt hospital. Source: Okhmatdyt's Instagram⁴⁸⁴

Endnotes

1. "Ukraine Energy Damage Assessment," UNDP, March 2023, https://ukraine.un.org/sites/default/files/2023-04/UNDPUkraineEnergy_ExecutiveSummary_eng.pdf
2. "Only 27% of large TPPs are operating in Ukraine - Shmyhal," Suspilne, June 7, 2024, <https://suspilne.media/763681-v-ukraini-pracuut-lise-27-velikih-tes-smigal/>.
3. Kateryna Hodunova, "Russia has destroyed all thermal power plants, nearly all hydroelectric capacity in Ukraine ahead of winter, Zelensky says," September 25, 2024, <https://kyivindependent.com/russia-destroys-all-thermal-power-plants-nearly-all-hydroelectric-capacity-in-ukraine-ahead-of-winter-zelensky-says/>
4. "Update by the Chair of the Independent International Commission of Inquiry on Ukraine at the 57th session of the Human Rights Council," Independent International Commission of Inquiry on Ukraine at the 57th session of the Human Rights Council, September 23, 2024, <https://www.ohchr.org/en/statements-and-speeches/2024/09/update-chair-independent-international-commission-inquiry-ukraine>; "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population," UN Human Rights Monitoring Mission in Ukraine, September 2024, <https://ukraine.ohchr.org/sites/default/files/2024-09/ENG%20Attacks%20on%20Ukraine%E2%80%99s%20Energy%20Infrastructure-%20%20Harm%20to%20the%20Civilian%20Population.pdf>
5. First Geneva Convention Article 19; Article 19 of the First Geneva Convention holds that "protection to which civilian hospitals are entitled shall not cease unless they are used to commit, outside their humanitarian duties, acts harmful to the enemy." There is no set definition as to what constitutes "acts harmful to the enemy." But examples of acts that are not "harmful to the enemy" - including using small arms in self-defense, actions to defend the sick and wounded and the presence of sick or wounded combatants under treatment, or of small arms and ammunition taken from these combatants but not yet handed over to proper service - make clear that the term is narrow. See Additional Protocol 1 13(2). Moreover, even when a health care facility loses its protected status by being the site of "acts harmful to the enemy," the attacking party must still give the health facility warning of attack within, where appropriate, "a reasonable time limit" of the attack. Under IHL, energy infrastructure is only a valid target when it qualifies as a military object; otherwise, IHL prohibits attacks on energy infrastructure as civilian objects DoD Law of War Manual § 5.6.8.5; Commentary of 1987 on Additional Protocol I, note 3(b) to Article 52.
6. "Pain and Miracle: Chronicles of the War at Kyiv Children's Hospital 'Okhmatdyt,'" LB.UA, November 19, 2022, https://lb.ua/society/2022/11/19/536252_bil_i_divo_hroniki_viyini_kiivskoi.html; "Children's Hospital in Kyiv Amid Russia's Attack," Time, March 14, 2022, <https://time.com/6152374/children-hospital-kyiv-ukraine-russia/>.
7. "Kyiv Doctor Killed in Airstrike," The Washington Post, March 26, 2023, <https://www.washingtonpost.com/world/2023/03/26/doctor-kyiv-airstrike-killed-car/>.
8. Survey; Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file); "The largest children's hospital in Ukraine continues to operate and provide care to children despite the power outage," Okhmatdyt, November, 24, 2022, <https://ohmatdyt.com.ua/najbilsha-dityacha-likarnya-ukrayini-prodovzhuye-pratsyuvati-ta-nadavati-dopomogu-diyam-nezvazhayuchi-na-vimkennya-svitla/>.
9. "Health cluster: Okhmatdyt children's hospital attack response - Key figures and humanitarian efforts," Health Cluster Ukraine, July 10, 2024, <https://reliefweb.int/report/ukraine/health-cluster-okhmatdyt-childrens-hospital-attack-response-key-figures-and-humanitarian-efforts>.
10. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
11. "Health cluster: Okhmatdyt children's hospital attack response - Key figures and humanitarian efforts," Health Cluster Ukraine, July, 10, 2024, <https://reliefweb.int/report/ukraine/health-cluster-okhmatdyt-childrens-hospital-attack-response-key-figures-and-humanitarian-efforts>.
12. "Russians destroy 2 energy substations on premises of Okhmatdyt children's hospital," Ukrainska Pravda, July 9, 2024, <https://www.pravda.com.ua/eng/news/2024/07/9/7464822/>.
13. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
14. Interview with Dr. Oksana Kyrsanova, conducted by the Media Initiative for Human Rights on March 19, 2022 (on-file); Interview with Dr. Oksana Kyrsanova, conducted by the Media Initiative for Human Rights on December 2, 2022 (on-file); "They Drove a Tank and Two Armored Personnel Carriers and Started Shooting Houses Around... ' How the Russians Captured the Hospital in Mariupol, and What Happened There After That," 0629.com.ua Mariupol City Website, March 31, 2022, <https://www.0629.com.ua/news/3362062/voni-prignali-tank-i-dva-btra-i-pocali-rozstriluvati-budinki-navkolo-ak-rosiani-zahopili-likarnu-v-mariupoli-i-so-tam-vidbuvalos-pisla-cogo>; "Armoury, Prison, Graveyard: Mariupol Intensive Care Hospital under Russian Occupation," International Partnership for Human Rights, Truth Hounds, Global Diligence, November 2022, https://www.iphonline.org/wp-content/uploads/2022/11/Mariupol-report_for_distribution_final_1.pdf; "'Our City Was Gone'. Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITU, Truth Hounds, 2024, p. 49, p. 87, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf.
15. "'Our City Was Gone'. Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITU, Truth Hounds, 2024, p. 21, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf; Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024 (on-file); Interview with witness D-2594, conducted by Truth Hounds on June 23, 2023, (on-file).
16. "Lost equipment and displaced doctors. How Mariupol regional hospital works in Kyiv," Suspilne Donbas, April 01, 2023, <https://suspilne.media/431571-vtracene-obladnanna-ta-mediki-pereselenci-ak-oblasna-mariupolska-likarna-pracue-u-kievi/>; Mariupolska City Council, Telegram, Post on December 22, 2022, at 11:44, <https://t.me/mariupolrada/12175?single>.
17. Interview with Dr. Olena Lazareva, conducted by Truth Hounds on August 25, 2024 (on-file).
18. Interview with Dr. Olena Lazareva.
19. Interview with the witness W-5748.
20. Article 19 of the First Geneva Convention holds that "protection to which civilian hospitals are entitled shall not cease unless they are used to commit, outside their humanitarian duties, acts harmful to the enemy." There is no set definition as to what constitutes "acts harmful to the enemy." But examples of acts that are not "harmful to the enemy" - including using small arms in self-defense, actions to defend the sick and wounded and the presence of sick or wounded combatants under treatment, or of small arms and ammunition taken from these combatants but not yet handed over to proper service - make clear that the term is narrow. See Additional Protocol 1 13(2). Moreover, even when a health care facility loses its protected status by being the site of "acts harmful to the enemy," the attacking party must still give the health facility warning of attack within, where appropriate, "a reasonable time limit" of the attack. See First Geneva Convention Article 19.
21. "Security Council Adopts Resolution 2286 (2016), Strongly Condemning Attacks against Medical Facilities, Personnel in Conflict Situations," United Nations, May 3, 2016, <https://press.un.org/en/2016/sc12347.doc.htm>
22. "Critical Conditions: Violence Against Health Care in Conflict," Safeguarding Health in Conflict Coalition (SHCC), 2023, <https://insecurityinsight.org/wp-content/uploads/2024/05/2023-SHCC-Critical-Conditions.pdf>.
23. "Destruction and Devastation: One Year of Russia's Assault on Ukraine's Health Care System," eyeWitness to Atrocities, Insecurity Insight, Media Initiative for Human Rights, Physicians for Human Rights, and Ukrainian Healthcare Center, February 2023, <https://phr.org/our-work/resources/russias-assault-on-ukraines-health-care-system>.
24. "Coercion and Control: Ukraine's Health Care System under Russian Occupation," eyeWitness to Atrocities, Insecurity Insight, Media Initiative for Human Rights, and Physicians for Human Rights, December 2023, <https://phr.org/our-work/resources/coercion-and-control-ukraines-health-care-system-under-russian-occupation>.
25. National Health Service of Ukraine, Dashboard "Report on income and expenses of healthcare providers (selected indicators)," Data as of August, 2024, <https://edata.e-health.gov.ua/e-data/dashboard/1-hc>; By the end of 2022, health care workforce shrunk by an estimated 13.7 percent, see "Healthcare at War: The impact of Russia's full-scale invasion on the Healthcare

Endnotes

continued

- in Ukraine," Ukrainian Healthcare Center, April 2023, https://drive.google.com/file/d/1dZQHg_aSdY9xIOiJwz6nM_G3fWSny30I/view
26. "HeRAMS Ukraine Status Update Report May - October 2023," World Health Organization, November 20, 2023, p. VIII-XII, <https://www.who.int/publications/m/item/herams-ukraine-status-update-report-may-to-october-2023-en>
 27. "Meeting with permanent members of the Security Council," President of Russia, <https://web.archive.org/web/20240923184234/en.kremlin.ru/events/president/news/69568>. Vladimir Putin announced the start of the campaign of attacks on energy infrastructure on October 10, 2022: "This morning, at the proposal of the Defence Ministry and in accordance with the plan of Russia's General Staff, a massive strike was launched with long-range precision air, sea and land-based weapons against Ukrainian energy, military and communications facilities."
 28. "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Ivanovich Kobylash and Viktor Nikolayevich Sokolov," International Criminal Court, March 5, 2024, <https://www.icc-cpi.int/news/situation-ukraine-icc-judges-issue-arrest-warrants-against-sergei-ivanovich-kobylash-and>; "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Kuzhugetovich Shoigu and Valery Vasilyevich Gerasimov," International Criminal Court, June 25, 2024, <https://www.icc-cpi.int/news/situation-ukraine-icc-judges-issue-arrest-warrants-against-sergei-kuzhugetovich-shoigu-and>.
 29. "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Ivanovich Kobylash and Viktor Nikolayevich Sokolov"; "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Kuzhugetovich Shoigu and Valery Vasilyevich Gerasimov"
 30. "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population," UN Human Rights Monitoring Mission in Ukraine, September 2024, <https://ukraine.ohchr.org/sites/default/files/2024-09/ENG%20Attacks%20on%20Ukraine%E2%80%99s%20Energy%20Infrastructure-%20%20Harm%20to%20the%20Civilian%20Population.pdf>
 31. "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population."
 32. "Update by the Chair of the Independent International Commission of Inquiry on Ukraine at the 57th session of the Human Rights Council," Independent International Commission of Inquiry on Ukraine at the 57th session of the Human Rights Council, September 23, 2024, <https://www.ohchr.org/en/statements-and-speeches/2024/09/update-chair-independent-international-commission-inquiry-ukraine>
 33. "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, <https://www.who.int/publications/i/item/9789240066960>, p. XXV
 34. Elini Giorgou and Abby Zeith, "When the lights go out: the protection of energy infrastructure in armed conflict," Humanitarian Law and Policy, April 20, 2023, <https://blogs.icrc.org/law-and-policy/2023/04/20/protection-energy-infrastructure-armed-conflict/>
 35. "Code of Ethics for Documenters," Truth Hounds, May 23, 2023, <https://truth-hounds.org/en/document/code/>.
 36. References to "power generation" and "transmission infrastructure," and variations on these phrases, refer respectively to power from primary energy sources, including coal, geothermal, water (hydropower), wind, nuclear, solar, oil, natural gas, and biomass, or facilities such as power substations that transform or transmit energy from a power generation site. Under different circumstances and in different settings, suspension of power generation can lead to loss of electricity, water supply, and other utilities typically used in urban communities as these systems are often interconnected. For the purposes of this study, "energy" and "power" are often used interchangeably, and "electricity" is sometimes used to describe situations of power cuts.
 37. Hathaway, Oona A., Caitlin N. Howarth, Kaveh Khoshnood, Nathaniel A. Raymond et al., "Remote Assessment of Bombardment of Ukraine's Power Generation and Transmission Infrastructure, October 1, 2022, to April 30, 2023," February 29, 2024. Humanitarian Research Lab at Yale School of Public Health and Ukraine Digital Verification Lab: New Haven, <https://hub.conflictobservatory.org/portal/home/item.html?id=99b805af18e94843a641c07114a3f1b0>.
 38. The online survey is available at: <https://archive.ph/nSWJL> (Ukrainian), <https://archive.ph/kNiDd> (English).
 39. Demographic data in this table reflects only valid responses, with unanswered or non-applicable entries excluded. As a result, the total number of respondents shown may differ from the overall survey count included in the report.
 40. 12 respondents chose "Prefer not to say" when responding to the question, and eight respondents did not answer the question at all.
 41. National Health Service of Ukraine, "Dashboard Contracts for medical care of the population under the program of medical guarantees", as of September 25, 2024, <https://edata.e-health.gov.ua/e-data/dashboard/pmg-contracts>,
 42. Statistical Data of the systems of the Ministry of Health of Ukraine, "Report on medical staff for 2023 (form #17)," accessed on September 19, 2024, <http://medstat.gov.ua/ukr/statdanMMXIX.html>.
 43. The dataset categorizes incidents in alignment with the World Health Organization's definition of attacks on health: "any act of verbal or physical violence, obstruction, or threat of violence that interferes with the availability, access and delivery of curative and/or preventative health services during emergencies." "Attacks on Health Care Initiative," World Health Organization, July 22, 2020, <https://www.who.int/news-room/questions-and-answers/item/attacks-on-health-care-initiative>.
 44. "Attacks on Health Care in Ukraine," eyeWitness to Atrocities, Insecurity Insight, Media Initiative for Human Rights, Physicians for Human Rights, and Ukrainian Healthcare Center, <https://www.attacksonhealthukraine.org/>. Data as of July 31, 2024. The dataset brings together individual incidents from a range of sources, including open-source research, the eyeWitness app, witness and victim accounts, site visits undertaken by Ukrainian Healthcare Center, Media Initiative for Human Rights, and PHR, and networks from organizations working on the ground.
 45. eyeWitness app has been used in Ukraine since 2017 to capture photos, video, and sound and to record metadata. It enables users to capture material and uses the device sensors to record metadata (such as GPS, nearby cell towers, and/or nearby Wi-Fi networks) that helps to authenticate the date, time, and location of the images and sound. The app is designed so that neither the footage nor its associated metadata can be tampered with by the user or third parties. In conjunction with transmission protocols, eyeWitness' server creates a chain of custody with embedded information for the footage from the point of capture to its receipt by the server. See <https://www.eyewitness.global/resources>
 46. Official governmental reports about incidents of attacks on energy infrastructure often refer to "attacks on critical infrastructure" or "attacks on energy infrastructure".
 47. A number of incidents could not be immediately placed in one of those categories and are included in "Other". These are the incidents where an energy infrastructure object and a health facility were damaged in one attack, but it was not immediately possible to determine the connection and impact on the health facility, or where a health facility or its vicinity was impacted by an attack, and it was not (yet) clear whether the energy supply was interrupted.
 48. This methodology focuses on receiving detailed answers to the five "W+H" questions (who, what, where, when, why, how) and the "so what" question, alongside personal information, incident details, contextual elements, and any physical or documentary evidence while ensuring confidentiality and independent testimony of respondents. "Truth Hounds' documentation methodology is based on the principle of collecting information from as many sources as possible and necessarily includes checking the relevance of each source," Truth Hounds, May 22, 2014, <https://truth-hounds.org/document/methodology/>.
 49. According to the definition by the European Commission, energy poverty occurs when a household must reduce its energy consumption to a level that negatively affects the health and well-being of its inhabitants, see "Energy Poverty," European Commission, https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumers-and-prosumers/energy-poverty_en.
 50. "Interconnected Network of ENTSO-E," ENTSO-E, 2023, <https://eepublicdownloads.entsoe.eu/clean-documents/Publications/>

Endnotes

continued

- [maps/2023/230922/Map_ENTSO-E-4.000.000.pdf](https://www.entsoe.eu/media/Default/2023/230922/Map_ENTSO-E-4.000.000.pdf)
51. "Ukrainian energy sector evaluation and damage assessment – I (as of August 24, 2022)," International Energy Charter, August, 2022, page 3, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/20220829_UA_sectoral_evaluation_and_damage_assessment_final.pdf.
 52. "Ukraine Energy Damage Assessment," UNDP, March 2023, https://ukraine.un.org/sites/default/files/2023-04/UNDP_Ukraine_Energy_ExecutiveSummary_eng.pdf.
 53. "Ukrainian energy sector evaluation and damage assessment – I (as of August 24, 2022)," International Energy Charter, August, 2022, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/20220829_UA_sectoral_evaluation_and_damage_assessment_final.pdf.
 54. "Report on the assessment of the sufficiency (compliance) of generating capacities," Ukrenergo, 2019, <https://www.ukrenergogoexport.com/sites/default/files/2020-03/zvitotinkividpovidnosti-generuyuchyhpotugnostey-2019-200313120710.pdf>; "Only 27% of large TPPs are operating in Ukraine - Shmyhal," Suspilne, June 7, 2024, <https://suspilne.media/763681-v-ukraini-pracuut-lise-27-velikih-tes-smigal/>.
 55. Ukraine Energy Damage Assessment, UNDP, March 2023, https://ukraine.un.org/sites/default/files/2023-04/UNDP_Ukraine_Energy_ExecutiveSummary_eng.pdf.
 56. During transportation, some portion of the energy initially generated is lost. The share of lost energy depends on a number of characteristics, and usually varies from 5 percent to 20 percent, according to estimates for the distribution grid. To keep down the losses, the higher voltage is used; the higher the voltage, the lower the losses. See "Expert: A number of state regional power distribution companies have stepped up efforts to reduce technological losses of electricity," Energobusiness, May 12, 2023, <https://e-b.com.ua/ryad-derzavnix-oblenergo-aktivizovali-roboti-zi-zmensennya-texnologicnix-vtrat-elektroenergiyi-ekspert-5549>.
 57. The Ukrainian electricity transmission system includes 23,600 km of overhead lines, with some lower estimates. See "Ukrainian energy sector evaluation and damage assessment – XI (as of June 24, 2023)," International Energy Charter, June 2023, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_06_30_UA_sectoral_evaluation_and_damage_assessment_Version_XI_final.pdf. Ukraine operates a high-voltage 750 kV power line in the east of Ukraine, see Susanne Nies, Oleh Savytskyi, "Six options to boost power transfers from Continental Europe to Ukraine, for the next two winters," Green Deal Ukraina, <https://greendealukraina.org/assets/images/reports/grid-solutions-ukraine-next-winters-final.pdf>.
 58. "Ukrainian energy sector evaluation and damage assessment – XI (as of June 24, 2023)."
 59. "We urgently need to focus on the engineering protection of our power plants, - former CEO of Ukrenergo Volodymyr Kudrytskyi," Espresso, September 22, 2024, <https://espresso.tv/article-volodimir-kudrytskyi-eksgolova-prat-nek-ukrenergo-intervyu-espresso-20-veresnya-2024-roku>.
 60. "We urgently need to focus on the engineering protection of our power plants, - former CEO of Ukrenergo Volodymyr Kudrytskyi".
 61. Petro Bodnar, Nadja Kelm, "What's up with the power? How Russia destroys energy infrastructure," Texty.org, December 8, 2022, <https://texty.org.ua/articles/108414/whats-up-with-the-power-how-russia-destroys-energy-infrastructure/>.
 62. "There will definitely be shelling of the power system, the Russians are preparing". Interview with the chief dispatcher of Ukrenergo, "Ekonomichna Pravda, January 16, 2024, <https://www.epravda.com.ua/publications/2024/01/16/708767/>.
 63. "The Ukrainian energy system is synchronized with the European network," Energy Security Project, December 5, 2023, <https://energysecurityua.org/news/the-ukrainian-energy-system-finalized-synchronization-with-the-european-network/>.
 64. On 16 March 2022, emergency synchronization of Ukraine with the Continental Europe power system took place. Ukraine system managed to operate 21 days in island mode during the full-scale invasion. See "Maxim Timchenko: synchronizing with ENTSO-E was Ukraine's existential choice," DTEK, March 16, 2023, <https://dtek.com/en/media-center/news/maxim-timchenko-synchronizing-with-entso-e-was-ukraines-existential-choic/>
 65. "Continental European TSOs announce completion of synchronisation project with Ukrenergo and significant increase in export capacity from Continental Europe to Ukraine," ENTSO-E, November 28, 2023, <https://www.entsoe.eu/news/2023/11/28/continental-european-tsos-announce-completion-of-synchronisation-project-with-ukrenergo-and-significant-increase-in-export-capacity-from-continental-europe-to-ukraine/>.
 66. "Ukraine faces winter power shortfall of one-third of peak demand, IEA says," Reuters, September 19, 2024, <https://www.reuters.com/world/europe/ukraine-faces-6-gw-power-supply-shortfall-this-winter-iea-says-2024-09-19/>
 67. Julia E. Sullivan, Dmitriy Kamensky, Jeff D. Makhholm, "Gas Wars in Ukraine Illustrate Europe's Vulnerability to Russian Energy Dominance," Oil, Gas & Energy Law Intelligence 16, no. 5 (2018): https://www.academia.edu/38602361/Gas_Wars_in_Ukraine_Illustrate_Europes_Vulnerability_to_Russian_Energy_Dominance
 68. Kateryna Filipenko, "A timeline of major events in Ukraine-Russia gas relations," Wood Mackenzie, December 20, 2019, <https://www.woodmac.com/news/opinion/a-timeline-of-major-events-in-ukraine-russia-gas-relations/>.
 69. "Gas Crisis in Ukraine: People Start to Freeze, Factories Shut Down," Ukrainska Pravda, January 8, 2009, <https://www.pravda.com.ua/news/2009/01/8/3663350/>.
 70. "Risks and impacts from attacks on energy infrastructure in Ukraine / Environment & Conflict Alert, Ukraine," PAX, Centre for Information Resilience, December 2022, https://paxforpeace.nl/wp-content/uploads/sites/2/import/2023-01/PAX_Ukraine_energy_infrastructure_FIN.pdf; "Coal output in Ukraine declines 22.4% in 2014," Kyiv Post, January 8, 2015, <https://archive.kyivpost.com/article/content/ukraine-politics/coal-output-in-ukraine-declines-224-in-2014-376952.html>. The Russian state seized and appropriated the resources of Ukrainian energy producers in Crimea, see "UNCITRAL tribunal finds Russia liable to pay USD 207.8 million for the unlawful expropriation of the assets of a Ukrainian electricity company," Investment Treaty News, January 14, 2024, <https://www.iisd.org/itn/en/2024/01/13/uncitral-tribunal-findsrussia-liable-to-pay-usd-207-8-million-for-the-unlawful-expropriation-of-theassets-of-a-ukrainian-electricity-company/>. Active conflict damaged mining enterprises and deprived Ukraine of gas and oil fields, see "Komsomolets Donbassa mine was shelled again," DTEK says, RBC-UKRAINE, October 19, 2014, <https://www.rbc.ua/rus/news/shahta-komsomolets-donbassa-vnovpovdverglas-artobstrelu--19102014002700>; "Amidst the carnage of war, Ukraine reaffirms commitment to renewables," Energy Monitor, April 12, 2022, <https://www.energymonitor.ai/tech/renewables/amidst-the-carnage-of-war-ukraine-reaffirms-commitment-to-renewables/?cf-view>.
 71. "Ukraine pays for two more vessels carrying coal from South Africa – energy minister," Interfax-Ukraine, January 8, 2015, <https://en.interfax.com.ua/news/economic/243387.html>; "Ukraine to Import Coal From 'Far Away' as War Curtails Mines," Bloomberg News, December 31, 2014, <https://www.bloomberg.com/news/articles/2014-12-31/ukraine-to-import-coal-from-far-away-as-war- Curtails-mines>; "Batch of South African coal supplied to Ukraine," Unian, August 4, 2015, <https://www.unian.info/politics/1108007-batch-of-south-african-coal-supplied-to-ukraine.html>.
 72. Julia E. Sullivan, Dmitriy Kamensky, "How cyber-attacks in Ukraine show the vulnerability of the U.S. power grid," The Electricity Journal 30, no. 3 (2017): 30-35; <https://www.sciencedirect.com/science/article/abs/pii/S1040619017300507>.
 73. "Timeline of the war and DTEK's vision of the future," DTEK, April 27, 2024, <https://dtek.com/en/anniversary-of-the-war/>
 74. "Timeline of the war and DTEK's vision of the future."
 75. Drew Hinshaw, Joe Parkinson, "Russian Army Turns Ukraine's Largest Nuclear Plant into a Military Base," The Wall Street Journal, July 5, 2022, <https://www.wsj.com/articles/russian-army-turns-ukraines-largest-nuclear-plant-into-a-military-base-11657035694>.
 76. "Russian Army Turns Ukraine's Largest Nuclear Plant into a Military Base";

Endnotes

continued

- "Update 171 – IAEA Director General Statement on Situation in Ukraine." IAEA, July 5, 2023, <https://www.iaea.org/newscenter/pressreleases/update-171-iaea-director-general-statement-on-situation-in-ukraine>.
77. Igor Piddubnyi and Dmytro Goriunov, "Assessment of damages and losses to Ukraine's energy sector due to Russia's full-scale invasion," Kyiv School of Economics, May 2024, https://dtek.com/content/upload/urc/Kyiv%20School%20of%20Economics_2024.pdf
78. "Assessment of damages and losses to Ukraine's energy sector due to Russia's full-scale invasion."
79. "Timeline of the war and DTEK's vision of the future."
80. "Ukraine has commissioned 660 MW of new RES capacities in two years," Ukrainska Pravda, January 26, 2024, <https://ua-energy.org/uk/posts/ukraina-protiahom-dvokh-rokiv-vvela-660-mwt-novykh-potuzhnostei-vde-minenerho>.
81. "Ukrainian energy sector evaluation and damage assessment - II (as of September 24, 2022)," International Energy Charter, September 2022, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_09_30_UA_sectoral_evaluation_and_damage_assessment_Version_II.pdf
82. "Ukrainian energy sector evaluation and damage assessment - II (as of September 24, 2022)."
83. Katherine Lawlor, Grace Mappes, Mason Clark, and Frederick W. Kagan, "Russian Offensive Campaign Assessment, September 16," Institute for the Study of the War, September 16, 2022, <https://www.understandingwar.org/backgroundunder/russian-offensive-campaign-assessment-september-16>.
84. "Ukrainian energy sector evaluation and damage assessment - II (as of September 24, 2022)," p. 4.
85. "Ukrainian energy sector evaluation and damage assessment - II (as of September 24, 2022)."
86. "Risks and impacts from attacks on energy infrastructure in Ukraine," PAX, January 2023, https://paxvoorvrede.nl/wp-content/uploads/import/2023-01/PAX_Ukraine_energy_infrastructure_FIN.pdf p.8
87. President of the Russian Federation, "Meeting with permanent members of the Security Council," October 10, 2022, <http://www.en.kremlin.ru/events/president/transcripts/deliberations/69568>.
88. "Ukrainian energy sector evaluation and damage assessment - V (as of November 24, 2022)," International Energy Charter, November, 2022, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_11_24_UA_sectoral_evaluation_and_damage_assessment_Version_IV.pdf.
89. "Ukrainian energy sector evaluation and damage assessment - V (as of November 24, 2022)."
90. "Ukrainian energy sector evaluation and damage assessment - V (as of November 24, 2022)."
91. "Ukrainian energy sector evaluation and damage assessment - V (as of November 24, 2022)"; "Brief Ukrainian energy sector evaluation and damage assessment - III (as of October 24, 2022)," International Energy Charter, October, 2022, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_10_24_UA_sectoral_evaluation_and_damage_assessment_Version_III.pdf.
92. "Ukrainian energy sector evaluation and damage assessment - V (as of November 24, 2022)," International Energy Charter, November 2022, p. 4-6.
93. "Ukrainian energy sector evaluation and damage assessment - V (as of November 24, 2022)," p 7-8.
94. "Ukrainian energy sector evaluation and damage assessment - V (as of November 24, 2022)."
95. "Ukrainian energy sector evaluation and damage assessment - IV (as of November 24, 2022)," p 9.
96. "Report of the Independent International Commission of Inquiry on Ukraine," UNHRC, A/HRC/52/62, September 25, 2023, para 41. <https://documents.un.org/doc/undoc/gen/g23/049/73/pdf/g2304973.pdf>.
97. "Report of the Independent International Commission of Inquiry on Ukraine."
98. "Number of Ukrainians and Their Migration Abroad Because of the War," Civil Network OPORA, July 5, 2023, <https://www.oporaua.org/en/viyina/24791-kilkist-ukrayintsiv-ta-yikh-migratsiia-za-kordon-cherез-viinu-doslidzhennia-gromadianskoyi-merezhi-opora-24791>.
99. "Remote Assessment of Bombardment of Ukraine's Power Generation and Transmission Infrastructure, 1 October 2022 to 30 April 2023," p. 8-9.
100. "Remote Assessment of Bombardment of Ukraine's Power Generation and Transmission Infrastructure, 1 October 2022 to 30 April 2023," p 5.
101. "Air Force tells how Russians disguise drones from Ukrainian air defense," Ukrinform, March 6, 2023, <https://www.ukrinform.ua/rubric-ato/3678952-u-povitranih-silakh-rozpovili-ak-rosiani-maskuut-droni-vid-ukrainskoi-ppo.html>.
102. "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population," UN Human Rights Monitoring Mission to Ukraine, September 2024, <https://ukraine.un.org/en/278992-attacks-ukraine%E2%80%99s-energy-infrastructure-harm-civilian-population>.
103. Ukrainian energy sector evaluation and damage assessment - VII (as of February 24, 2023), p. 3.
104. "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population", p.2.
105. "Remote Assessment of Bombardment of Ukraine's Power Generation and Transmission Infrastructure, 1 October 2022 to 30 April 2023," p. 3.
106. "Ukrainian energy sector evaluation and damage assessment - VII (as of February 24, 2023)," p. 3
107. UN Human Rights Monitoring Mission to Ukraine (HRMMU), p 2.
108. UN HRMMU.
109. UN HRMMU.
110. UN HRMMU.
111. UN HRMMU.
112. UN HRMMU.
113. UN HRMMU, p 3.
114. UN HRMMU.
115. UN HRMMU.
116. UN HRMMU.
117. UN HRMMU.
118. UN HRMMU.
119. UN HRMMU. In total, the HRMMU recorded 36 strikes on power generation facilities, including 25 on TPPs and CHPPs in nine regions, seven on HEPPs in five regions, two on renewable energy facilities in one region, and two on heating plants in two regions. HRMMU also recorded at least 101 strikes on power distribution and transmission facilities in 17 regions.
120. UN HRMMU, p 4.
121. Kateryna Hodunova, "Russia has destroyed all thermal power plants, nearly all hydroelectric capacity in Ukraine ahead of winter, Zelensky says", September 25, 2024, <https://kyivdependent.com/russia-destroys-all-thermal-power-plants-nearly-all-hydroelectric-capacity-in-ukraine-ahead-of-winter-zelensky-says/>.
122. UN HRMMU, p. 4.
123. UN HRMMU, p. 5.
124. UN HRMMU.
125. UN HRMMU.
126. This category of weapons includes cruise and ballistic missiles such as the 3M14 Kalibr, Kh-101, 9M723, 9M727, 9M728, 9M729, among others. See, e.g. Air Force of the Armed Forces of Ukraine, Telegram, Post from July 8, 2024, at 14:54, <https://t.me/kpszs/16341>; Oleskandr Kovalenko, "Kovalenko: Ukraine's missile terror has turned against Russia. What the analysis of strikes over the entire period of the full-scale war showed," Oboz.ua, August 22, 2024, <https://war.obozrevatel.com/ukr/kovalenko-raketnij-terror-ukraini-obermuvysya-proti-rosii-scho-pokazav-analiz-udariv-za-ves-chas-povnomasshtabnoi-vijni.htm>; UN HRMMU, p. 2-3.
127. "It won't be easy": Ukraine's power transmission operator announces

Endnotes

continued

- electricity situation forecast for winter”, *Ukrainska Pravda*, June 27, 2024, <https://www.pravda.com.ua/eng/news/2024/06/27/7462855/>; Attacks on Ukraine’s Energy Infrastructure: Harm to the Civilian Population, UN Human Rights Monitoring Mission in Ukraine, September 2024, p.6, https://ukraine.un.org/sites/default/files/2024-09/ENG%20Attacks%20on%20Ukraine%E2%80%99s%20Energy%20Infrastructure-%20%20Harm%20to%20the%20Civilian%20Population_0.pdf
128. UN HRMMU, p. 9.
129. UN HRMMU, p. 2.
130. Andriyana Velyanik, “A work shift lasting about 63 days.’ How the largest children’s hospital, Okhmatdyt, works during the war,” *Svidomi*, March 29, 2023, <https://svidomi.in.ua/en/page/a-work-shift-lasting-about-63-days-how-the-largest-childrens-hospital-okhmatdyt-works-during-the-war>.
131. Independent International Commission of Inquiry on Ukraine, A/ HRC/52/62549 (Oct. 25, 2024), para. 25, https://www.ohchr.org/sites/default/files/documents/hrbodies/hrcouncil/coiukraine/A_79_4632_AUV.pdf; “Health cluster: Okhmatdyt children’s hospital attack response - Key figures and humanitarian efforts,” *Health Cluster Ukraine*, July 10, 2024, <https://reliefweb.int/report/ukraine/health-cluster-okhmatdyt-childrens-hospital-attack-response-key-figures-and-humanitarian-efforts>.
132. Mansur Murovalev, “As Ukraine’s largest children’s hospital is hit, anger towards Russia rages,” *Al Jazeera*, July 8, 2024, <https://www.aljazeera.com/news/2024/7/8/as-ukraines-largest-childrens-hospital-is-hit-anger-towards-russia-rages>; OKHMATDYT, <https://ohmatdyt.com.ua/en/slider/the-hospital-is-working-and-standing-for-life/>, accessed on September 20, 2024.
133. “As Ukraine’s largest children’s hospital is hit, anger towards Russia rages.”
134. “As Ukraine’s largest children’s hospital is hit, anger towards Russia rages.”
135. “As Ukraine’s largest children’s hospital is hit, anger towards Russia rages.”
136. “Pain and Miracle: Chronicles of the War at Kyiv Children’s Hospital ‘Okhmatdyt,’” *LB.UA*, November 19, 2022, https://lb.ua/society/2022/11/19/536252_bil_i_divo_hroniki_viyni_kiivskoi.html.
137. “Pain and Miracle: Chronicles of the War at Kyiv Children’s Hospital ‘Okhmatdyt.”
138. Velyanik, “A work shift lasting about 63 days.’ How the largest children’s hospital, Okhmatdyt, works during the war.”
139. Iryna Kyporenko, “The Fight to Save Lives in Ukraine’s Largest Children’s Hospital,” *TIME*, February 28, 2022, <https://time.com/6152374/children-hospital-kyiv-ukraine-russia/>; Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on file). 2024 (on-file); “A work shift lasting about 63 days.’ How the largest children’s hospital, Okhmatdyt, works during the war.”
140. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
141. Kyporenko, “The Fight to Save Lives in Ukraine’s Largest Children’s Hospital.”
142. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
143. Interview with Dr. Lesia Lysytsia.
144. Interview with Dr. Lesia Lysytsia.
145. Phil McCausland, “Kids with cancer in Ukraine shelter in hospital basements, hoping to evacuate,” *NBC News*, March 1, 2022, <https://www.nbcnews.com/news/world/kids-cancer-ukraine-shelter-hospital-basements-hoping-evacuate-rcna17939>.
146. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
147. “Kyiv Doctor Killed in Airstrike,” *The Washington Post*, March 26, 2023, <https://www.washingtonpost.com/world/2023/03/26/doctor-kyiv-airstrike-killed-car/>.
148. Survey; Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
149. Survey; Interview with Dr. Lesia Lysytsia.
150. Survey; Interview with Dr. Lesia Lysytsia.
151. “The largest children’s hospital in Ukraine continues to operate and provide care to children despite the power outage,” *Okhmatdyt*, November, 24, 2022, <https://ohmatdyt.com.ua/najbilsha-dityacha-likarnya-ukrayini-prodovzhuye-pratsyuvati-ta-nadavati-dopomogu-dityam-nezvazhayuchi-na-vimknennya-svitla/>.
152. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
153. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
154. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
155. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
156. Interview with Dr. Anastasiia Zakharova.
157. For detailed analysis, see Annex II.
158. Michael Sheldon, “Russian Missile Identified in Kyiv Children’s Hospital Attack,” *Bellingcat*, July 9, 2024, <https://www.bellingcat.com/news/2024/07/09/russian-missile-identified-in-kyiv-childrens-hospital-attack/>; Also see Annex II to this report.
159. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
160. Interview with Dr. Anastasiia Zakharova.
161. Interview with Dr. Anastasiia Zakharova.
162. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
163. Independent International Commission of Inquiry on Ukraine, A/ HRC/52/62549 (October 25, 2024), para. 25, https://www.ohchr.org/sites/default/files/documents/hrbodies/hrcouncil/coiukraine/A_79_4632_AUV.pdf; “Health cluster: Okhmatdyt children’s hospital attack response - Key figures and humanitarian efforts,” *Health Cluster Ukraine*, July 10, 2024, <https://reliefweb.int/report/ukraine/health-cluster-okhmatdyt-childrens-hospital-attack-response-key-figures-and-humanitarian-efforts>; Tetiana Oliynyk, “Boy dies in hospital after being injured in Russian attack on Okhmatdyt,” *Ukrainska Pravda*, July 10, 2024, <https://www.pravda.com.ua/eng/news/2024/07/10/7465054/>.
164. *Health Cluster Ukraine*; Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
165. “Russia’s July 8 Attack on a Children’s Hospital in Ukraine,” *Human Rights Watch*, July 11, 2024, <https://www.hrw.org/news/2024/07/11/russias-july-8-attack-childrens-hospital-ukraine>; Natalia Yermak, “Hard work underway to reopen Kyiv children’s hospital hit by Russian missile”, *Kyiv Independent*, July 17, 2024, <https://kyivindependent.com/hard-work-underway-to-reopen-kyiv-childrens-hospital-hit-by-russian-missile/>.
166. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
167. Interview with Dr. Lesia Lysytsia.
168. Interview with Dr. Lesia Lysytsia.
169. “Russians destroy 2 energy substations on premises of Okhmatdyt children’s hospital,” *Ukrainska Pravda*, July 9, 2024, <https://www.pravda.com.ua/eng/news/2024/07/9/7464822/>.
170. Yermak, “Hard work underway to reopen Kyiv children’s hospital hit by Russian missile”.
171. “627 children were in Okhmatdyt hospital during Russian attack, most have been discharged,” *Ukrainska Pravda*, July 9, 2024, <https://www.pravda.com.ua/eng/news/2024/07/9/7464833/>.
172. Interview with Dr. Lesia Lysytsia, conducted by the Truth Hounds on September 10, 2024 (on-file).
173. Interview with Dr. Lesia Lysytsia.
174. Yermak, “Hard work underway to reopen Kyiv children’s hospital hit by Russian missile”.
175. “Experts estimate Okhmatdyt Hospital restoration costs after Russian

Endnotes

continued

- missile attack," The New Voice of Ukraine, July 13, 2024, <https://english.nv.ua/nation/estimated-cost-of-restoring-okhmatdyt-children-s-hospital-destroyed-by-russian-missile-50434544.html>; Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
176. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
177. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file); Interview with Dr. Lesia Lystysia.
178. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
179. Interview with Dr. Lesia Lystysia, conducted by Truth Hounds on September 10, 2024 (on-file).
180. Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
181. Interview with Dr. Anastasiia Zakharova.
182. "Critical Conditions: Violence Against Health Care in Conflict," Safeguarding Health in Conflict Coalition, May 2024, <https://insecurityinsight.org/projects/healthcare/shcc>.
183. In Gaza, Israeli assaults have deprived the strip of even a single functioning hospital, see Mohamed Soulaïmane al-Astal, "Inside the siege on Gaza's largest remaining hospital," The New Humanitarian, February 12, 2024, <https://www.thenewhumanitarian.org/2024/02/12/inside-siege-gaza-largest-remaining-hospital-nasser-khan-younis>. Those that remain work with limited power, water, and supplies, see "Gaza's children running out of time: Water shortages spark disease alarm," UNICEF, November 21, 2023, <https://www.unicef.org/press-releases/gazas-children-running-out-time-water-shortages-spark-disease-alarm>, <https://www.unicef.org/press-releases/gazas-children-running-out-time-water-shortages-spark-disease-alarm>, "Barely a drop to drink": children in the Gaza Strip do not access 90 percent of their normal water use," UNICEF, December 20, 2023, <https://www.unicef.org/press-releases/barely-drop-drink-children-gaza-strip-do-not-access-90-cent-their-normal-water-use>.
184. "The Destruction of Hospitals – A Strategic Component in Regime Military Offensives," Physicians for Human Rights, <https://phr.org/issues/health-under-attack/attacks-in-syria/the-destruction-of-hospitals-a-strategic-component-in-regime-military-offensives/>; "Kafr Nabl Hospital: In the Crosshairs of a Murderous Barrage of Attacks," Physicians for Human Rights, <https://phr.org/issues/health-under-attack/attacks-in-syria/case-study-number-3/>; "Al-Quds Hospital: The Last Hospital Standing in Aleppo," Physicians for Human Rights, November 19, 2019, <https://phr.org/issues/health-under-attack/attacks-in-syria/al-quds-hospital-the-last-hospital-standing-in-aleppo/>; "Repeated attacks on underground medical facility demonstrate deliberate targeting," Physicians for Human Rights, <https://phr.org/issues/health-under-attack/attacks-in-syria/repeated-attacks-on-underground-medical-facility-demonstrate-deliberate-targeting/>. Of the 604 total attacks on health documented by Physicians for Human Rights in Syria to date, 80 percent were perpetrated by the Syrian government and/or Russian armed forces since October 2015 when Russia entered the conflict, with their scale, frequency and intensity peaking in the two years following Russian intervention, see "A Map of Attacks on Health Care in Syria," Physicians for Human Rights, Data as of March 5, 2024, <https://phr.org/our-work/resources/a-map-of-attacks-on-health-care-in-syria/>; "Expert Report to the U.N. Human Rights Committee on Russia's Attacks on Health Care in Syria," Physicians for Human Rights, May 2024, <https://phr.org/wp-content/uploads/2024/05/PHR-Syria-Expert-Report-HRC-May-2024-EN.pdf>; Rubenstein, Leonard, "Perilous Medicine: The Struggle to Protect Health Care from the Violence of War," New York Chichester, West Sussex: Columbia University Press, 2021, <https://doi.org/10.7312/rube19246>.
185. "Critical Conditions: Violence Against Health Care in Conflict," Safeguarding Health in Conflict Coalition, May 2024, <https://insecurityinsight.org/projects/healthcare/shcc>.
186. Garber K, Fox C, Addalla M, et al., "Estimating access to health care in Yemen, a complex humanitarian emergency setting: A descriptive applied geospatial analysis," Lancet Global Health 2020; 8: e1435-e1443, [https://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(20\)30359-4/fulltext](https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(20)30359-4/fulltext); "Aleppo abandoned: A case study on healthcare in Syria," Physicians for Human Rights, November 2015, <https://phr.org/wp-content/uploads/2015/11/aleppo-abandoned.pdf>; Hagopian A, Lafta R, Hassan J, et al., "Trends in childhood leukemia in Basrah, Iraq, 1993–2007," American Journal of Public Health 2010; 100: 1081-1087, <https://pmc.ncbi.nlm.nih.gov/articles/PMC2866604/>; Skelton M., "Iraqi's Cancer Itineraries: War, Medical Travel, and Therapeutic Geographies" in C Lutz, A Mazzarino (eds.), "War and Health: The Medical Consequences of the Wars in Iraq and Afghanistan," New York: New York University Press, 2019, pp. 152-171, https://www.researchgate.net/publication/341572090_Iraqis'_Cancer_Itineraries_War_Medical_Travel_and_Therapeutic_GeographiesWar_Medical_Travel_and_Therapeutic_Geographies.
187. "Health Workers at Risk: Violence Against Health Care," Safeguarding Health in Conflict Coalition, June 2020, <https://www.safeguardinghealth.org/sites/shcc/files/SHCC2020final.pdf>.
188. "Centers for Disease Control and Prevention. Status of public health - Bosnia and Herzegovina," August-September 1993. Morbidity and Mortality Weekly Report 1993; 42: 979-982, <https://www.cdc.gov/mmwr/preview/mmwrhtml/00031513.htm>.
189. "Barker Hypothesis," Dictionary of Public Health, Oxford Reference, <https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095447459>; Kimbrough W, Saliba V, Dahab M, et al., "The burden of tuberculosis in crisis-affected populations: A systematic review," Lancet Infectious Diseases 2012; 12: 950-965, <https://pubmed.ncbi.nlm.nih.gov/23174381/>; Ozaras R, Leblebicioglu H, Sunbul M, et al., "The Syrian conflict and infectious diseases," Expert Review of Anti-Infective Therapy 2016; 14: 547-555, <https://pubmed.ncbi.nlm.nih.gov/27063349/>.
190. Jenna M. Loyd, "A Microscopic Insurgent": Militarization, Health, and Critical Geographies of Violence," Annals of the Association of American Geographers, 2009, 99:5, 863-873, 867, DOI: 10.1080/00045600903253478; "Iraqi's Cancer Itineraries: War, Medical Travel, and Therapeutic Geographies".
191. "Attacks on Health Care in Ukraine," eyeWitness to Atrocities, Insecurity Insight, Media Initiative for Human Rights, Physicians for Human Rights, and Ukrainian Healthcare Center, Data as of July 31, 2024, <https://www.attacksonhealthukraine.org/>.
192. "Destruction and Devastation: One Year of Russia's Assault on Ukraine's Health Care System," eyeWitness to Atrocities, Insecurity Insight, Media Initiative for Human Rights, Physicians for Human Rights, and Ukrainian Healthcare Center, February 2023, <https://phr.org/our-work/resources/russias-assault-on-ukraines-health-care-system>.
193. "Coercion and Control: Ukraine's Health Care System under Russian Occupation," eyeWitness to Atrocities, Insecurity Insight, Media Initiative for Human Rights, and Physicians for Human Rights, December 2023, <https://phr.org/our-work/resources/coercion-and-control-ukraines-health-care-system-under-russian-occupation>.
194. "'Our City Was Gone': Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITU Research, Truth Hounds, February 2024, <https://truth-hounds.org/en/cases/our-city-is-gone-new-data-on-the-destruction-of-mariupol-by-russia-in-a-report-by-truth-hounds-human-rights-watch-and-situ-research/>.
195. "Attacks on Health Care Initiative," World Health Organization, July 22, 2020, <https://www.who.int/news-room/questions-and-answers/item/attacks-on-health-care-initiative>.
196. Haar R, Rayes D, Tappis H, et al. "The cascading impacts of attacks on health in Syria: A qualitative study of health system and community impacts," PLOS Glob Public Health, June 13, 2024, 2024;4(6): e0002967, doi:10.1371/journal.pgph.0002967
197. "Remote Assessment of Bombardment of Ukraine's Power Generation and Transmission Infrastructure, 1 October 2022 to 30 April 2023," p. 13.
198. "Damage to Ukraine's power, gas, and heating infrastructure exceeds \$10 billion, according to new assessment by UN Development Programme and World Bank," UNDP Resident Representative to Ukraine, April 5,

Endnotes

continued

- 2023, <https://www.undp.org/ukraine/press-releases/damage-ukraines-power-gas-and-heating-infrastructure-exceeds-10-billion-according-new-assessment-un-development-programme-and>.
199. "Almost 7 million children in Ukraine at risk as attacks on energy infrastructure cause widespread blackouts and disruption of heating and water," UNICEF, December 13, 2022, <https://www.unicef.org/press-releases/almost-7-million-children-ukraine-risk-attacks-energy-infrastructure-cause>.
200. "Statement – Winter in Ukraine: people's health cannot be held hostage," World Health Organization, November 21, 2022, <https://www.who.int/europe/news/item/21-11-2022-statement--winter-in-ukraine--people-s-health-cannot-be-held-hostage>.
201. "Attacks on Health Care in Ukraine". This information cited is based on reported incidents. The team has sought data from multiple sources, including audiovisual evidence, open-source research, and, where possible, interviews with Ukrainian healthcare workers. However, the ability to physically document and verify attacks on the ground remains complicated and impeded, constraining the scope of this analysis. To that end, the reported incidents are almost certainly an undercount.
202. "Attacks on Health Care in Ukraine".
203. For survey limitations, see section "Methodology". For the full findings of the survey, see section "Impact of attacks on energy infrastructure on health care".
204. In 13 incidents the type of explosives used was not recorded.
205. "Attacks on Health Care in Ukraine".
206. "Attacks on Health Care in Ukraine".
207. Incident 45515, "Attacks on Health Care in Ukraine"; "Dnipro is recovering from a massive drone attack. Some schools are on distance learning, patients evacuated from hospital," Dnipro Region, February 13, 2024, <https://region.dp.ua/dnipro-ohovtuitsia-vid-masovanoi-ataky-dronamy-deiaki-shkoly-na-dystantsijnomu-navchanni-patsientiv-zi-statsionaru-evakujovano/>.
208. Incident 45716, "Attacks on Health Care in Ukraine"; "Hospital and schools left without heating in Prykarpattia region after Russian missile attack," Ukrinform, March 22, 2024, <https://www.ukrinform.ua/rubric-regions/3843651-na-prikarpatti-pisla-raketnoi-ataki-rf-likarna-j-skolizalisila-bez-tepla.html>.
209. "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, <https://www.who.int/publications/i/item/9789240066960>, p.8; Reliable electricity is also integral to the WHO's health systems building blocks which are: leadership and governance, service delivery, health system financing, the health workforce, medical products, vaccines and technologies, and health information systems. See: "Health system building blocks," World Health Organization, accessed on September 17, 2024, <https://extranet.who.int/nhptool/BuildingBlock.aspx>.
210. "Mariupol: Why Mariupol is so important to Russia's plan," BBC, March 21, <https://www.bbc.com/news/world-europe-60825226>; "High Commissioner updates the Human Rights Council on Mariupol, Ukraine," OHCHR, June 16, 2022, <https://www.ohchr.org/en/statements/2022/06/high-commissioner-updates-human-rights-council-mariupol-ukraine>.
211. "'Our City Was Gone'. Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITU, Truth Hounds, 2024, p. 22, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf.
212. Joel Gunter, "Ukrainian city of Mariupol 'near to humanitarian catastrophe' after bombardment," BBC, March 2, 2022, <https://www.bbc.com/news/world-europe-60585603>.
213. Interview with the witness I-8375, conducted by Truth Hounds on September 23, 2022 (on-file).
214. Interview with the witness Y-1783, conducted by Truth Hounds on September 29, 2022 (on-file).
215. "'Our City Was Gone'. Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITU, Truth Hounds, 2024, p. 23, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf.
216. "High Commissioner updates the Human Rights Council on Mariupol, Ukraine," OHCHR, June 16, 2022, <https://www.ohchr.org/en/statements/2022/06/high-commissioner-updates-human-rights-council-mariupol-ukraine>; "Destruction of Healthcare in Mariupol, February 24 – May 20, 2022", Ukrainian Healthcare Center, January 2023, https://drive.google.com/file/d/1tJyaa_9eBF_lfkPiDb5i9D2BqB-2n5w/view; Poole, D., Andersen, D., et al. "The effect of conflict on medical facilities in Mariupol, Ukraine: a quasi-experimental study," Yale School of Public Health's Humanitarian Research Lab, August 7, 2023, <https://hub.conflictobservatory.org/portal/apps/sites/#/home/pages/medical-1>; Report of the Independent International Commission of Inquiry on Ukraine to the Human Rights Council (A/HRC/55/66), March 15, 2024, <https://documents.un.org/doc/undoc/gen/g24/037/31/pdf/g2403731.pdf>.
217. "Lost equipment and displaced doctors. How Mariupol regional hospital works in Kyiv," Suspilne Donbas, April 1, 2023, <https://suspilne.media/donbas/431571-vtracene-obladnanna-ta-mediki-pereseleenci-ak-oblasna-mariupolska-likarna-pracue-u-kievi/>; "On approval of the network of the municipal non-profit enterprise "Regional Intensive Care Hospital of Mariupol" for 2019," Order of the Donetsk Oblast State Administration no. 759 from October 1, 2019, <https://doz.donoda.gov.ua/wp-content/uploads/2019/10/Merezha-OLIL-Mariup.pdf>; "Competition for the position of Director of the municipal non-profit enterprise Regional Intensive Care Hospital of Mariupol," Donetsk Oblast State Administration, October 16, 2019, <https://dn.gov.ua/news/konkurs-na-zajnyattya-posadi-direktora-komunalnogo-nekomercijnogo-pidpriemstva-oblasna-likarnya-intensivnogo-likuvannya-m-mariupol/>; "Regional intensive care hospital from Mariupol reopens in Kyiv," Suspilne Kyiv, December 22, 2022, <https://suspilne.media/kyiv/344214-u-kievi-vidnovila-robotu-oblasna-likarna-intensivnogo-likuvannya-z-mista-mariupol/>.
218. Interview with Dr. Oksana Kyrsanova, conducted by the Media Initiative for Human Rights on March 19, 2022 (on-file); Interview with Dr. Oksana Kyrsanova, conducted by the Media Initiative for Human Rights on December 2, 2022 (on-file).
219. Dr. Kyrsanova did not remember the exact date but said that the missile hit the hospital before March 12, 2022. Interview with Dr. Oksana Kyrsanova, MIHR, December 2, 2022 (on-file). Other witnesses reported bombings in the area on March 10 and 11, 2022. See "They Drove a Tank and Two Armored Personnel Carriers and Started Shooting Houses Around... How the Russians Captured the Hospital in Mariupol, and What Happened There After That," 0629.com.ua Mariupol City Website, March 31, 2022, <https://www.0629.com.ua/news/3362062/voni-prignali-tank-i-dva-btra-i-pocali-rozstriluvati-budinki-navkolo-ak-rosiani-zahopili-likarnu-v-mariupoli-i-so-tam-vidbuvalos-pisla-cogo/>; "Armoury, Prison, Graveyard: Mariupol Intensive Care Hospital under Russian Occupation," International Partnership for Human Rights, Truth Hounds, Global Diligence, November 2022, https://www.iphronline.org/wp-content/uploads/2022/11/Mariupol-report_for_distribution_final_1.pdf. Other witnesses placed the attack on March 13. See "'Our City Was Gone'. Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITU, Truth Hounds, 2024, p. 49, p. 87, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf.
220. "Destruction and Devastation: One Year of Russia's Assault on Ukraine's Health Care System," eyeWitness to Atrocities, Insecurity Insight, Media Initiative for Human Rights, Physicians for Human Rights, and Ukrainian Healthcare Center, February 2023, <https://phr.org/our-work/resources/russias-assault-on-ukraines-health-care-system/>; Dr. Kyrsanova did not remember the exact date but said that the missile hit the hospital before March 12, 2022. Interview with Dr. Oksana Kyrsanova, MIHR, December 2, 2022 (on-file).
221. Interview with Dr. Oksana Kyrsanova, MIHR, March 19, 2022 (on-file); Interview with Dr. Oksana Kyrsanova, MIHR on December 2, 2022 (on-file).
222. Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024 (on-file).
223. "'Our City Was Gone'. Russia's Devastation of Mariupol, Ukraine," Human

Endnotes

continued

- Rights Watch, SITU, Truth Hounds, 2024, p. 21, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf.
224. Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024 (on-file).
225. Interview with the witness D-2594, conducted by Truth Hounds on June 23, 2023, (on-file).
226. Interview with the witness D-2594.
227. "Destruction and Devastation: One Year of Russia's Assault on Ukraine's Health Care System," eyeWitness to Atrocities, Insecurity Insight, the Media Initiative for Human Rights, Physicians for Human Rights, and the Ukrainian Healthcare Center, February 2023, <https://phr.org/our-work/resources/russias-assault-on-ukraines-health-care-system>; Interview with Dr. Oksana Kyrsanova, conducted by MIHR on March 19, 2022 (on-file); Interview with Dr. Oksana Kyrsanova, conducted by MIHR on December 2, 2022 (on-file).
228. "As a medical professional, I'd say it's just a disaster," Kommerstant, April 25, 2022, <https://www.kommerstant.ru/doc/5326872>
229. "Lost equipment and displaced doctors. How Mariupol regional hospital works in Kyiv", Suspilne Donbas, April 01, 2023, <https://suspilne.media/431571-vtracene-obladnanna-ta-mediki-pereselenci-ak-oblasna-mariupolska-likarna-pracue-u-kiievi/>; Mariupolska City Council, Telegram, Post on December 22, 2022, at 11:44, <https://t.me/mariupolrada/12175?single>.
230. "Lost equipment and displaced doctors. How Mariupol regional hospital works in Kyiv", Suspilne Donbas, April 01, 2023, <https://suspilne.media/431571-vtracene-obladnanna-ta-mediki-pereselenci-ak-oblasna-mariupolska-likarna-pracue-u-kiievi/>.
231. Interview with Dr. Olena Lazariyeva, conducted by Truth Hounds on August 25, 2024 (on-file).
232. Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024 (on file).
233. Interview with Dr. Olena Lazariyeva, conducted by Truth Hounds on August 25, 2024 (on-file).
234. Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024 (on file).
235. Interview with Dr. Olena Lazariyeva, conducted by Truth Hounds on August 25, 2024 (on-file).
236. Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024 (on file).
237. This is because wages are dependent on the volume of doctor-patient interactions. Interview with Dr. Olena Lazariyeva, conducted by Truth Hounds on August 25, 2024 (on-file).
238. Interview with Dr. Olena Lazariyeva, conducted by Truth Hounds on August 25, 2024 (on-file).
239. Interview with Dr. Olena Lazariyeva, conducted by Truth Hounds on August 25, 2024 (on-file).
240. Interview with Dr. Olena Lazariyeva.
241. Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024 (on-file).
242. Anesi GL, Lynch Y, Evans L. "A Conceptual and Adaptable Approach to Hospital Preparedness for Acute Surge Events Due to Emerging Infectious Diseases," *Crit Care Explor.* 2020;2(4):e0110. Published 2020 Apr 29. doi:10.1097/CCE.0000000000000110
243. Okie S. Dr. Pou and the Hurricane - Implications for Patient Care during Disasters. *New England Journal*; Anderson GB, Bell ML., "Lights out: impact of the August 2003 power outage on mortality in New York, NY," *Epidemiology.* 2012;23(2):189-193. doi:10.1097/EDE.0b013e318245c61c; "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, <https://www.who.int/publications/i/item/9789240066960>; "The Deadly Choices at Memorial," *The New York Times*, August 1, 2009, <https://www.nytimes.com/2009/08/30/magazine/30doctors.html>.
244. Interview with the witness K-3561, conducted by Truth Hounds on September 5, 2024 (on-file).
245. "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, <https://www.who.int/publications/i/item/9789240066960>.
246. Sell, Tara & Lien, Onora & Toner, Eric. "A Framework for Healthcare Resilience During Widespread Electrical Power Loss," *Journal of Critical Infrastructure Policy*, Volume 1, Number 1, August 2020, 10.18278/jcip.1.1.3.
247. "Ohio Fertility Clinic Says 4,000 Eggs And Embryos Destroyed When Freezer Failed," NPR, March 28, 2018, <https://www.npr.org/sections/thetwo-way/2018/03/28/597569116/ohio-fertility-clinic-says-4-000-eggs-and-embryos-destroyed-when-freezer-failed>.
248. Granholm et. al. "Critical Energy Infrastructure and Health: How Loss of Power May Kill", *Prehosp Disaster Med.* 2023;38(2):279-280, <https://pubmed.ncbi.nlm.nih.gov/36872453/>.
249. "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, p. 48, <https://www.who.int/publications/i/item/9789240066960>.
250. "Electronic Health Care System," Ministry of Health of Ukraine, accessed September 18, 2024, <https://moz.gov.ua/uk/elektronna-sistema-ohoroni-zdorovya>.
251. "Sector Resilience Report: Hospitals," US Department of Homeland Security, National Protection and Programs Directorate, December 19, 2014, <https://www.hsd.org/c/view?docid=763639>.
252. Granholm et. al. "Critical Energy Infrastructure and Health: How Loss of Power May Kill", *Prehosp Disaster Med.* 2023;38(2):279-280, <https://pubmed.ncbi.nlm.nih.gov/36872453/>; "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, <https://www.who.int/publications/i/item/9789240066960>, p. XXVI; Sell, Tara & Lien, Onora & Toner, Eric. "A Framework for Healthcare Resilience During Widespread Electrical Power Loss," *Journal of Critical Infrastructure Policy*, Volume 1, Number 1, August 2020, 10.18278/jcip.1.1.3.
253. "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, <https://www.who.int/publications/i/item/9789240066960>.
254. "Ukrainian hospitals are preparing for the heating season to increase their resilience during possible enemy attacks in winter - Viktor Liaszko," Ministry of Health of Ukraine, June 28, 2024, <https://moz.gov.ua/uk/trivaye-pidgotovka-ukrayinskih-likaren-do-opalyvalnogo-sezonu-shobi-pidvishiti-yih-stijkist-pid-chas-mozhliivih-atak-voroqa-vzimku-viktor-lyashko>
255. "The Cabinet of Ministers has ordered the massive installation of solar panels with batteries for hospitals and schools," *Business Censor*, August 9, 2024, https://biz.censor.net/news/3503918/uryad_doruchyv_vstanovyty_sonyachni_paneli_z_akumulyatoramy_na_shkolah_i_likarnyah.
256. Granholm et. al. "Critical Energy Infrastructure and Health: How Loss of Power May Kill", *Prehosp Disaster Med.* 2023;38(2):279-280, <https://pubmed.ncbi.nlm.nih.gov/36872453/>.
257. "A Case of a Power Failure in the Operating Room - PMC (nih.gov)," <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2527046/>
258. Two cases of organ damage due to lack of dialysis were reported by health care providers at the same facility, four cases of organ damage from delayed surgeries were reported by four providers across two facilities, and two cases of organ damage from other life-saving equipment failures were reported by providers at the same facility.
259. No cause of death was reported more than once from the same facility.
260. Interview with the witness K-3561, conducted by Truth Hounds on September 5, 2024 (on-file).
261. Granholm et. al. "Critical Energy Infrastructure and Health: How Loss of Power May Kill", <https://pubmed.ncbi.nlm.nih.gov/36872453/>; Casey JA, Fukurai M, Hernández D, Balsari S, Kiang MV. "Power Outages and Community Health: a Narrative Review," *Curr Environ Health Rep.*

Endnotes

continued

- 2020;7(4):371-383. doi:10.1007/s40572-020-00295-0. For instance, the August 2023 power outage in New York City (USA) led to increases in accidental deaths and injuries, while also straining emergency services, and limiting access to primary care, see Anderson GB, Bell ML, "Lights out: impact of the August 2003 power outage on mortality in New York, NY," *Epidemiology*. 2012;23(2):189-193. doi:10.1097/EDE.0b013e318245c61c. When the results of the analysis of this blackout were applied to other large and localized outages in New York City, it was found that power outages during cold seasons were associated with an increase in mortality due to dangerous exposure to lower temperatures, see Casey JA, Fukurai M, Hernández D, Balsari S, Kiang MV. "Power Outages and Community Health: a Narrative Review," *Curr Environ Health Rep*. 2020;7(4):371-383. doi:10.1007/s40572-020-00295-0. Also see: Klinger C, Landeg O, Murray V. "Power outages, extreme events and health: a systematic review of the literature from 2011-2012." *PLoS Curr*. 2014; 6:ecurrents.dis.04eb1dc5e73dd1377e05a10e9edde673. Published January 2, 2014. doi:10.1371/currents.dis.04eb1dc5e73dd1377e05a10e9edde673.
262. National Health Service of Ukraine, Dashboard "Statistics on electronic medical records in the Electronic Health Records", as of October 30, 2024, <https://edata.e-health.gov.ua/e-data/dashboard/emz-stats>.
263. "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, p. 2, <https://www.who.int/publications/i/item/9789240066960>.
264. Koroglu M, Irwin BR, Grépin KA. "Effect of power outages on the use of maternal health services: evidence from Maharashtra, India," *BMJ Glob Health*. 2019;4(3):e001372. Published 2019 Jun 4. doi:10.1136/bmjgh-2018-001372.
265. Casey JA, Fukurai M, Hernández D, Balsari S, Kiang MV. "Power Outages and Community Health: a Narrative Review," *Curr Environ Health Rep*. 2020;7(4):371-383. doi:10.1007/s40572-020-00295-0.
266. "Energizing health: accelerating electricity access in health-care facilities," World Health Organization, 2023, p. 4, <https://www.who.int/publications/i/item/9789240066960>.
267. Interview with Dr. Yevheniia Poliakovska, conducted by Truth Hounds on September 30, 2024 (on-file).
268. Interview with Dr. Yevheniia Poliakovska.
269. Interview with Dr. Yevheniia Poliakovska.
270. Interview with Dr. Yevheniia Poliakovska.
271. Interview with Dr. Yevheniia Poliakovska.
272. Adam X Andresen et al. "Understanding the social impacts of power outages in North America: a systematic review," *Environ. Res. Lett.*, May 2023, 10.1088/1748-9326/acc7b9.
273. Molinari NA, Chen B, Krishna N, Morris T. "Who's at Risk When the Power Goes Out? The At-home Electricity-Dependent Population in the United States, 2012," *J Public Health Manag Pract*. 2017;23(2):152-159. doi:10.1097/PHH.0000000000000345.
274. Gul Tuysuz, Pierre Bairin, Svitlana Vlasova and Will Ripley, "Blackouts pose potentially deadly risk to Ukrainians who need power for lifesaving medical devices," *CNN World*, December 27, 2022, <https://edition.cnn.com/2022/12/27/europe/ukraine-blackout-medical-risks-intl-cmd/index.html>.
275. Adam X Andresen et al., "Understanding the social impacts of power outages in North America: a systematic review," *Environ. Res. Lett.*, May 2023, 10.1088/1748-9326/acc7b9.
276. "Powering the Health Sector – Annex A - Literature Review," GVEP, p.12, January 2013, <https://assets.publishing.service.gov.uk/media/57a08a09e5274a31e00003ba/61311-LiteratureReview.pdf>
277. Marc Santora and Thomas Gibbons-Neff, "'Every hour is getting harder': Surgeons in Ukraine struggle to operate when the power goes out," *The New York Times*, November 24, 2022, <https://www.nytimes.com/2022/11/24/world/europe/ukraine-power-outages-hospitals.html>; Oksana Ruda, "Surgey seen by the whole world: how Ukrainian doctors with flashlights save lives during blackout," *TSN*, November 25, 2022, <https://tsn.ua/exclusive/operaciya-yaku-pobachiv-uves-svit-yak-ukrayinski-likari-z-lihtarikami-ryatuyut-zhittya-pid-chas-blekautu-2209219.html>; Iryna Sysak, "How Ukrainian Heart Surgeons Keep Operating Amid Blackouts," *Radio Free Liberty Europe*, January 11, 2023, <https://www.rferl.org/a/ukraine-war-kyiv-surgeons-blackouts-/32218789.html>.
278. Ben Farmer, "Caesareans by torchlight: Ukraine's doctors are operating without electricity," *The Telegraph*, December 2, 2022, <https://www.telegraph.co.uk/global-health/terror-and-security/lights-ukraines-doctors-face-darkest-days-war-russia/>; "How Lutsk polyclinics work during power outages and air raid alerts," *Volynska Sluzhba Novyn*, November 17, 2022, <https://vsn.ua/news/yak-pratsuyut-lutski-polikliniki-pid-chas-vidklyuchennya-svitla-ta-povitryaniy-trivozi-14261>.
279. "Natalia Husak, "Head of the National Health Service of Ukraine: We expect that in 2023 we will have the first signed agreements with medical institutions in Crimea," *UkrInform*, February 16, 2023, <https://www.ukrinform.ua/rubric-health/3670456-natalia-gusak-golovna-nacionalnoi-sluzbi-zdorova-ukraini.html>.
280. "Healthcare at War: The impact of Russia's full-scale invasion on the Healthcare in Ukraine," *Ukrainian Healthcare Center*, April 2023, https://drive.google.com/file/d/1dZQHq_aSdY9xOiJwz6nM_G3fW5ny3OI/view.
281. Naushad, Vamanjore Aboobaker, Joost JLM Bierens, et al, "A Systematic Review of the Impact of Disaster on the Mental Health of Medical Responders," *Prehospital and Disaster Medicine* 34, no. 6 (2019): 632–43. <https://doi.org/10.1017/S1049023X19004874>.
282. Casey JA, Fukurai M, Hernández D, Balsari S, Kiang MV, "Power Outages and Community Health: a Narrative Review," *Curr Environ Health Rep*. 2020;7(4):371-383. doi:10.1007/s40572-020-00295-0; Adam X Andresen et al. "Understanding the social impacts of power outages in North America: a systematic review," *Environ. Res. Lett.*, May 2023, 10.1088/1748-9326/acc7b9.
283. Interview with witness K-3561, conducted by Truth Hounds on September 5, 2024 (on-file).
284. Interview with Dr. Yevheniia Poliakovska, conducted by Truth Hounds on September 30, 2024 (on-file).
285. "Renewed focus on health critical as Ukraine approaches third winter amid full-scale war. Statement by WHO Regional Director for Europe, Dr Hans Henri P. Kluge," *World Health Organization*, September 12, 2024, <https://www.who.int/europe/news/item/12-09-2024-statement--renewed-focus-on-health-critical-as-ukraine-approaches-third-winter-amid-full-scale-war>.
286. An international armed conflict exists if one state uses force of arms against another state. This also applies to all cases of total or partial military occupation, even if the said occupation meets with no armed resistance. See Article 2 common to the Geneva Conventions.
287. The four Geneva Conventions of 1949 have been ratified by 196 countries, including Russia and Ukraine, both of which also ratified Additional Protocol I of 1977.
288. The Hague Convention of 1899 and The Hague Convention IV of 1907 and annexed regulations on the Laws and Customs of War on Land have been ratified by Russia and Ukraine. The two versions differ only slightly from each other. See ICRC, "Convention (IV) respecting the Laws and Customs of War on Land and its Annex," access October 4, 2024, <https://ihl-databases.icrc.org/en/ihl-treaties/hague-conv-iv-1907?activeTab=default>.
289. See ICRC, Customary IHL Database, access October 4, 2024, <https://ihl-databases.icrc.org/en/customary-ihl>.
290. ICJ, Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996, paras 78–79, <https://www.icj-cij.org/case/95>.
291. International Committee of the Red Cross (ICRC), "Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts," June 8, 1977, 1125 UNTS 3 (Additional Protocol I), Article 48; ICRC, Customary International Humanitarian Law, Rules 1, 7, accessed January 16, 2023, <https://ihl-databases.icrc.org/en/customary-ihl/v1>. Russia's and Ukraine's military

Endnotes

continued

- manuals specifically provide for the principle of distinction. See ICRC, "Practice relating to Rule 7 (Russian Federation)," accessed January 16, 2023, <https://ihl-databases.icrc.org/en/customary-ihl/v2/rule7?country=ru>; see ICRC, "Practice relating to Rule 7 (Ukraine)," accessed January 16, 2023, <https://ihl-databases.icrc.org/en/customary-ihl/v2/rule7?country=ua>; Additional Protocol I, Article 51(3); ICRC, Customary International Humanitarian Law, Rules 6, 10.
293. Additional Protocol I, Article 51(4).
294. Additional Protocol I, Article 51(4)(a).
295. Commentary on the Geneva Convention, 1987 (the "Commentary") at 600.
296. Commentary on the Geneva Convention.
297. Ukrainian energy sector evaluation and damage assessment - VII (as of February 24, 2023), p. 3.
298. UN HRMMU, p. 1; survey data.
299. UN HRMMU, p. 11.
300. Additional Protocol I, Article 51(5)(b).
301. Additional Protocol I, Article 51(5)(b).
302. Additional Protocol I, Article 57(2)(a)(ii)-(iii).
303. "Report on Violations of International Humanitarian and Human Rights Law, War Crimes and Crimes against Humanity Committed in Ukraine since 24 February 2022," Organization for Security and Co-operation in Europe, April 22, 2022, p. 29, <https://www.osce.org/files/f/documents/f/a/515868.pdf>.
304. Katanga ICC-01/04-01/07 at para. 893; ICRC 1987 Commentary on Additional Protocol I, para. 2209; ICRC, "The principles of proportionality in the rules governing the conduct of hostilities under international humanitarian law (International Expert Meeting), 2016)," p. 18.
305. "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Kuzhugetovich Shoigu and Valery Vasilyevich Gerasimov," International Criminal Court, July 25, 2024, <https://www.icc-cpi.int/news/situation-ukraine-icc-judges-issue-arrest-warrants-against-sergei-kuzhugetovich-shoigu-and-situation-in-ukraine-icc-judges-issue-arrest-warrants-against-sergei-ivanovich-kobylash-and-viktor-nikolayevich-sokolov>, March 5, 2024, <https://www.icc-cpi.int/news/situation-ukraine-icc-judges-issue-arrest-warrants-against-sergei-ivanovich-kobylash-and>.
306. See Bogdan Miroshnichenko, "Blackouts at defense plants. Are weapons manufacturers ready for blackouts?," Ekonomichna Pravda, May 28, 2024, <https://www.epravda.com.ua/news/2024/05/28/714364/>; G.B. Kravchenko, G.I. Lagutin, "General Requirements for Power Supply Systems of Defense Complexes and Military Equipment," Collection of scientific works of Kharkiv Air Force University, (4), 177-179, 2010.
307. "The Cabinet of Ministers has named the priority objects for energy supply - resolutions," Interfax – Ukraine, May 27, 2024, <https://interfax.com.ua/news/general/989551.html>.
308. "Blackouts at defense plants. Are weapons manufacturers ready for blackouts?," Ekonomichna Pravda, May 2024, <https://www.epravda.com.ua/news/2024/05/28/714364/>.
309. Eirini Giorgou and Abby Zeith, "When the lights go out: the protection of energy infrastructure in armed conflict".
310. UN HRMMU, p. 11.
311. Additional Protocol I, Article 57(1); ICRC, Customary International Humanitarian Law, Rule 15. See also ICRC, "Practice relating to Rule 15 (Russian Federation)," accessed January 16, 2023, <https://ihl-databases.icrc.org/en/customary-ihl/v2/rule15?country=ru>; ICRC, "Practice relating to Rule 15 (Ukraine)," accessed January 16, 2023, <https://ihl-databases.icrc.org/en/customary-ihl/v2/rule15?country=ua>.
312. Additional Protocol I, Article 57(2)(a)(i); ICRC, Customary International Humanitarian Law, Rules, 16, 18, 19, 20.
313. UN HRMMU, p. 11.
314. UN HRMMU.
315. UN HRMMU.
316. Health care facilities may lose their legal protection in narrow circumstances, and only then after proper warning has been given. Article 19 of the First Geneva Convention holds that "protection to which civilian hospitals are entitled shall not cease unless they are used to commit, outside their humanitarian duties, acts harmful to the enemy." There is no set definition as to what constitutes "acts harmful to the enemy." But examples of acts that are not "harmful to the enemy" - including using small arms in self-defense, actions to defend the sick and wounded and the presence of sick or wounded combatants under treatment, or of small arms and ammunition taken from these combatants but not yet handed over to proper service - make clear that the term is narrow. See Additional Protocol I, Article 13(2). Moreover, even when a health care facility loses its protected status by being the site of "acts harmful to the enemy," the attacking party must still give the health facility warning of attack within, where appropriate, "a reasonable time limit" of the attack. See First Geneva Convention Article 19.
317. ICRC, Geneva Convention Relative to the Protection of Civilian Persons in Time of War (Fourth Geneva Convention), 75 UNTS 287, 12 August 1949, Article 19.
318. Additional Protocol I to the Geneva Conventions, Article 49(1).
319. U.S. Dept. of Defense, Law of War Manual, § 7.10; see also International Committee of the Red Cross (ICRC) 2016 Commentary, para. 1799.
320. General Assembly: Human Rights Council, 55th Session, Agenda item 5, para. 38-9; Organization for Security and Co-operation in Europe Office for Democratic Institutions and Human Rights, Report on Violations of International Humanitarian and Human Rights Law, War Crimes and Crimes Against Humanity Committed in Ukraine since February 24, 2022, pp. 46-7.
321. Interview with Dr. Oksana Kyrsanova, MIHR, December 2, 2022 (on-file). Other witnesses reported bombings in the area on March 10 and 11, 2022. See "They Drove a Tank and Two Armored Personnel Carriers and Started Shooting Houses Around... How the Russians Captured the Hospital in Mariupol, and What Happened There After That," 0629.com.ua Mariupol City Website, March 31, 2022, <https://www.0629.com.ua/news/3362062/voni-prignali-tank-i-dva-btra-i-pocali-rozstriluvati-budinki-navkolo-akrosiani-zahopili-likarnu-v-mariupoli-i-so-tam-vidbuvalos-pisla-cogo>; "Armoury, Prison, Graveyard: Mariupol Intensive Care Hospital under Russian Occupation," International Partnership for Human Rights, Truth Hounds, Global Diligence, November 2022, https://www.iphonline.org/wp-content/uploads/2022/11/Mariupol-report_for_distribution_final_1.pdf. Other witnesses placed the attack on March 13. See "'Our City Was Gone': Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITEU, Truth Hounds, 2024, p. 49, p. 87, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf; Interview with Dr. Lesia Lysytsia, conducted by the Truth Hounds on September 10, 2024 (on-file); "Russia's July 8 Attack on a Children's Hospital in Ukraine," Human Rights Watch, July 11, 2024, <https://www.hrw.org/news/2024/07/11/russias-july-8-attack-childrens-hospital-ukraine>; Interview with Witness K-3561, conducted by Truth Hounds on September 05, 2024 (on-file).
322. "The largest children's hospital in Ukraine continues to operate and provide care to children despite the power outage," Okhmatdyt, November, 24, 2022, <https://ohmatdyt.com.ua/najbilsha-dityacha-likarnya-ukrayini-prodovzhuye-pratsyuvati-ta-nadavati-dopomogu-dityam-nezvzhayuchina-vimknennya-svitla/>; Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
323. Interview with Dr. Yevheniia Poliakova, conducted by Truth Hounds on September 30, 2024 (on-file).
324. Interview with witness K-3561, conducted by Truth Hounds on September 5, 2024 (on-file).
325. Interview with witness K-3561, conducted by Truth Hounds on September 5, 2024 (on-file); Interview with the witness W-5748, conducted by Truth Hounds on September 18, 2024, on file; Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file); Kyporenko, "The Fight to Save Lives in Ukraine's Largest Children's Hospital".
326. Interview with witness W-5748, conducted by Truth Hounds on September 18, 2024 (on-file).

Endnotes

continued

327. Interview with Dr. Olena Lazariyeva, conducted by Truth Hounds on August 25, 2024 (on-file).
328. Survey data.
329. Interview with witness W-5748, conducted by Truth Hounds on September 18, 2024 (on-file); Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file); Interview with witness K-3561, conducted by Truth Hounds on September 5, 2024 (on-file); Interview with Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file).
330. Interview with witness W-5748; Interview with Dr. Lesia Lysytsia; Interview with witness K-3561.
331. See Bogdan Miroshnichenko, "Blackouts at defense plants. Are weapons manufacturers ready for blackouts?," *Ekonomichna Pravda*, May 28, 2024, <https://www.epravda.com.ua/news/2024/05/28/714364/>; G.B. Kravchenko, G.I. Lagutin, "General Requirements for Power Supply Systems of Defense Complexes and Military Equipment," *Collection of scientific works of Kharkiv Air Force University*, (4), 177-179, 2010; "The Cabinet of Ministers has named the priority objects for energy supply - resolutions," *Interfax – Ukraine*, May 27, 2024, <https://interfax.com.ua/news/general/989551.html>
332. See, e.g. Kateryna Hodunova, "Russia has destroyed all thermal power plants, nearly all hydroelectric capacity in Ukraine ahead of winter, Zelensky says", September 25, 2024, <https://kyivindependent.com/russia-destroys-all-thermal-power-plants-nearly-all-hydroelectric-capacity-in-ukraine-ahead-of-winter-zelensky-says/>; "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population", p.2; "Ukrainian energy sector evaluation and damage assessment - VII, as of February 24, 2023," p. 3.
333. Additional Protocol I, Article 57(2)(a)(i); ICRC, Customary International Humanitarian Law, Rules, 16, 18, 19, 20.
334. UN HRMMU at 3; "Ukrainian energy sector evaluation and damage assessment - VII as of February 24, 2023," p. 3.
335. Commentary of 1987 on Additional Protocol I, note 3(b) to Article 52.
336. Additional Protocol I, Article 52(2), <https://ihl-databases.icrc.org/ihl/WebART/470-750067>; Customary IHL, rule 8, https://ihl-databases.icrc.org/customary-ihl/eng/docs/v1_rul_rule8.
337. Bruderlein, Claude, "Manual on International Law Applicable to Air and Missile Warfare," rule 22(c), 2013, https://www.researchgate.net/profile/Claude-Bruderlein/publication/264036862_Manual_on_International_Law_Applicable_to_Air_and_Missile_Warfare/links/59a911d50f7e9b27900e2f0e/Manual-on-International-Law-Applicable-to-Air-and-Missile-Warfare.pdf.
338. "Manual on International Law Applicable to Air and Missile Warfare"; "The Additional Protocols at 40: Achievements and Challenges," ICRC, pp 139-50, https://www.coleurope.eu/sites/default/files/uploads/page/collegium_48_webversie.pdf.
339. Eirini Giorgou, Abby Zeith, "When the lights go out: the protection of energy infrastructure in armed conflict," *Humanitarian Law and Policy*, April 20, 2023, <https://blogs.icrc.org/law-and-policy/2023/04/20/protection-energy-infrastructure-armed-conflict/>.
340. "When the lights go out: the protection of energy infrastructure in armed conflict".
341. International Humanitarian Law Database: Customary IHL, ICRC, Rule 54; Additional Protocol I, Article 56.
342. International Humanitarian Law Database: Customary IHL, ICRC, Rule 54.
343. Additional Protocol I, Article 56.
344. Michael N. Schmitt, "Ukraine Symposium – Attacking Power Infrastructure under International Humanitarian Law," *Lieber Institute*, West Point, October 20, 2022, <https://lieber.westpoint.edu/attacking-power-infrastructure-under-international-humanitarian-law/>; Hodunova.
345. UN HRMMU, p. 1.
346. Survey data.
347. "Ukrainian energy sector evaluation and damage assessment – II, as of September 24, 2022," p. 4; Kateryna Denisova, "Zaporizhzhia nuclear plant 'on verge of blackout' after Russian attack on substation, Ukraine says," *Kyiv Independent*, October 1, 2024, <https://kyivindependent.com/russian-attack-on-substation-cuts-off-power-line-to-occupied-zaporizhzhia-nuclear-plant-kyiv-says/>.
348. "International Criminal Law," ICRC, https://casebook.icrc.org/a_to_z/glossary/international-criminal-law.
349. Additional Protocol I Article 85(3)(a); Rome Statute Article 8(2)(b)(i)-(ii).
350. ICRC, Geneva Convention Relative to the Protection of Civilian Persons in Time of War (Fourth Geneva Convention), 75 UNTS 287, 12 August 1949, Article 19.
351. Rome Statute Article 8(b)(2)(xxiv).
352. Additional Protocol I, Annex I, Article 3.
353. Additional Protocol I, Annex I, Article 3.
354. Additional Protocol I, Article 52(2), <https://ihl-databases.icrc.org/ihl/WebART/470-750067>; Customary IHL, rule 8, https://ihl-databases.icrc.org/customary-ihl/eng/docs/v1_rul_rule8.
355. Commentary of 1987 to Additional Protocol I para. 3474; CTY, Prosecutor v. Stanislav Galic, Judgement and opinion, Trial Chamber, 5 December 2003; IT-98-29-T at para 57.
356. Commentary of 1987 Additional Protocol I para 3474.
357. The Prosecutor v. Germain Katanga ICC-01/04-01/07 (Int'l Criminal Court March 27, 2014) at para 807.
358. See, for example, The Prosecutor v. Radovan Karadžić, Case no. MICT-13-55-A, Judgment, March 20, 2019, para. 496; Prosecutor v. Germain Katanga, Case. No. ICC-01/04-01/07, Judgment, 07 March 2024, para. 802; The Prosecutor v. Bosco Ntaganda, Case no. ICC-01/04-02/06 A, Situation in the Democratic Republic of the Congo in the case of The Prosecutor v. Bosco Ntaganda, March 30, 2021, paras. 490-491.
359. "Boy dies in hospital after being injured in Russian attack on Okhmatdyt"; "Russian Missile Identified in Kyiv Children's Hospital Attack".
360. "Russian Missile Identified in Kyiv Children's Hospital Attack"; Air Force of the Armed Forces of Ukraine
361. Valentyna Romanenko, "Russian strike on Okhmatdyt hospital: experts identify more than 30 parts and fragments of Kh-101 missile – photos", *Ukrainska Pravda*, July 10, 2024, <https://www.pravda.com.ua/eng/news/2024/07/10/7464979/>.
362. "Russian Missile Identified in Kyiv Children's Hospital Attack"; Air Force of the Armed Forces of Ukraine, Telegram, Post from July 8, 2024, at 14:54, <https://t.me/kpszs/16341>.
363. Ivashkiv Olena, "Russian officials fail to coordinate their statements on Okhmatdyt children's hospital at UN", *Ukrainska Pravda*, July 18, 2024, <https://www.pravda.com.ua/eng/news/2024/07/18/7466232/>.
364. "Russian Missile Identified in Kyiv Children's Hospital Attack"; Air Force of the Armed Forces of Ukraine, Telegram, Post from July 8, 2024 at 14:54, <https://t.me/kpszs/16341>; Michael Sheldon, *Bellingcat*, July 9, 2024, <https://www.bellingcat.com/news/2024/07/09/russian-missile-identified-in-kyiv-childrens-hospital-attack/>. For detailed analysis, see Annex II.
365. See Ivashkiv Olena, "Russian officials fail to coordinate their statements on Okhmatdyt children's hospital at UN", *Ukrainska Pravda*, July 18, 2024, <https://www.pravda.com.ua/eng/news/2024/07/18/7466232/>.
366. Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
367. Interview with Dr. Lesia Lysytsia; Interview of Dr. Anastasiia Zakharova, conducted by Truth Hounds on September 6, 2024 (on-file); "Health cluster: Okhmatdyt children's hospital attack response - Key figures and humanitarian efforts".
368. Rome Statute, Article 8(b)(2)(xxiv).
369. Babel, Telegram, Post from September 10, 2024, at 13:23, <https://t.me/babel/56502>.
370. "Situation in Ukraine: ICC judges issue arrest warrants against Sergei

Endnotes

continued

- Ivanovich Kobylash and Viktor Nikolayevich Sokolov," International Criminal Court, March 5, 2024, <https://www.icc-cpi.int/news/situation-ukraine-icc-judges-issue-arrest-warrants-against-sergei-ivanovich-kobylash-and>.
371. "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Ivanovich Kobylash and Viktor Nikolayevich Sokolov".
372. See, e.g., Sarah Fowles, "Zaporizhzhia strike kills newborn baby at Ukraine hospital," BBC, November 23, 2022, <https://www.bbc.com/news/world-europe-63727260>; "Russian double-tap attack on Sumy hospital kills 10, injures 22, officials say," Kyiv Independent, September 28, 2024, <https://kyivindependent.com/russian-double-tap-attack-on-sumy-hospital-kills-6-injures-1-interior-minister-says/>.
373. Interview with witness K-3561; Interview with Dr. Yevheniia Poliakova, conducted by Truth Hounds on September 30, 2024 (on-file); Interview with Dr. Oksana Kyrsanova, conducted by the Media Initiative for Human Rights on March 19, 2022 (on-file); Interview with Dr. Oksana Kyrsanova, conducted by the Media Initiative for Human Rights on December 2, 2022 (on-file).
374. "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Kuzhugetovich Shoigu and Valery Vasilyevich Gerasimov," International Criminal Court, July 25, 2024, <https://www.icc-cpi.int/news/situation-ukraine-icc-judges-issue-arrest-warrants-against-sergei-kuzhugetovich-shoigu-and>; "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Ivanovich Kobylash and Viktor Nikolayevich Sokolov," International Criminal Court, March 5, 2024, <https://www.icc-cpi.int/news/situation-ukraine-icc-judges-issue-arrest-warrants-against-sergei-ivanovich-kobylash-and>.
375. UN HRMMU, p. 1-2.
376. UN HRMMU; "Ukrainian energy sector evaluation and damage assessment - VII (as of February 24, 2023)," p. 3.
377. UN HRMMU, p. 3; "Ukraine war latest: Russia launches largest aerial attack on Ukraine so far," The Kyiv Independent, August 26, 2024, <https://kyivindependent.com/ukraine-war-latest-aug-26-2024/>.
378. See UN HRMMU.
379. Art 8(b)(iv).
380. Office of the Prosecutor, International Criminal Tribunal for the Former Yugoslavia (ICTY): Final Report to the Prosecutor by the Committee Established to Review the NATO Bombing Campaign Against the Federal Republic of Yugoslavia, 39 INT'L LEGAL MATERIALS 1257 (2000); see also Galic IT-98-29-T at para 58.
381. Cf. Additional Protocol I, Article 85 3(b), which defines as a grave breach of the Geneva Conventions the launching of "an indiscriminate attack affecting the civilian population or civilian objects in the knowledge that such attack will cause excessive loss of life, injury to civilians or damage to civilian objects." This definition requires, like that of the Rome Statute, the mens rea of knowing, but, unlike the Rome Statute, requires actual harm to occur for the launching of a disproportionate attack to be culpable. Additional Protocol I, Article 85(3), chapeau. Though referring to the notion of indiscriminate attack, discussed in IV.C, supra, the definition explicitly and in primary part criminalizes disproportionate attacks as defined in Article 57(2)(iii).
382. International Humanitarian Law Databases: Customary IHL, Rule 14, ICRC, <https://ihl-databases.icrc.org/en/customary-ihl/v1/rule14>.
383. Katanga ICC-01/04-01/07 at para. 893; ICRC 1987 Commentary on Additional Protocol I, para. 2209; ICRC, "The principles of proportionality in the rules governing the conduct of hostilities under international humanitarian law (International Expert Meeting), 2016," p. 18.
384. "Ukraine Symposium – Attacking Power Infrastructure under International Humanitarian Law."
385. "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Kuzhugetovich Shoigu and Valery Vasilyevich Gerasimov"; "Situation in Ukraine: ICC judges issue arrest warrants against Sergei Ivanovich Kobylash and Viktor Nikolayevich Sokolov."
386. A/HRC/52/62 at paras. 41-3.
387. Francis Scarr, X, Post from November 26, 2022 at 10:17, <https://x.com/i/status/1596417788616536064>; Francis Scarr, X, Post from November 26, 2022 at 10:45, https://x.com/francis_scarr/status/1597149654793478144.
388. A/HRC/52/62 at para. 41.
389. See generally, UN HRMMU; "Remote Assessment of Bombardment of Ukraine's Power Generation and Transmission Infrastructure, 1 October 2022 to 30 April 2023"; A/HRC/52/62 at para. 42.
390. See, e.g., General Assembly: Human Rights Council, 55th Session, Agenda item 5, para. 38-9; Organization for Security and Co-operation in Europe Office for Democratic Institutions and Human Rights, "Report on Violations of International Humanitarian and Human Rights Law, War Crimes and Crimes against Humanity Committed in Ukraine Since 24 February 2022," pp. 46-7; Interview with Dr. Oksana Kyrsanova, MIHR, December 2, 2022 (on-file). Other witnesses reported bombings in the area on March 10 and 11, 2022. See "They Drove a Tank and Two Armored Personnel Carriers and Started Shooting Houses Around... ' How the Russians Captured the Hospital in Mariupol, and What Happened There After That," 0629.com.ua Mariupol City Website, March 31, 2022, <https://www.0629.com.ua/news/3362062/voni-prignali-tank-i-dva-btra-i-pocali-rozstriluvati-budinki-navkolo-ak-rosiani-zahopili-likarnu-v-mariupoli-i-so-tam-vidbuvalos-pisla-cogo>; "Armoury, Prison, Graveyard: Mariupol Intensive Care Hospital under Russian Occupation," International Partnership for Human Rights, Truth Hounds, Global Diligence, November 2022, https://www.iphronline.org/wp-content/uploads/2022/11/Mariupol-report_for_distribution_final_1.pdf. Other witnesses placed the attack on March 13. See "Our City Was Gone": Russia's Devastation of Mariupol, Ukraine," Human Rights Watch, SITU, Truth Hounds, 2024, p. 49, p. 87, https://www.hrw.org/sites/default/files/media_2024/02/ukraine0224web.pdf; Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file); "Russia's July 8 Attack on a Children's Hospital in Ukraine," Human Rights Watch, July 11, 2024, <https://www.hrw.org/news/2024/07/11/russias-july-8-attack-childrens-hospital-ukraine>.
391. See, example. Volodymyr Tuniz-Fryk, "Russians struck Ukraine's energy infrastructure over 1,000 times since October 2022," Ukrainska Pravda, September 22, 2024, <https://www.pravda.com.ua/eng/news/2024/09/22/7476259/>; Rachel Amran, "70% of energy infrastructure damaged by Russian attacks in Kyiv has been restored, authorities say," Kyiv Independent, August 25, 2024, <https://kyivindependent.com/70-of-energy-infrastructure-damaged-by-russian-shelling-in-kyiv-have-been-restored/>; "Ukraine: Electricians fight to restore power to villages in Mykolaiv and Kherson," France24, December 12, 2022, <https://www.france24.com/en/europe/20221212-ukraine-electricians-fight-to-restore-power-to-villages-in-mykolaiv-and-kherson>.
392. See "Elements of Crimes," ICC, page 13, <https://www.icc-cpi.int/sites/default/files/Publications/Elements-of-Crimes.pdf>.
393. Additional Protocol I, Article 13(2); Article 51(2).
394. See Galic, IT-98-29-T, paras. 132-33; Prosecutor v. Milosevic, IT-98-29/1-A, Judgement and Opinion, Appeals Chamber, November 12, 2009; see also Statute of the International Criminal Tribunal for Rwanda, adopted by UN Security Council, Res. N. 955, November 8, 1994.
395. Milosevic, IT-98-29/1-A at para 37.
396. Milosevic, IT-98-29/1-A at para 37.
397. UN HRMMU.
398. UN HRMMU, p. 11.
399. Additional Protocol I, Article 13(2); Article 51(2)
400. Rome Statute 7(1)(k).
401. ICC, Situation in Kenya (ICC-01/09), Decision Pursuant to Article 15 of the Rome Statute on the Authorization of an Investigation into the Situation in the Republic of Kenya, March 31, 2010, para. 95, https://www.icc-cpi.int/sites/default/files/CourtRecords/CR2010_02409.PDF.
402. ICC, Situation in Kenya. At para 96. These include a) murder; b) extermination; c) enslavement; d) deportation or forcible transfer of population; e) Imprisonment or other severe deprivation of physical liberty in violation of fundamental rules of international law; f) torture; g) Rape, sexual

Endnotes

continued

- slavery, enforced prostitution, forced pregnancy, enforced sterilization, or any other form of sexual violence of comparable gravity; h) Persecution against any identifiable group or collectivity on political, racial, national, ethnic, cultural, religious, gender as defined in paragraph 3, or other grounds that are universally recognized as impermissible under international law, in connection with any act referred to in this paragraph or any crime within the jurisdiction of the Court; i) Enforced disappearance of persons; and j) The crime of apartheid.
403. ICC, Situation in Kenya, at 7(2)(a); International Criminal Court, Elements of Crimes, 2013, at 3, 8.
404. Rome Statute Article 7(1)(k); cf *ibid.* Article 6.
405. UN HRMMU, p. 3-4; "Remote Assessment of Bombardment of Ukraine's Power Generation and Transmission Infrastructure, 1 October 2022 to 30 April 2023," p. 6-7.
406. See UN HRMMU, p. 2.
407. United Nations Human Rights Council, Fifty-second session, "Conference room paper of the Independent International Commission of Inquiry on Ukraine," Office of the High Commissioner for Human Rights, A/HRC/52/CRP.4, August 29, 2023, <https://perma.cc/Y2K7-4MZX>, https://www.ohchr.org/sites/default/files/2023-08/A_HRC_52_CRP.4_En%20%28003%29.pdf.
408. "Conference room paper of the Independent International Commission of Inquiry on Ukraine," at para 111; see also UN HRMMU, p. 9-11.
409. Survey data.
410. UN HRMMU, p. 10.
411. UN HRMMU, p. 9; Survey Data.
412. Marc Santora and Thomas Gibbons-Neff, "Russian Missile Barrage Cuts Power and Water Across Ukraine," *The New York Times*, November 23, 2022, <https://www.nytimes.com/2022/11/23/world/europe/russia-ukraine-missiles-power.html?referringSource=articleShare&smid=nytcore-ios-share&login=email&auth=login-email>.
413. International Criminal Court.
414. "Putin promotes generals to higher military ranks after Syria operation," TASS, February 22, 2017, <https://web.archive.org/web/20230930163741/https://tass.com/defense/932489>
415. "In accordance with the decision of the Supreme Commander-in-Chief of the Armed Forces of the Russian Federation, Vladimir Putin, the Russian Ministry of Defense is starting to reduce the grouping of the Armed Forces in Syria," Ministry of Defense of the Russian Federation, January 6, 2017, https://web.archive.org/web/20231226033342/https://function.mil.ru/news_page/country/more.htm?id=12107843@egNews
416. "Russia to scale back military presence in Syria," *France24*, January 6, 2017, <https://www.france24.com/en/20170106-russia-scale-back-defence-forces-syria>.
417. Concluding Observations on the fourth periodic report Israel, 12; Human Rights Committee, Consideration of Reports submitted by states parties under article 40 of the Covenant: Comments of the Human Rights Committee, 8, U.N. Doc. CCPR/C/79/Add.42, November 10, 1994, https://tbinternet.ohchr.org/_layouts/15/TreatyBodyExternal/Download.aspx?symbolno=CCPR%2FC%2F79%2FAdd.42&Lang=en.
418. "Report of the Special Rapporteur of the Human Rights Council on extrajudicial, summary or arbitrary executions: Saving lives is not a crime," U.N. Doc. A/73/314, August 6, 2018, <https://www.ohchr.org/en/documents/thematic-reports/a73314-extrajudicial-summary-or-arbitrary-executions-note-secretary>.
419. Human Rights Committee, Views adopted by the Committee under article 5 (4) of the Optional Protocol, concerning communication No. 2348/2014, 11.3, U.N. Doc. CCPR/C/123/D/2348/2014, August 30, 2018, <https://juris.ohchr.org/casedetails/2541/en-US>.
420. HRC, General Comment No. 36, 67; Armed Activities on the Territory of the Congo (Democratic Republic of the Congo v. Uganda), Judgment, 2005 I.C.J. 168, December 19, <https://www.icj-cij.org/sites/default/files/case-related/116/116-20051219-JUD-01-00-EN.pdf> (international human rights treaties are applicable in respect of acts committed by a State in the exercise of its jurisdiction outside its own territory); "Human Rights Law," ICRC, <https://www.icrc.org/en/law-and-policy/human-rights-law>.
421. HRC, General Comment No. 36, CCPR/C/GC/36, September 3, 2019, para. 70, <https://documents.un.org/doc/undoc/gen/g19/261/15/pdf/g1926115.pdf>.
422. International Covenant on Economic, Social and Cultural Rights, Article 12; Office of the High Commissioner for Human Rights, "The Right to Health: Fact Sheet No. 31," at 25 <https://www.ohchr.org/sites/default/files/Documents/Publications/Factsheet31.pdf>.
423. See Ukrainian energy sector evaluation and damage assessment – VII, (as of February 24, 2023) p. 3; Kyiv City Military Administration, Telegram, Post from July 15, 2024 at 10:41, https://t.me/VA_Kyiv/6903; UN HRMMU, p. 3; "Ukraine war latest: Russia launches largest aerial attack on Ukraine so far," *The Kyiv Independent*, August 26, 2024, <https://kyivindependent.com/ukraine-war-latest-aug-26-2024/>.
424. See survey data; Interview with Dr. Lesia Lysytsia, conducted by Truth Hounds on September 10, 2024 (on-file).
425. UN HRMMU p. 6-8.
426. This report does not address Russian actions that restrict access to health care in territory beyond their control as violations of the right to health, but notes that this is a subject that deserves further attention given the long-term and cascading way in which way in which a warring state can extraterritorially restrict access to, and quality of, health care.
427. See: "Ukrainian energy sector evaluation and damage assessment – II (as of September 24, 2022)," International Energy Charter, September 2022, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_09_30_UA_sectoral_evaluation_and_damage_assessment_Version_II.pdf; <https://ceobs.org/ukraine-damage-map-kurakhivska-thermal-power-plant/>; "PJSC «DTEK Dniproenergo," DTEK, <https://energo.dtek.com/en/business/generation/dniproenergo/>.
428. While reviewing various sources, we came across different assigned capacity. It is our understanding that the differences may be due to planned and actual capacity, some blocs awaiting repairs and thus unavailable, and potential different approaches in calculations.
429. "Dusting Off Ukraine's Energy. Why the country must address inefficiency and pollution at its ageing coal-fired power plants," CEE Bankwatch Network, September 2014, p. 4. <https://bankwatch.org/wp-content/uploads/2014/09/dusting-off-Ukraine-energy.pdf>.
430. Russia seized and illegally appropriated wind and solar power stations in Crimea which produced about 1.2 TWh of electricity in 2013, meeting around 16 percent of the peninsula's total demand. The assets of "DTEK Krymenergo", the company responsible for electricity distribution and supply, were also nationalized by the occupation authorities. See Igor Piddubnyi, Dmytro Goriunov, "Assessment of Damages and Losses to Ukraine's Energy Sector due to Russia's Full-Scale Invasion," Kyiv School of Economics, p.7, https://kse.ua/wp-content/uploads/2024/06/KSE_Impact-of-the-war-on-energy_ENG-1.pdf.
431. "Assessment of Damages and Losses to Ukraine's Energy Sector due to Russia's Full-Scale Invasion," p.8.
432. "Since 2014, two TPPs with an installed capacity of 3.3 GW have been located in the occupied territories in the east of Ukraine."
433. "Ukrainian energy sector evaluation and damage assessment – VIII (as of March 24, 2023)," International Energy Charter, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_03_28_UA_sectoral_evaluation_and_damage_assessment_Version_VIII.pdf.
434. Five large power plants have been located on the Ukrainian territory occupied by Russia since February 24: Zaporizhzhia NPP, DTEK Zaporizka TPP, Kakhovska HPP, Vuhlehirska TPP, DTEK Luhanska TPP. Their total capacity is about 14 GW. This does not include municipal CHP plants, solar and wind power plants. The total capacity of the Ukrainian power system is over 50 GW. See Igor Orel, "Since February 24, Russia has occupied five

Endnotes

continued

- large power plants, and four more are close to the front. Forbes infographic," Forbes Ukraine, August 11, 2022,
435. <https://forbes.ua/news/z-24-lyuturo-rosiya-okupuvala-pyat-velikikh-elektrostantsiy-shche-chotiri-blizki-do-frontu-infografika-forbes-11082022-7636>. Four more power plants are located less than 20 kilometers from the frontline: DTEK Kryvorizka TPP, DTEK Kurakhivska TPP, Zmiivska TPP, and Slovianska TPP. Their total capacity is about 8 GW.
436. "DTEK reaches 1 GW of Renewable Energy Generation," DTEK, November 15, 2019, <https://renewables.dtek.com/en/media-center/press/dtek-reaches-1-gw-of-renewable-energy-generation/>.
437. "'The scale of the destruction is terrible'. After the destruction of Trypillia TPP, Centrenergy lost all generation," RBC-UKRAINA, April 11, 2024, <https://www.rbc.ua/rus/news/masshtabi-ruynuvan-zhahlivi-pislyaznishchennya-1712826701.html>.
438. "Trypilska TPP," Tsentrenerg, <https://www.centrenerg.com/en/subdivision/tripil-s-ka-tes/>; "'We will face many challenges in the winter, but there will be no catastrophe' - CEO of Ukrenerg," BBC Ukraine, August 29, 2024, <https://www.bbc.com/ukrainian/articles/cn02kqwnrwo>; "Only 27% of large TPPs are operating in Ukraine – Shmyhal," Suspilne Novyny, June 7, 2024, <https://suspilne.media/763681-v-ukraini-pracuut-lise-27-velikh-tes-smigal/>.
439. "Zmiyiv Thermal Power Plant of Open Joint-Stock Company Tsentrenerg," Ukraine Today, <https://rada.com.ua/eng/catalog/8981/>; PAT "Tsentrenerg", Facebook, post from April 11, 2024 at 12:04, <https://www.facebook.com/PATCentrenerg/posts/pfbid0mWQjw2yCoBgPvZWupXBGEpVJYzdbcAdw15sw2Ew9mKSHmngKmiJZi4yJPoDi8cidl>.
440. "Vuhlehirka TPP (Examples of environmental harm in Ukraine)," Conflict and Environment Observatory, January 1, 2024, <https://ceobs.org/ukraine-damage-map-vuhlehirka-thermal-power-plant/>; PAT "Tsentrenerg", Facebook, post from April 11, 2024 at 12:04, <https://www.facebook.com/PATCentrenerg/posts/pfbid0mWQjw2yCoBgPvZWupXBGEpVJYzdbcAdw15sw2Ew9mKSHmngKmiJZi4yJPoDi8cidl>.
441. "'We will face many challenges in the winter, but there will be no catastrophe' - CEO of Ukrenerg," BBC Ukraine, August 29, 2024, <https://www.bbc.com/ukrainian/articles/cn02kqwnrwo>; "Only 27% of large TPPs are operating in Ukraine – Shmyhal," Suspilne Novyny, June 7, 2024, <https://suspilne.media/763681-v-ukraini-pracuut-lise-27-velikh-tes-smigal/>.
442. "Only 5% of electricity is generated: all TPPs in Ukraine are damaged or destroyed – Ukrenerg," Unian, May 28, 2024, <https://www.unian.ua/economics/energetics/energostema-ukrajini-usi-tes-ukrajini-poshkodzheno-chi-zruynovano-12649485.html>
443. The Crimean power grid is designed to supply electricity to the peninsula on four overhead lines from Ukraine's United Energy System. The system can transmit 1,250 MW of power, which corresponds to the maximum possible energy consumption on the peninsula. Crimea had its own heat generation capacity of about 205.5 MW, including Sevastopol. Basic local generation comprised 100 MW at Simferopol combined heat and power plant (CHP) (with design capacity of 100 MW), 6 MW at Kamysh-Burunskaya CHP (with design capacity of 30 MW), 14.5 MW at Saki CHP (design capacity 14.5 MW) and Sevastopol CHP with a capacity of 60 MW. See "Energy Aspects of the Occupation of Crimea and the Strategy for Overcoming Its Effects," Centre for Defence Strategy, February 2022,
444. <https://defence.org.ua/wp-content/uploads/doslidzhennya/CDS-Energy-Aspects-of-the-Occupation-of-Crimea-eng.pdf>.
445. "Ukrainian energy sector evaluation and damage assessment – VIII (as of March 24, 2023)," International Energy Charter, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_03_28_UA_sectoral_evaluation_and_damage_assessment_Version_VIII.pdf.
446. Gas-fired power plants are an additional important flexibility option, since their ramp rates and start-up times are significantly below those of even state-of-the-art coal-fired power plants. See Michael Vemuri, Isabel Bohn, Marius Schrade, "From 'baseload' to flexible generation: meeting the power generation requirements of the future," Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), May 2018, <https://www.giz.de/en/downloads/giz2018-en-flexible-generation-philippines.pdf>.
447. In 2006, the city of Alchevsk in Luhansk Oblast, with a population of approximately 100,000, experienced a heating crisis when a central heating system broke down, leaving residents without heat in temperatures plunging to 20 degrees below zero. Source: <https://archive.kyivpost.com/article/content/ukraine-politics/accident-in-alchevsk-may-boost-communal-reform-23801.html>.
448. "Ukrainian energy sector evaluation and damage assessment – X (as of May 24, 2023)," International Energy Charter, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_05_24_UA_sectoral_evaluation_and_damage_assessment_Version_X_final.pdf.
449. "Ukraine: Current status of nuclear power installations," Nuclear Energy Agency, https://www.oecd-nea.org/jcms/pl_66130/ukraine-current-status-of-nuclear-power-installations.
450. "Ukrainian energy sector evaluation and damage assessment – I (as of August 24, 2022)," International Energy Charter, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/20220829_UA_sectoral_evaluation_and_damage_assessment_final.pdf. The Security Service and the Office of the Prosecutor General collected evidence against two Russian citizens who tried to disconnect Zaporizhzhia NPP from the unified energy system of our country, see "SBU serves notice of suspicion to Russian hackers of Zaporizhzhia NPP who tried to disconnect the plant from the Ukrainian power grid," Security Service of Ukraine, April 23, 2024, <https://ssu.gov.ua/novyny/sbu-povidomya-pro-pidozru-rosiiskym-hauliaiteram-zaporizkoj-ae-yaki-vidiednaly-stantsiiu-vid-enerhosystemy-ukrainy>.
451. The IAEA noted that since September 2022, Zaporizhzhia NPP has not produced electricity, but since October 2022, at least one generator of the station has remained in a "hot shutdown" state, in particular, for the operation of centralized heating, see "Update 223 – IAEA Director General Statement on Situation in Ukraine," IAEA, April 13, 2024, <https://www.iaea.org/newscenter/pressreleases/update-223-iaea-director-general-statement-on-situation-in-ukraine>.
452. "Baseload Generation," National Electrical Manufacturers Association, <https://energytransition.nema.org/baseload-generation/>.
453. "Nuclear Power in Ukraine," World Nuclear Association, March 25, 2024, <https://world-nuclear.org/information-library/country-profiles/countries-t-z/ukraine>.
454. "Update 158 – IAEA Director General Statement on Situation in Ukraine," IAEA, May 29, 2023, <https://www.iaea.org/newscenter/pressreleases/update-158-iaea-director-general-statement-on-situation-in-ukraine>.
455. "Update 148 – IAEA Director General Statement on Situation in Ukraine," IAEA, February 28, 2023, <https://www.iaea.org/newscenter/pressreleases/update-148-iaea-director-general-statement-on-situation-in-ukraine>.
456. "Update 220 – IAEA Director General Statement on Situation in Ukraine," IAEA, April 7, 2024, <https://www.iaea.org/newscenter/pressreleases/update-220-iaea-director-general-statement-on-situation-in-ukraine>; "Update 245 – IAEA Director General Statement on Situation in Ukraine," IAEA, August 17, 2024, <https://www.iaea.org/newscenter/pressreleases/update-245-iaea-director-general-statement-on-situation-in-ukraine>; "Update 191 - IAEA Director General Statement on Situation in Ukraine," IAEA, October 23, 2023, <https://www.iaea.org/newscenter/pressreleases/update-191-iaea-director-general-statement-on-situation-in-ukraine>; "Update 144 – IAEA Director General Statement on Situation in Ukraine," IAEA, January 26, 2023, <https://www.iaea.org/newscenter/pressreleases/update-144-iaea-director-general-statement-on-situation-in-ukraine>; "Update 106 – IAEA Director General Statement on Situation in Ukraine," IAEA, September 27, 2022, <https://www.iaea.org/newscenter/pressreleases/update-106-iaea-director-general-statement-on-situation-in-ukraine>.
457. "Update 130 – IAEA Director General Statement on Situation in Ukraine," IAEA, November 21, 2022, <https://www.iaea.org/newscenter/pressreleases/update-130-iaea-director-general-statement-on-situation-in-ukraine>; "Update 89 – IAEA Director General Statement on Situation in Ukraine," IAEA, August

Endnotes

continued

- 9, 2022, <https://www.iaea.org/newscenter/pressreleases/update-89-iaea-director-general-statement-on-situation-in-ukraine>.
458. "Update 80 – IAEA Director General Statement on Situation in Ukraine," IAEA, June 7, 2022, <https://www.iaea.org/newscenter/pressreleases/update-80-iaea-director-general-statement-on-situation-in-ukraine>.
459. "Update 134 – IAEA Director General Statement on Situation in Ukraine," IAEA, December 2, 2022, <https://www.iaea.org/newscenter/pressreleases/update-134-iaea-director-general-statement-on-situation-in-ukraine>; "Update 133 – IAEA Director General Statement on Situation in Ukraine," IAEA, November 25, 2022, <https://www.iaea.org/newscenter/pressreleases/update-133-iaea-director-general-statement-on-situation-in-ukraine>.
460. "Update 248 – IAEA Director General Statement on Situation in Ukraine," IAEA, September 5, 2024, <https://www.iaea.org/newscenter/pressreleases/update-248-iaea-director-general-statement-on-situation-in-ukraine>.
461. "Nuclear Safety, Security and Safeguards in Ukraine," IAEA, <https://www.iaea.org/topics/response/nuclear-safety-security-and-safeguards-in-ukraine>.
462. "IAEA Steps Up Nuclear Safety Assistance to Ukraine, Director General Grossi Announces in Kyiv," IAEA, September 3, 2024, <https://www.iaea.org/newscenter/pressreleases/iaea-steps-up-nuclear-safety-assistance-to-ukraine-director-general-grossi-announces-in-kyiv>.
463. "Update 212 – IAEA Director General Statement on Situation in Ukraine," IAEA, February 21, 2024, <https://www.iaea.org/newscenter/pressreleases/update-212-iaea-director-general-statement-on-situation-in-ukraine>.
464. See "Pumped-Storage Hydroelectricity," Energy Storage in Energy Markets, 2021, <https://www.sciencedirect.com/topics/engineering/pumped-storage-hydroelectricity>; "Hydropower. Technology Brief," International Renewable Energy Agency, Energy Technology Systems Analysis Programme (IEA), February 2015, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA-ETSAP_Tech_Brief_E06_Hydropower.pdf.
465. "Ukrainian energy sector evaluation and damage assessment – VIII (as of March 24, 2023)," International Energy Charter, https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2023_03_28_UA_sectoral_evaluation_and_damage_assessment_Version_VIII.pdf; "Fourth hydropower unit commissioned at Dniester PSPP," Zaxid, December 23, 2021, https://zaxid.net/na-dnistrovskiy-gaes-zapratsyuvav-chetvertiy-gidroagregat_n1532867.
466. "How HPPs and PSPs work in Ukraine," November 16, 2021, Ukrhidroenergo, https://uhe.gov.ua/media_tsentrvnovyny/yak-pracyuyut-ges-ta-gaes-v-ukraini.
467. "All hydroelectric power plants in Ukraine been attacked by Russia – Ukrhidroenergo," RBC-Ukraine, August 28, 2024, <https://newsukraine.rbc.ua/news/all-hydroelectric-power-plants-in-ukraine-1724845536.html>.
468. For the reasons of clarity, it is important to differentiate between legal definitions of the "alternative energy sources" and "renewable energy".
469. "Ukraine should restore old geothermal wells – expert," DW, July 22, 2010, <https://www.dw.com/uk/%D1%83%D0%BA%D1%80%D0%B0%D1%97%D0%BD%D1%96-%D0%B2%D0%B0%D1%80%D1%82%D0%BE-%D0%B2%D1%96%D0%B4%D0%BD%D0%BE%D0%B2%D0%B8%D1%82%D0%B8-%D1%81%D1%82%D0%B0%D1%80%D1%96-%D0%B3%D0%B5%D0%BE%D1%82%D0%B5%D1%80%D0%BC%D0%B0%D0%BB%D1%8C%D0%BD%D1%96-%D1%81%D0%B2%D0%B5%D1%80%D0%B4%D0%BB%D0%BE%D0%B2%D0%B8%D0%BD%D0%B8-%D0%B5%D0%BA%D1%81%D0%BF%D0%B5%D1%80%D1%82/a-5823624>; "Ukraine's renewable energy sector before, during and after the war," Razumkov Center, November 11, 2022, <https://razumkov.org.ua/statti/sekto-vidnovlyuvanoyi-energetyky-ukrayiny-do-pid-chas-ta-pislya-viyny>; "The capacity of "green" generation in Ukraine is close to 8.5 GW," Liyvi Bereh, January 13, 2022, https://lb.ua/economics/2022/01/13/503011_potuzhnist_zelenoi_generatsii.html; "Vision for Ukrainian biogas/biomethane sector development," Bioenergy Association of Ukraine, February 2021, <https://uabio.org/wp-content/uploads/2021/02/Visio-Ukrainian-Biogas-sector-2021-EN.pdf>; Igor Orel, "Shelling, torture and fraud. How Ukrainian power plants work under occupation," Forbes Ukraine, August 29, 2022, <https://forbes.ua/inside/obstrili-katuvannya-ta-shakhraystvo-yak-pratsyuyut-ukrainski-elektrostantsii-v-okpatsii-29082022-7935>.
470. "Ukraine's renewable energy sector before, during and after the war," Razumkov Center, November 11, 2022, <https://razumkov.org.ua/statti/sekto-vidnovlyuvanoyi-energetyky-ukrayiny-do-pid-chas-ta-pislya-viyny>.
471. "SAF: Electricity production from renewable energy sources in 2023," UaBio, February 19, 2024, <https://uabio.org/materials/15759/>.
472. "SAF: Electricity production from renewable energy sources in 2023".
473. Air Force of the Armed Forces of Ukraine, Telegram, Post from July 8, 2024, at 14:54, <https://t.me/kpszsuz/16341>.
474. Kyiv City Military Administration, Telegram, Post from July 15, 2024, at 10:41, https://t.me/VA_Kyiv/6903.
475. Vitaliy Klytschko, Telegram, Post from July 8, 2024, at 10:30, https://t.me/vitaliy_klytschko/3250.
476. "Russia Strikes Children's Hospital in Deadly Barrage Across Ukraine," The New York Times, July 8, 2024, <https://www.nytimes.com/2024/07/08/world/europe/russia-ukraine-missile-strikes-childrens-hospital.html>; "Two people killed and more than 50 injured in russian attack on Okhmatdyt Children's Hospital," Ministry of Health of Ukraine, July 8, 2024, <https://moz.gov.ua/en/news/two-people-killed-and-more-than-50-injured-in-russian-attack-on-okhmatdyt-children-s-hospital>.
477. Okhmatdyt, Accessed on September 20, 2024, <https://ohmatdyt.com.ua/en/>.
478. TSAPLIENKO_UKRAINE FIGHTS, Telegram, Post from July 8, 2024, at 15:23, <https://t.me/Tsaplienko/56581>.
479. TSAPLIENKO_UKRAINE FIGHTS, Telegram, Post from July 8, 2024, at 14:35, <https://t.me/Tsaplienko/56555>.
480. Ukraine Emergency Security Council Meeting, United Nations, July 9, 2024, <https://www.youtube.com/watch?v=59INLRYIOWk> (Timecode: 1:25:42 - 1:38:21).
481. Ukraine Emergency Security Council Meeting.
482. Michael Sheldon, "Russian Missile Identified in Kyiv Children's Hospital Attack," Bellingcat, July 9, 2024, <https://www.bellingcat.com/news/2024/07/09/russian-missile-identified-in-kyiv-childrens-hospital-attack/>.
483. "Kh-101 / Kh-102," CSIS Missile Defense Project, Last updated April 23, 2024, <https://missilethreat.csis.org/missile/kh-101-kh-102/>.
484. Kotsnews, Telegram, Post from July 8, 2024, at 16:49, <https://t.me/sashakots/47743>; Colonelcassad, Telegram, Post from July 8, 2024, at 15:34, https://t.me/boris_rozhin/129394.
485. "Kh-101 / Kh-102," CSIS Missile Defense Project, Last updated April 23, 2024, <https://missilethreat.csis.org/missile/kh-101-kh-102/>.
486. "PATRIOT Deployment," North Atlantic Treaty Organization, May 2015, https://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2015_05/20150508_1505-Factsheet-PATRIOT_en.pdf.
487. Grygorska, N., "There is no building. Okhmatdyt showed a video of the first minutes after the Russian shelling", NV, July 8, 2024, <https://nv.ua/ukr/kyiv/ohmatdit-kijiv-video-i-foto-pershiih-hvilin-pislya-raketnoji-ataki-8-lipnya-novini-kiyeva-50433343.html>.
488. "Sohodni vrantsi rosiyskiy ahresor nanis raketnyi udar," @okhmatdyt via Instagram, https://www.instagram.com/p/C9KAuhJo4VF/?utm_source=ig_embed&ig_rid=5e244d6a-892e-4829-bd93-5d4c770c044f&img_index=2.
489. "Aim-120 AMRAAM (Advanced Medium-Range Air-To-Air Missile)," European Defense Missiles, Accessed on September 6, 2024, <https://www.armedforces.co.uk/Europeandefence/edequipment/edemis/edmis2a5.htm>; "PATRIOT," European Defense Missiles, Accessed on September 6, 2024, <https://www.armedforces.co.uk/Europeandefence/edequipment/edemis/edemis5a8.htm>; "PATRIOT," CSIS Missile Defense Project, Last updated August 23, 2024, <https://missilethreat.csis.org/system/patriot/>.
490. "Kh-101 / Kh-102," CSIS Missile Defense Project, Last updated April 23, 2024, <https://missilethreat.csis.org/missile/kh-101-kh-102/>; "Unexploded Kh-101 Warhead Shows Russia Uses Missiles Fresh From Conveyor For Shelling Ukraine," Defense Express, January 23, 2024,

Endnotes

continued

- https://en.defence-ua.com/industries/unexploded_kh_101_warhead_shows_russia_uses_missiles_fresh_from_conveyor_for_shelling_ukraine-9272.html.
491. Security Service of Ukraine, Telegram, Post from July 8, 2024, at 14:30, <https://t.me/SBUkr/12339>; Security Service of Ukraine, Telegram, Post from July 9, 2024, at 12:18, <https://t.me/SBUkr/12348>; Ministry of Justice of Ukraine, Facebook, Post from July 10, 2024, at 10:47, <https://www.facebook.com/minjust.official/posts/pfbid02cQn6iVwADB5GXz6wreGckwv3TSGqRe4F4y779nNzh23x5uNRuAXooDb7Ar6MBWEI>.
492. "Kh-101 / Kh-102," CSIS Missile Defense Project, Last updated April 23, 2024, <https://missilethreat.csis.org/missile/kh-101-kh-102/>.
493. "A strike on Okhmatdyt: how the X-101 missiles, with which Russia destroyed a children's hospital in Kyiv today, work," NV, July 8, 2024, <https://nv.ua/ukr/ukraine/events/ohmatdit-kijiv-8-lipnya-video-udaru-raketoyu-h-101-shcho-ce-za-raketi-z-yakih-litaktiv-novini-kiyeva-50429098.html>.
494. "Russian Forces use Kh-101 and Kh-555 air-launched cruise missiles in strikes against Ukraine," Army Recognition, May 3, 2024, <https://armyrecognition.com/focus-analysis-conflicts/army/conflicts-in-the-world/russia-ukraine-war-2022/russian-forces-use-kh-101-and-kh-555-air-launched-cruise-missiles-in-strikes-against-ukraine>.
495. Joseph Trevithick, "Russian Kh-101 Cruise Missile Filmed Firing-Off Decoy Flares," The Warzone, December 29, 2023, <https://www.twz.com/russian-kh-101-cruise-missile-filmed-firing-off-decoy-flares>; "Russia starts using new variant Kh-101 cruise missile with upgraded warhead lower range," Army Recognition, May 13, 2024, <https://armyrecognition.com/news/aerospace-news/2024/russia-starts-using-new-variant-kh-101-cruise-missile-with-upgraded-warhead-lower-range>.
496. Ministry of Health of Ukraine, Facebook, Post from July 9, 2024, at 12:23, <https://www.facebook.com/moz.ukr/posts/pfbid02uBjyzwrq3TKow5Y4AkcZf7x6erBRwkpL4mnTErkU2UZi5unXjBkqX3j1kx1ys2Ml>