METHODOLOGICAL GUIDE

DOCUMENTING CIVILIAN HARM FROM ATTACKS ON ENERGY INFRASTRUCTURE

Kobo

PHR Physicians for Human Rights

EXPLOSIVE WEAPONS MONITOR

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

This methodological guide was drafted by teams at Kobo, Physicians for Human Rights, and the Explosive Weapons Monitor.

Citation:
Vinck P, Marston J, Poltavets U, Young K. 2026. Methodological Guide: Documenting Civilian Harm from Attacks on Energy Infrastructure. Cambridge, MA: Kobo.

CONTENTS

ABOUT THIS GUIDE

The aim of this publication is to provide practical guidance and tools for documenting civilian harm from attacks on energy infrastructure. The focus is on measuring the *impacts* of attacks on energy infrastructure through indicators related to civilians' physical health, mental health, education, and livelihoods, among other aspects of civilian life. This guide provides an overview of data sources and methodologies for documenting attacks on energy infrastructure. However, the focus is on *what* to measure, rather than *how* to carry out the research.

The intended audience for this guide is researchers, information management officers, academics, and data analysts working in humanitarian relief, human rights, civilian protection, and similar fields. It assumes a basic familiarity with research design and data collection, analysis, and management. This document may be best suited for researchers at organizations planning to actively collect data about attacks on energy infrastructure, though organizations with systems designed to passively receive reports of attacks may also find relevant information. Users can apply the guide to structure their documentation efforts by identifying relevant domains of harm, selecting appropriate indicators, and linking them to available sources of data for analysis, advocacy, and response. Investigators at justice and accountability bodies might also find this guide useful for identifying relevant categories of civilian harm and data that may inform legal analysis, including proportionality assessments.[1] However, this guide does not provide a methodology for attributing specific attacks to perpetrators or for conducting a pattern analysis required to establish individual criminal responsibility.

Although methodology for documenting incidents of attacks on energy infrastructure is included, this guide is most relevant for investigating the impacts of attacks on civilians. This includes immediate effects, including death, injury, and damage to facilities, as well as reverberating or knock-on effects, including on civilians' health, education, and livelihoods.[2]

This methodological guide draws on the experience of the Explosive Weapons Monitor (EWM), Kobo, and Physicians for Human Rights (PHR). The EWM uses incident-level data on attacks against civilians and civilian infrastructure to report on harm from the use of explosive weapons, including disruptions to critical civilian services such as health care, education, humanitarian aid, food, and water. Kobo conducts large-scale surveys to document attacks on civilians and civilian infrastructure, including the impacts of attacks on energy infrastructure on civilians' physical and mental health, education, and livelihoods. Finally, PHR documents attacks on health, their patterns, and impacts, including attacks on energy infrastructure impacting health and health care.

This guide focuses on electricity infrastructure; however, given the interdependent nature of energy systems, other critical utilities like fuel and gas are also referenced. Although this document draws heavily on examples from Ukraine and attacks involving explosive weapons, it also holds relevance for other contexts and other forms of attack, such as arson or small arms fire. The authors relied on resources from across several adjacent fields to develop this guide and have included them as references.

THE NEED FOR DATA ON CIVILIAN HARM FROM ATTACKS ON ENERGY

Rich data about attacks on energy infrastructure and their impacts are crucial for understanding the scale and nature of civilian harm. Thousands of attacks and other conflict-related disruptions affecting energy systems occur each year in armed conflicts around the world, leading to immediate harm, damage, and death, as well as longer-lasting effects on civilians' well-being. In some contexts, energy infrastructure has been damaged by direct strikes; in others, civilian harm has resulted from a combination of bombardment, siege-like restrictions, fuel shortages, damaged distribution networks, cyber operations, occupation, or obstruction of repair and maintenance.

Despite media coverage of attacks on energy facilities and disruptions affecting energy systems in contexts such as Ukraine, Iran, and Gaza, the full impact of attacks, including on civilians' health, education, and livelihoods, is not well documented or understood. Yet high-quality data collection and analyses are critical for advocacy, prevention, response, compliance with international law, and accountability initiatives to limit these attacks.

INTRODUCTION

Attacks on energy infrastructure have been documented in multiple recent armed conflicts.[3] These attacks involve airstrikes, shelling, and ground assaults on power plants, substations, and distribution grids. Military occupation, looting, and arson attacks have also been documented.[4] Damage to energy infrastructure disrupts critical civilian services, including health care, education, and water and sanitation, producing grave humanitarian consequences and violating fundamental rights.[5] Disruptions to the power grid also hamstring the local economy. In recent years, attacks on energy infrastructure have occurred in diverse contexts, including Gaza, Iran, Myanmar, Sudan, Ukraine, and Yemen.[6]

Several advances have been made in documenting and analyzing attacks on civilian infrastructure. Organizations including the Global Coalition to Protect Education from Attack (GCPEA), Insecurity Insight, and the United Nations Institute for Disarmament Research (UNIDIR) have developed frameworks and toolkits to monitor attacks on schools, hospitals, and other civilian infrastructure, which can be applied to the energy sector. Adapting these approaches is crucial for improving the global community's understanding of attacks on energy infrastructure and for bolstering evidence-based advocacy, accountability, and prevention and response.

Attacks on energy facilities, as civilian infrastructure, are generally prohibited under international humanitarian law. The principles of distinction, proportionality, and precautions are important in determining the legitimacy of targets and ensuring civilian suffering is limited.[7] Relevant initiatives have been taken to prevent and respond to attacks on civilian infrastructure, particularly among nongovernmental organizations (NGOs) and United Nations (UN) agencies working to limit the use of explosive weapons in towns and cities. In particular, a 2022 political declaration set international standards for addressing the civilian harm caused by the use of explosive weapons in populated areas.[8]

INTERNATIONAL LAW AND ATTACKS ON ENERGY INFRASTRUCTURE

Civilian energy infrastructure is protected under international humanitarian law.[9] Even where a component of an energy system may qualify as a military objective, parties to the conflict must comply with the principles of distinction, proportionality, and precautions in attack.[10] In assessing expected civilian harm, parties to the conflict must consider not only immediate death, injury, and physical damage, but also reasonably foreseeable consequences for civilians, particularly in relation to the assessment of proportionality and precautions in attack.[11]

The rights to health, education, water and sanitation, and to an adequate standard of living[12]—as contained in the International Covenant on Economic, Social and Cultural Rights as well as other human rights instruments—require at their core that states refrain from restricting access to essential services such as health care, sanitation, safe drinking water, food, and schools, in territory under their control, in particular to marginalized groups.[13]

Documentation of attacks on energy infrastructure should therefore preserve information relevant to legal analysis, including about impacts on physical and mental health and infringements on the rights to education, water and sanitation, and an adequate standard of living. Where appropriate, such documentation can support accountability efforts by helping investigators assess whether parties to a conflict adhered to distinction, proportionality, and precautions, and assess the cumulative or widespread character of attacks. Doing so can also factor into the legal analysis of what is or is not permissible in future targeting and operational decisions.

BACKGROUND ON CIVILIAN INFRASTRUCTURE AND SERVICES

Electricity, water, telecommunications, and other infrastructure and services are essential for sustaining the daily lives of civilian populations. According to Zeitoun and Talhami, services consist of three interdependent components: "people (e.g. service provider staff, private sector contractors and entrepreneurs), consumables (e.g. fuel, chlorine, medicines), and hardware (e.g. equipment, heavy machinery, infrastructure)."[14] In the case of electricity, these might be seen as operations staff and consumers, a water source to power production, and an electrical power plant.

The path of service distribution is often broken into three elements, based on their distance and level in the production and delivery of a service: upstream, midstream, and downstream. For energy, these divisions might be into electrical power plants (upstream), substations and transmission lines (midstream), and electrical transformers that serve consumers (downstream). Upstream infrastructure serves the most people and has the widest reach, while downstream infrastructure serves a limited number of consumers in a smaller area. Since they serve the most people over the widest area, attacks on upstream infrastructure typically have the greatest impact on service provision.[15]

The interdependent nature of civilian infrastructure and services means that the damage or destruction of one often impacts another. For instance, an attack on an electrical grid may produce power cuts in hospitals or schools.[16]

The severity of damage from attacks also depends on how centralized the energy infrastructure is. Compared to decentralized or localized systems, centralized energy systems, where electricity is generated at large-scale facilities removed from end users, tend to be more vulnerable to cascading grid failures due to physical and cyberattacks.[17]

DEFINITION OF ATTACKS ON ENERGY INFRASTRUCTURE AND PERSONNEL

Attacks on energy infrastructure and personnel are any physical or threatened violence or digital obstruction carried out by a military force, non-state armed group, or other armed actor against the facilities or staff involved in the extraction, production, transmission, or distribution of energy supplies.[18] Although this definition encompasses attacks against both energy infrastructure and personnel, this guide focuses on infrastructure-related damage, disruption, and civilian harm. Attacks on energy personnel are included where they constitute direct harm or affect the operation, repair, or restoration of energy systems.

Attacks on energy infrastructure may include nuclear power plants, oil refineries, and water reservoirs, since these are often used to generate electricity or produce the fuels to power the grid. Damage to such infrastructure merits particular attention since it can result in the release of airborne contaminants, hazardous waste, flooding, toxic spills and fires, and other immediate and reverberating effects for civilians and the environment.

ELECTRICITY INFRASTRUCTURE

Electricity infrastructure is the facilities, equipment, and services needed to move electrical energy from the point of generation (e.g., hydroelectric dams, fossil fuel refineries, nuclear or wind power plants) to the end user. This infrastructure includes power plants, substations, transmission towers and lines, and transformers for the transmission (high-voltage) and distribution (low-voltage) of energy.[19] According to Hoicka and MacArthur, "Electricity infrastructure…is made up of power generation that travels long distances over transmission and distribution to demand centers, such as cities, buildings, and industries, for electrical use. The infrastructure that moves generated power along these points is collectively known as 'the grid.'"[20]

DOCUMENTING CIVILIAN HARM FROM ATTACKS ON ENERGY INFRASTRUCTURE

Attacks on energy infrastructure often result in direct damage to the facility and can cause the injury or death of energy workers. For instance, a suicide bombing attack on a state-run power plant in Iraq in September 2017 resulted in damage to the facility and the death of seven employees.[21] Although less frequent, attacks may also affect energy personnel only, not facilities; in Gaza, for example, two electricity technicians were killed in an airstrike while on their way to repair previously damaged transmission lines.[22] Beyond direct damage and harm, these attacks can have far-reaching impacts due to the interconnectedness and interdependencies among energy and other civilian systems. Attacks on the energy grid can affect civilian well-being across a range of factors, including health, mental health, education, access to safe drinking water, and income.[23]

The destruction of energy infrastructure produces grave consequences for the health care sector. Power cuts compromise both a health facility's internal capacity to provide care and the facility's service delivery to the surrounding population. Hospitals cannot function without access to water, heating, and ventilation, which often depend on electricity. Proper lighting is essential for surgeries and diagnostic procedures, such as magnetic resonance imaging (MRI) and computer tomography (CT) scans, cannot be performed without stable electricity. Emergency services also suffer when communications go down and life support systems dependent on electricity are nonfunctional.[24] In Ukraine, for example, power outages have forced surgeons to operate by flashlight, interrupted or delayed critical surgeries, and led to failures in life-support systems. Around 66 percent of Ukrainian health care workers surveyed in 2024 reported that power outages resulting from attacks on energy infrastructure affected medical procedures.[25]

Disruptions to electricity also severely impact access to education. Schools rely on electricity for heating, lighting, preparing meals, computers, and remote learning platforms, among other educational needs. Prolonged power outages interrupt learning since many schools do not have backup generators, meaning students must stay home during power outages. Remote learning is also impacted by power outages, affecting students displaced by conflict or those who were forced to study online after their schools were damaged by direct attacks. Combined, the effects of power cuts have exacerbated learning loss in Ukraine, Sudan, and Myanmar.[26]

Moreover, water and sanitation are affected by energy disruptions, since water pumping stations, treatment plants, and wastewater systems require stable electricity to function. Power outages have led to widespread interruptions in access to safe drinking water and adequate sanitation in Ukraine, Gaza, and Sudan.[27] Meanwhile, damage to energy infrastructure resulting in a lack of access to clean water increases the risk of waterborne diseases.[28] For instance, drone attacks on a power plant in Atbrara city, Sudan, in May 2025 caused power outages that prevented a local water treatment plant from operating at full capacity, putting local communities at risk of cholera and other waterborne diseases.[29]

Among other impacts on civilians' day-to-day lives, energy outages also affect their ability to earn wages. Energy outages often translate to missed work, business and banking interruptions, store closures, and reduced productivity due to unreliable electricity, lighting, and internet. For instance, in Ukraine, around one-quarter of households surveyed in 2025 reported lost income or work linked to power outages, with higher percentages among households experiencing frequent and prolonged outages.[30] Meanwhile, bakeries in Gaza had to cease or limit their operations in 2023 due to a lack of electricity, fuel, or other means of energy production for use by generators.[31]

In all cases, the most vulnerable populations are most at risk from power outages. Older persons and persons with disabilities, pregnant and postpartum women, infants, children, and people with chronic illnesses are differentially impacted by power outages. For instance, these groups may be more susceptible to waterborne diseases or more impacted by extreme temperatures or prolonged gaps in health services.[32] Research also shows that the impacts on vulnerable populations do not exist in isolation but are cumulative, and each additional risk factor increases overall vulnerability exponentially. They interact, overlap, and mutually reinforce one another, creating more complex patterns of vulnerability than the individual factors alone. For example, in Ukraine, disruptions to the usability of in-home medical devices, treatment routines, and basic services often combined with water and heating outages, leading to heightened and compounding risks for people with chronic illness or disabilities and for older adults.[33]

CONCEPTUALIZING THE IMPACTS OF ATTACKS ON ENERGY INFRASTRUCTURE

Energy infrastructure enables the provision of many essential services across a wide geography, often powering devices for the majority of a population. Electrified schools, for instance, allow for technology in the classroom and learning at more times of the day; electricity is also associated with improved educational outcomes.[34] Reliable energy sources also enable pumping and filtration for clean drinking water and sanitation.[35] Beyond that, energy infrastructure creates job opportunities, facilitates banking, and connects communities.

The distinct nature of energy infrastructure must be taken into account when conceptualizing the impacts of attacks. In contexts where energy infrastructure is in place, it is generally networked, has broad geographic coverage, and touches most segments of a population–traits that make the service unique. Energy infrastructure also enables the provision of other services; as such, it is typically prioritized for repair after attacks, to the extent possible. Although other services, such as health care and education, share these traits to some extent, they are typically less networked, more geographically isolated, and do not touch as many segments of society on a daily basis. Water, sanitation, and transportation, on the other hand, may be closer to energy infrastructure along several of these axes.

MEASURING THE IMPACTS OF ATTACKS ON ENERGY INFRASTRUCTURE

Measuring the *impacts* of attacks on energy infrastructure requires novel indicators, since this infrastructure and service is unique. Around much of the world, energy infrastructure touches all segments of a population, enables the provision of other services, runs on a networked grid, and has a wide geographic spread.[36] An attack on a power plant means not only the loss of electricity for grid-connected households, but also the potential loss of health care and education in far-off communities connected to that grid.

Due to this interconnectedness, disruptions to other services should be assessed when documenting the impacts of attacks on energy infrastructure. For this reason, the indicators developed below include numerous sectors. Relatedly, impacts far from the attack should be considered, and the effects of energy outages on all demographic groups should be taken into account. As such, multiple domains and data sources are relevant and included below.

IMMEDIATE AND REVERBERATING EFFECTS OF ATTACKS AND CUMULATIVE AND COMPOUNDING HARM

The impacts of an attack are often divided into *immediate effects* and *reverberating effects* on the relevant civilians, infrastructure, and services. Immediate effects include the initial attack, often resulting in death, injury, and damage to energy facilities. Reverberating effects, on the other hand, are the consequences of the former spread further across time, geography, and communities impacted, and may include harms from loss of services, spread of communicable diseases, psychological trauma, and other knock-on effects.[37]

Attacks on energy infrastructure may produce cumulative and compounding harm. Cumulative harm arises when repeated or prolonged attacks and outages create successive losses over time, including the depletion of household resources, deterioration of infrastructure and services, and reduced capacity to cope with future disruptions. Compounding harm occurs when multiple effects, such as loss of electricity, water, heating, health care, communications, education, or income interact and intensify one another, producing consequences that may be more severe than the effect of any single disruption.

The indicators below for assessing the civilian impacts from attacks on energy infrastructure encompass both immediate and reverberating effects, and are sufficiently flexible to track cumulative and compounding harm.

DOMAINS, KEY COMPONENTS, AND DATA SOURCES FOR DOCUMENTING CIVILIAN HARM

Unique domains, components, and data must be considered for documenting harm caused by attacks, due to the distinct nature of energy infrastructure. Different actors undertake this documentation for a variety of purposes. For example, documenting civilian harm from attacks on energy infrastructure can inform operational and humanitarian responses, such as victim assistance, preparedness, and reconstruction. This documentation also supports increased understanding of the reverberating effects of attacks, including how civilians' needs might shift over time, as well as accountability efforts. Actors with varied mandates may draw on a range of different domains, components, and data.[38]

Incident-based methodologies collect open- and closed-source data that can be linked to specific attacks, with information recorded in a standardized manner that may identify locations, dates, weapons categories, damage, and other vital information. Although verified methodologies have been developed, an incident-level, open-source monitor dedicated to global attacks on energy infrastructure does not yet exist.[39] Impact-based methodologies, which employ qualitative, quantitative, and field research methods to understand patterns of harm that extend beyond an attack, include surveys, interviews, and field data collection about the short- and long-term impacts on the lives and well-being of civilians.[40]

Table 1: Domain, components, and data sources to document civilian harm caused by attacks on energy infrastructure

Domain	Key components	Data sources
Attacks	Extent of damage to infrastructure or harm to personnel, perpetrator, weapon type, whether targeted, and connection with critical infrastructure	News reports, databases of violent incidents, NGO databases, satellite imagery, forensic assessments of damage, and technical documentation (e.g., grid operational logs)
Power cuts[41]	Duration of disruption, number of consumers affected, number of consumers for which electricity supply was restored	Reports from transmission and distribution system operators, news reports, remote sensing data, NGO databases, and technical documentation (e.g., grid operational logs)
Service provision (e.g. health care facilities, water treatment plants, communication networks)	Description of services that were disrupted, duration of disruption, impact on critical services, humanitarian harm caused (e.g., health crises, disease outbreaks, food safety)	Government data on number of facilities functioning, survey with service providers (e.g., health care facilities, municipal water authorities) and humanitarian organizations, administrative records analysis (e.g., mortality), public health surveillance data (e.g., outbreaks, nutrition status)
Civilian experience	Experiences of disruption, harm, adaptation and coping, and stress and anxiety	Population-based surveys, focus groups, testimonies from affected individuals, social media content monitoring

INDICATORS TO MEASURE THE IMPACTS OF ATTACKS ON ENERGY INFRASTRUCTURE

This guide introduces indicators for measuring the impacts of attacks on energy infrastructure. Some of these indicators incorporate measures from other sectors, given the interdependence between energy and other civilian systems. Another set of indicators are unique to energy infrastructure. The table is broken into immediate and reverberating effects. Data types are also included at a high level; specific examples of open-source investigations and surveys are available in the resources listed at the end of the guide.

GUIDANCE FOR USING THE INDICATORS

Researchers should begin by considering the level of effects (immediate or reverberating) and the sector or sectors relevant for their analysis. The next step is identifying the indicator or indicators most relevant for measuring the civilian impact of interest. In selecting the indicators for testing, researchers should consider the types of data available to them; possible data sources are provided in non-exhaustive lists in Table 2.

Civilian harm may be documented at several related levels: the individual or household; the facility or service provider; the community or population; and the energy system as a whole. Researchers should specify the unit of analysis for each indicator and avoid inferring individual harm solely from aggregate service disruption, or collective harm solely by aggregating individual outcomes. Relatedly, where relevant, researchers should define "collective harm." For example, whether this form of harm refers to widespread or community-level deprivation, harm to a particular group, or degradation of a system on which a population depends.

Establishing a link between a power outage and civilian harm is distinct from determining how the outage was caused. In the indicators, references to harm occurring "due to" or "as a result of" a power outage relay the self-reported relationship between the disruption of electricity and the civilian impact. They do not, by themselves, establish whether the outage was due to an attack rather than maintenance or another cause, confirm that the energy infrastructure was deliberately targeted, identify the actor responsible, or support a legal determination regarding the attack.[42]

Given the interconnectedness of energy infrastructure and the compounding nature of harm, simultaneous impacts across services should be considered in most analyses. Likewise, the cumulative harm of attacks means that documentation should consider the frequency, duration, and sequencing of outages; previous exposure to attacks or disruption; pre-existing vulnerabilities; and changes in the ability of individuals, households, facilities, and communities to cope and recover.

In many cases, cross-sectional data is appropriate, since indicators measure civilian impact at one point in time. For instance, this might be the number of students without access to online learning due to outages during a particular month. In other cases, longitudinal data may be ideal, particularly for indicators that compare pre-conflict conditions to current ones, or if shifts in an indicator are measured over time to show cumulative harm.

Where possible and appropriate, indicators should be disaggregated by location, gender, age, disability, and other characteristics relevant to the sector to facilitate the identification of places and groups differentially impacted by attacks on energy infrastructure.[43]

Data types for the indicators below include information from government ministries and population surveys. Such data may not be available in some contexts, for instance where a government lacks the capacity to gather information, manipulates

statistics, or is the perpetrator of attacks. Additionally, the collection of such data may not be feasible due to resource or security constraints. Data may also be available but not sufficiently fine-grained to analyze the differential impacts of attacks by relevant groups. Finally, repeated data collection over time or drawing comparisons with pre-conflict data may not be feasible in some contexts. Information from the United Nations, humanitarian cluster system, NGOs, news reports, violence monitors, and other public sources is sufficient to measure some indicators; however, for other indicators, researchers may be limited by data availability and related constraints.

Table 2: Indicators to measure the impacts of attacks on energy infrastructure

Level of effects	Sector	Indicators	Data types
Immediate effects	Energy	Number or proportion of energy facilities (substations, powerlines, etc.) damaged, destroyed, or where supply is obstructed[44]	NGO reports, news reports, and other incident-level data; energy ministry press releases or records of total facilities; needs assessments
		Number of energy infrastructure personnel deaths and injuries	NGO and news reports; energy ministry press release
		Number of energy facilities occupied or used by armed forces or groups that damage facilities, harm personnel, or obstruct power generation or transmission	NGO and news reports; energy ministry press release
Reverberating effects	Energy	Number or proportion of energy facilities rendered inoperable or with degraded capacity for service delivery[45]	NGO and news reports; energy ministry data (e.g., grid operational logs)
		Electricity generation capacity lost (in gigawatts) or percentage of demand not served, relative to pre-conflict capability	Energy ministry data (e.g., grid operational logs)
		Average number of hours per day with electricity or number of outages, compared to pre-conflict[46]	Energy ministry data (pre- and post-conflict); population survey data (pre- and post-conflict); NGO and news reports
		Proportion of the population (or households) experiencing disruption of energy services and their geographic distribution	Population survey data; energy ministry data; energy transmission system operator and distribution system operator data
	Cross-sector	Number or proportion of schools, businesses, health, water and sanitation, or other civilian facilities experiencing power disruption	NGO and news reports; data from relevant ministries or facilities
		Number or proportion of schools, businesses, health, water and sanitation, or other civilian facilities forced to reduce, suspend, or relocate services due to power disruption	NGO and news reports; data from relevant ministries or facilities
		Duration and frequency of power cuts at schools, businesses, health, water and sanitation, or other civilian facilities due to power disruption[47]	NGO and news reports; data from relevant ministries or facilities; surveys or interviews with staff of civilian facilities
	Health[48]	Number or proportion of the population able to receive routine or emergency medical care during power outages[49]	Population survey data (representative of a region or the country); needs assessment data; ministry of health or health service provider data
		Number or proportion of the population able to obtain, use, or properly store prescribed	Population survey data, surveys or interviews with health service

Level of effects	Sector	Indicators	Data types
		medications during power outages[50]	providers or patients
		Number or proportion of the population able to operate medical devices that are needed for care at home during power outages	Population survey data; interviews with health service providers, humanitarian and NGO workers, and patients; emergency service reports, ministry of health or health service provider data
		Number or proportion of the population with injuries, illnesses linked to coping strategies, malnutrition, or worsening chronic conditions during power outages (e.g., falls, accidents, burns or carbon monoxide poisoning due to unsafe heating)	Population survey data, police and emergency services reports; ministry of health or health service provider data; public health surveillance data
		Proportion of the population that experienced lack of heating or cooling due to power outages	Population survey data; needs assessment data
		Number or proportion of the population with missed or complicated maternal, newborn, or infant care due to power outages[51]	Population survey data; needs assessment data; surveys or interviews with health providers or patients; ministry of health and hospital administrative data
		Incidents of disrupted, damaged, broken, or malfunctioning medical equipment due to power outages	Surveys or interviews with health care providers; ministry of health or local health authority data; hospital administrative data
		Incidents of disruptions in storage of medications, vaccines, or biological samples in health care facilities due to power outages	Surveys or interviews with health care providers; ministry of health or local health authority data; hospital administrative data
		Incidents of disrupted hospital functionality, communications, or data losses affecting medical care during power outages[52]	Surveys or interviews with health care providers; ministry of health or local health authority data; hospital administrative data
		Number of emergency, routine, or elective procedures delayed, interrupted, cancelled, or completed under degraded conditions due to power disruption[53]	Surveys or interviews with health care providers; ministry of health or local health authority data; hospital administrative data
		Number or proportion of patients referred elsewhere, discharged early, or unable to be admitted due to power disruption, or who experienced delays in diagnosis or treatment due to unavailable imaging, laboratory testing, or electronic records	Surveys or interviews with health care providers; ministry of health or local health authority data; hospital administrative data
		Disease outbreaks related to power disruption (e.g., respiratory infections linked to heating or	Public health surveillance data; ministry of health data (e.g.,

Level of effects	Sector	Indicators	Data types
		crowding, hospital-acquired infections linked to disruption of sterilization)	outbreaks); hospital records
		Number of permanent health harms and deaths reported as plausibly linked to power disruption, or excess morbidity and mortality associated with periods of power disruption	Health ministry data; representative population survey with surviving family members
	Mental health	Proportion of the population with new or deteriorating mental health symptoms linked to power disruption	Population survey data (pre- and post-conflict); surveys or interviews with mental health service providers; NGO reports
		Number or proportion of health workers reporting increased workload, stress, burnout, moral distress, or fear linked to power disruption	Surveys of clinicians, interviews with mental health providers; NGO reports
	Education	Number of days of virtual or in-person schooling lost due to power disruption	School or education ministry data; interviews with education staff; population survey data
		Proportion of students (or households with students) unable to participate in remote/online classes or complete homework due to power outages	Population survey data; school or education ministry data
	Water and sanitation	Number or proportion of population affected by the disruption of water and sanitation due to power outages	Relevant ministry data (health, environmental protection, etc.); population survey data (representative of a region or the country)
		Proportion of the population experiencing water-borne diseases or infections due to limited sanitation related to power outages	Relevant ministry data (health, environmental protection, etc.); population survey data (representative); needs assessment data
	Food security	Number or proportion of population who skipped meals or ate spoiled food due to power outages	Population survey data; needs assessment data; public health surveillance data (e.g., nutrition status)
		Number or proportion of markets, bakeries, food warehouses, or other food distribution points that stopped or limited operations due to power outages	NGO and news reports; data from relevant ministries or facilities
	Humanitarian aid	Number or proportion of internally displaced persons (IDPs) or refugees affected by power outages	International and local NGO data; data from relevant ministries or facilities; population survey data (representative); needs assessment data

Level of effects	Sector	Indicators	Data types
		Number or proportion of humanitarian facilities, offices, distribution points, or IDP/refugee camps that stopped or limited the provision of aid due to power outages	International and local NGO data; news reports; data from relevant ministries or facilities
	Income	Number or proportion of the population who lost income, work, or access to banking due to power outages	Population survey data; needs assessment data
		Amount or percentage of income lost due to power outages	Population survey data; needs assessment data; central bank data
	Cultural heritage	Number or proportion of cultural artifacts (e.g., art, archives, sites) damaged due to power outages[54]	NGO and news reports; museum and other cultural heritage site inventory logs; national cultural heritage registries
	Environment	Square mileage of agricultural, forest, or developed land flooded by a reservoir breach (e.g., damage to a hydroelectric dam)	NGO and news reports; ministry of agriculture land use data
		Hazardous waste as a proportion of all debris produced (e.g., damage to a nuclear power plant)	Ministry of environment pollution data
		Number or proportion of illnesses or deaths reported attributable to the spread of radioactive contaminants (e.g., damage to a nuclear power plant)[55]	Ministry of health data
	Resilience and coping strategies	Number or proportion of population that used a coping strategy (e.g., storing extra food) during power outages	NGO and news reports; population survey data
		Number or proportion of the population with back-up generators or renewable energy sources (or schools, businesses, health, water and sanitation, or other civilian facilities with the same)	NGO and news reports; population survey data; data from relevant ministries or facilities
		Number or proportion of population that reports the ability to cope with future power outages (e.g., have supplies or are otherwise prepared to remain in their home for more than one week)	Population survey data
		Number or proportion of the population that temporarily relocated, evacuated, or was displaced during power outages	NGO and news reports; population survey data; government or customs data

ETHICAL AND SECURITY CONSIDERATIONS

Documentation of attacks on energy infrastructure should be planned and conducted in accordance with standard ethical and do-no-harm principles. Where primary data collection involves individuals, researchers should obtain voluntary and informed consent, minimize the risk of distress or retraumatization, and clearly explain how information will be used, stored, shared, and protected.[56] For all forms of data collection, particular care should be taken with names, contact details, precise location details (e.g., geolocation), staffing patterns, repair routes, facility vulnerabilities, and other information that could expose respondents, energy workers, service providers, or infrastructure to retaliation, surveillance, or further attack. Researchers should collect only the information necessary for the stated purpose, use secure data-management procedures, and anonymize or aggregate data where possible. Decisions to collect or publish sensitive information should be based on an assessment of whether its evidentiary or operational value outweighs the foreseeable risks to individuals and communities.

RESOURCES FOR ETHICAL HUMAN SUBJECTS RESEARCH

- Institutional Review Boards (IRBs) or ethics committees at universities and hospitals
- *The Belmont Report* (guiding principles for research with human subjects)
- The Common Rule (U.S. regulations for the protection of human subjects)
- Office for Human Research Protections guidance
- Professional association ethics codes
- Collaborative Institutional Training Initiative (CITI) modules for research, ethics, compliance, and safety
- Global Code of Conduct for Gathering and Using Information about Systematic and Conflict-Related Sexual Violence (Murad Code) provides principles and resources for survivor-centered research approaches and informed consent

RELEVANT RESOURCES

Significant work has been undertaken by human rights and humanitarian organizations, UN agencies, academics, and legal experts to document the impacts of attacks on civilians and civilian infrastructure. Although developed for sectors adjacent to energy infrastructure, many of these indicators, toolkits, interactive maps, and other resources are relevant for measuring the impact of attacks on energy infrastructure. These resources are included below.

RESOURCES FOR DATA COLLECTION

REPORTS AND TOOLS RELATED TO THE IMPACTS OF ATTACKS ON ENERGY INFRASTRUCTURE

Impacts of attacks on energy infrastructure on civilian health, mental health, education, and livelihoods:

- Kobo, TJET, and Rating Group, *Ukraine: Household survey of effects of attacks on energy infrastructure (2020-2025)*
  - Survey instrument (English, Ukrainian, Russian)
- PHR and Truth Hounds, *Health Care in the Dark: The Impacts of Russian Attacks on Energy in Ukraine*
  - Survey instrument (English, Ukrainian)
- UN Human Rights Monitoring Mission in Ukraine, *Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population*

GUIDES, REPORTS, AND TOOLS FROM ADJACENT SECTORS WITH RELEVANCE FOR ATTACKS ON ENERGY INFRASTRUCTURE

Explosive weapons:

- UNIDIR, *Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas*
- UNIDIR, *Second Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas*
- UNIDIR and EWM, *Understanding Civilian Harm from the Indirect or Reverberating Effects of the Use of Explosive Weapons in Populated Areas*
- EWM, *Explosive Weapons Monitor*

Education:

- GCPEA, *Toolkit for Collecting and Analyzing Data on Attacks on Education*
- GCPEA, *Education under Attack* report series
- TRACE Data Portal, a collaboration between Kobo, GCPEA, Insecurity Insight, and the Education Above All Foundation
- UNICEF, Monitoring of Attacks on Education
- UN Monitoring and Reporting Mechanism, Guidelines and Field Manual

- Education Clusters, Monitoring of Attacks on Education
- Kobo, *"Learning under Fire": Attacks on Education in Colombia, 2020-2025*
- Kobo, *Methodological Guide for Documenting Attacks on Education: Lessons from Colombia*

Health:

- PHR, Truth Hounds, and partners, Map of Attacks on Health Care in Ukraine
- Safeguarding Health in Conflict Coalition (SHCC), Attacked and Threatened: Health Care at Risk map
- SHCC and partners, *Toolkit: Evidence that Protects Health Care*
- Researching the Impact of Attacks on Healthcare, Resources

Humanitarian aid:

- Insecurity Insight, *Aid in Danger*

Environment:

- Conflict and Environment Observatory, *Ukraine conflict environmental briefing (Fossil fuel infrastructure)*
- PAX, Environment, Peace and Security programme, *Risks and impacts from attacks on energy infrastructure in Ukraine*

Cultural heritage:

- International Centre for the Study of the Preservation and Restoration of Cultural Property, *First Aid to Cultural Heritage in Times of Crisis - Handbook*
- UNESCO, Learning on Culture in Emergencies
- Human Rights Watch, *Destroying Cultural Heritage: Explosive Weapons' Effects in Armed Conflict and Measures to Strengthen Protection*

Cumulative harm:

- Essex, Oxford, Georgetown, and Duke Universities, Cumulative Civilian Harm Project examining the legal and policy parameters for taking into account the aggregated harm to the civilian environment over time
- Hathaway, Khan, Revkin, "The Dangerous Rise of Dual-Use Objects in War," *Duke Law School Public Law & Legal Theory Series*

Accountability:

- International Criminal Court, *Guidance for documenting international crimes for accountability purposes*

Cyber attacks:

- International Group of Experts at the Invitation of the NATO Cooperative Cyber Defence Centre of Excellence, *Tallinn Manual on the International Law Applicable to Cyber Warfare*

ENDNOTES

1. Under international humanitarian law, all three principles of distinction, precautions and the duty of constant care, and proportionality work together to minimize civilian harm in war. The duty of constant care, in particular, provides important affirmative obligations on parties to a conflict throughout operations: "(i)n the conduct of military operations constant care shall be taken to spare the civilian population, civilians and civilian objects." AP I art. 57(1) and a general principle under customary international law. Furthermore, a proportionality assessment is the process of weighing expected incidental civilian harm against the anticipated military advantage of an attack. If the incidental harm—such as civilian casualties or damage to civilian objects—is excessive in relation to the direct and concrete military advantage anticipated, then that attack is prohibited AP I 57 2(b).. For more information see: ICRC, Customary International Humanitarian Law, Rule 14: Proportionality in Attack, International Humanitarian Law Database.

2. Reverberating effects are defined as harms "that are not directly and immediately caused by the attack, but are nevertheless the product thereof." Although the term is often associated with explosive weapons in monitoring frameworks or proportionality assessments under international humanitarian law, this guide uses the terminology regardless of weapon type or legal connotation. In this document, "reverberating effects" is interchangeable with "knock-on effects." For more see: Isabel Robinson and Ellen Nohle, "Proportionality and precautions in attack: The reverberating effects of using explosive weapons in populated areas," International Review of the Red Cross, 2016, 98 (1), 107–14; and Alfredo Malaret Baldo Francesca Batault, *Second Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas*, UNIDIR, 2022.

3. ICRC, "ICRC president: War on essential infrastructure is war on civilians; every effort to de-escalate is critical," Presidential Statement, March 23, 2026.

4. Truth Hounds, "Seizing Power: Rosatom's Complicity in Occupation, Torture, and Nuclear Safety Breaches at the Zaporizhzhia NPP," September 24, 2025; "Central Darfur: Sabotage attacks in Zalingei target power and water lines," *Radio Tamazuj*, February 11, 2024; Priam Nepomuceno, "AFP condemns NPA attack on Mindoro power plant," *Philippine News Agency*, February 26, 2019; Philip Acuña, "ELN guerillas allegedly attack Ecopetrol supply caravan," *Colombia Reports*, April 28, 2014; WB, EU, UN, *Gaza Strip: Rapid Damage and Needs Assessment*, April 2026.

5. Explosive Weapons Monitor, *Explosive Weapons Monitor 2024*, May 2025; OHCHR, "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population," Bulletin, UN Human Rights Monitoring Mission in Ukraine, September 2024;

6. Human Rights Watch, "Israel, Iran: Unlawful March Attacks on Energy Infrastructure," April 22, 2026; "Power-line attack plunges Yemen into darkness," *Al Jazeera*, June 11, 2014; United Nations, "Report: Gaza Strip Rapid Damage and Needs Assessment – European Union, United Nations and World Bank," April 20, 2026, p. 30; Safeguarding Health in Conflict and Insecurity Insight, "Care in the Crosshairs: Violence Against Health Care in Conflict," 2025, p. 17; Mohamed Elnourani, Hamid Suliman Hamid Elhag, Waleed Isameldin Alasad, and Mohamed Nasr Bashier, "Khartoum War's echoes in oil and energy sectors: Economic and environmental implications for Sudan and South Sudan," *Heliyon*, July 2024, 23;10(15):e34739; ICRC, "Sudan: Attacks on critical civilian infrastructure surge amid escalating fighting," January 27, 2025.

7. Commentary of 1987 on Additional Protocol I, note 3(b) to Article 52

8. The full name is the Political Declaration on Strengthening the Protection of Civilians from the Humanitarian Consequences Arising from the Use of Explosive Weapons in Populated Areas. More details can be found at EWIPA.org.

9. Article 54(2) of Additional Protocol I.

10. Customary International Humanitarian Law Database, Rule 10; Customary International Humanitarian Law Database, Rule 14; Article 48 of Additional Protocol I to the 1949 Geneva Conventions (AP I); Article 52(1) of AP I.

11. Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) (adopted 8 June 1977, entered into force 7 December 1979) 1125 UNTS 3, art. 51(5)(b); *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; Isabel Robinson and Ellen Nohle, "Proportionality and precautions in attack: The reverberating effects of using explosive weapons in populated areas," *International Review of the Red Cross*, 2016, 98 (1), 107–145; Eirini Giorgou and Abby Zeith, "When the lights go out: the protection of energy infrastructure in armed conflict," *ICRC Humanitarian Law & Policy Blog*, April 20, 2023.

12. The applicability of these rights in conditions of conflict varies, as does the degrees of obligations on the Parties to a conflict (e.g., attacking vs. invading vs. occupying States).

13. United Nations General Assembly. "International Covenant on Economic, Social and Cultural Rights," December 16, 1966, United Nations, Treaty Series, Vol. 993, p. 3.

14. Mark Zeitoun and Michael Talhami, "The impact of explosive weapons on urban services: Direct and reverberating effects across space and time," *International Review of the Red Cross*, 2016, 98 (1), 53–70.

15. Mark Zeitoun and Michael Talhami, "The impact of explosive weapons on urban services: Direct and reverberating effects across space and time," *International Review of the Red Cross*, 2016, 98 (1), 53–70.

16. Mark Zeitoun and Michael Talhami, "The impact of explosive weapons on urban services: Direct and reverberating effects across space and time," *International Review of the Red Cross*, 2016, 98 (1), 53–70. Diakonia International Humanitarian Law Centre, *Protection of Civilian Infrastructure in Armed Conflict: Q&A*, 2023.

17. United States Environmental Protection Agency, "Centralized Generation of Electricity and its Impacts on the Environment," December 23, 2005; François Bouffard and Daniel S. Kirschen, "Centralised and distributed electricity systems," *Energy Policy*, Vol. 36, Issue 12, 2008, pp. 4504-4508.

18. This definition adapts established definitions used to monitor attacks on civilians and civilian infrastructure from other sectors, while also drawing on academic and technical descriptions of energy infrastructure. For more, see: WHO, "Surveillance system for attacks on health care," WHO/WHE/EMO/2019.2/BRO, December, 2018; Office of the Special Representative of the Secretary-General for Children and Armed Conflict (OSRSG-CAAC), United Nations Children's Fund (UNICEF) and United Nations Department of Peacekeeping Operations (DPKO), "Field Manual: Monitoring and Reporting Mechanism (MRM) on Grave Violations Against Children in situations of Armed Conflict," June 2014; GCPEA, *Toolkit for Collecting and Analyzing Data on Attacks on Education*, January 2023, ICRC, "International Humanitarian Law and Cyber Operations during Armed Conflicts," position paper, 2019; Mark Zeitoun and Michael Talhami, "The impact of explosive weapons on urban services: Direct and reverberating effects across space and time," *International Review of the Red Cross*, 2016, 98 (1), 53–70; Christina Hoicka and Julie MacArthur, "The Infrastructure of Electricity," *The Oxford Handbook of Energy Politics*, 2021.

19. "Brief Overview of the Electricity Infrastructure Sector," International Trade Administration webpage, accessed June 13, 2025.

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21. Radio Free Europe/Radio Liberty, "Iraqi Officials Say Seven Killed In Suicide Attack On Power Plant," September 2, 2017.

22. UNICEF, "State of Palestine: Humanitarian Situation Report – UNICEF update," August 28, 2014.

23. Eirini Giorgou and Abby Zeith, "When the lights go out: the protection of energy infrastructure in armed conflict," *ICRC Humanitarian Law & Policy Blog*, April 20, 2023.

24. Mohammad Reza Farzanegan and Reza Majdzadeh, "When electricity infrastructure is targeted, health is targeted too," *BMJ*, April 30, 2026, 393:s831.

25. PHR and Truth Hounds, *Health Care in the Dark: The Impacts of Russian Attacks on Energy in Ukraine*, December 2024.

26. UNICEF, "Effect of Power Outages on Education in Ukraine [Presentation]," July 2024; GCPEA, "Attacks on Education and Military Use of Education Facilities in Ukraine in 2022," February 2023; Save the Children, *"I want a peaceful sky": Education and children's wellbeing in wartime Ukraine*," 2024; Esra Abdallah Abdalwahed Mahgoub, Amna Khairy, Samar Osman, Musab Babiker Haga, Sarah Hashim Mohammed Osman, Abubker Mohammed Abbu Hassan, Hala Kamal, and Ayia Babiker, "War and education: the attacks on medical schools amidst ongoing armed conflict, Sudan 2023," *Conflict and Health*, March 29, 2014 ;18(1):23, p. 7; Mizzima News, "Myanmar youth struggle for education amidst coup-triggered power outages," April 17, 2024.

27. UN Human Rights Monitoring Mission in Ukraine, "Attacks on Ukraine's Energy Infrastructure: Harm to the Civilian Population," September 2024; UNICEF, "'Barely a drop to drink': children in the Gaza Strip do not access 90 per cent of their normal water use," UNICEF press release, December 20, 2023; MSF Sudan, "Sudan: Drone Attacks on Power Plant Threaten Lives and Health Services in River Nile State."

28. UNICEF, "Ukraine Humanitarian Situation Report," December 2022.

29. MSF Sudan, "Sudan: Drone Attacks on Power Plant Threaten Lives and Health Services in River Nile State," May 7, 2025.

30. Vinck P, Mysiv L, Marston J, Pham PN. 2026. "Household Survey of Effects of Attacks on Energy Infrastructure (2022-2025)," 2026. Kobo.

31. Abdelhakim Abu Riash, "Gaza bakeries targeted and destroyed by Israeli air attacks," *Al Jazeera*, November 2, 2023.

32. UNICEF, "Water under Fire," 2019. ACAPS, "Ukraine: Energy infrastructure attacks - Updated outlook and impact during the 2024–2025 cold season."

33. PHR, "Attacks on Health in Ukraine Continue to Escalate Four Years into Russia's Full-Scale Invasion," February 12, 2025.

34. UNDESA, *Electricity and education: The benefits, barriers, and recommendations for achieving the electrification of primary and secondary schools*, 2014.

35. UNESCO, *United Nations World Water Development Report, Water and Energy*, 2014.

36. Mark Zeitoun and Michael Talhami, "The impact of explosive weapons on urban services: Direct and reverberating effects across space and time," *International Review of the Red Cross*, 2016, 98 (1), 53–70.

37. Mark Zeitoun and Michael Talhami, "The impact of explosive weapons on urban services: Direct and reverberating effects across space and time," *International Review of the Red Cross*, 2016, 98 (1), 53–70. Christina Wille and Alfredo Malaret Baldo,

Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas, UNIDIR, 2020. Bárbara Morais Figueiredo and Katherine Young, *Understanding Civilian Harm from the Indirect or Reverberating Effects of the Use of Explosive Weapons in Populated Areas*, UNIDIR and EWM, 2024.

38. Bárbara Morais Figueiredo and Katherine Young, *Understanding Civilian Harm from the Indirect or Reverberating Effects of the Use of Explosive Weapons in Populated Areas*, UNIDIR and EWM, 2024.

39. To the authors' knowledge. Exceptions are emerging, however: Insecurity Insight has developed the methodologies for open-source monitoring of attacks on energy infrastructure, including through social media scraping using natural language processing (NLP); ACAPS monitors incident-level attacks on energy infrastructure in select countries; and the Armed Conflict Location & Event Data (ACLED) project tracks events that target or damage infrastructure in Ukraine, including energy, using automated NLP tags. For more, see: "Recorded facility damages," Ukraine Interactive Dashboard, ACAPS; and ACLED, "ACLED's methodology on Ukraine civilian infrastructure automated tags," February 20, 2026.

40. Bárbara Morais Figueiredo and Katherine Young, *Understanding Civilian Harm from the Indirect or Reverberating Effects of the Use of Explosive Weapons in Populated Areas*, UNIDIR and EWM, 2024.

41. Power cuts are included as a separate domain, since not all attacks on energy infrastructure result in power cuts and not all power cuts are the result of attacks. This domain is a bridge between the attack and knock-on effects for services and civilians.

42. Where possible, researchers should separately document whether the infrastructure appears to have been directly targeted, damaged during an attack on another objective, or affected in circumstances that remain unclear, along with the alleged responsible actor and the evidentiary basis for that attribution, and the strength of the causal link between the incident, the power outage, the disruption of services, and the resulting civilian harm.

43. Where possible, indicators should be disaggregated to capture differences in exposure, access, vulnerability, and severity of harm. Relevant disaggregation will vary by sector and indicator. Disaggregation is particularly important for identifying which groups and services are most affected and comparing impacts across locations or periods.

44. For instance, the following report assesses the number of power plants damaged across seven governorates in Iraq in 2017, alongside residents' access to electricity in nine cities. World Bank, *Iraq: Damage and Needs Assessment of Affected Governorates*, 2018.

45. Adapted from: Alfredo Malaret Baldo Francesca Batault, *Second Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas*, UNIDIR, 2022.

46. Adapted from: Alfredo Malaret Baldo Francesca Batault, *Second Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas*, UNIDIR, 2022.

47. Could also include: time to restore power at civilian facilities, availability and reliability of backup power, and incidents of generator failure or delayed generator activation

48. For health indicators, data should be disaggregated where possible by type of care or service affected, including routine, urgent, emergency, surgical, laboratory, imaging, pharmacy, maternity, newborn, rehabilitation, mental health, ambulance, referral, and home-based care.

49. In the case of health facilities, this could include for instance urgent care, maternal and newborn care, chronic disease care, disability-related care, and medication access.

50. Specifically, number or proportion of health facilities or patients able to refrigerate medicines, insulin, vaccines, blood products, or other temperature-sensitive medical items.

51. For instance, numbers of deliveries, pre-term deliveries, ante and postnatal complications, C-sections, neonatal interventions, or obstetric emergencies

52. Disruptions of hospital functionality could include lighting; elevators; heating/cooling/ventilation; water; sanitation; sterilization/infection prevention; oxygen systems; internal transport; back-up power generation. Disruptions in communications could include delays/errors in patient identification, emergency dispatch, ambulance coordination, referral pathways, delays in prescription dispatching, telemedicine, and patient contact systems.

53. For instance, dialysis, chemotherapy, radiotherapy, intensive care unit (ICU), neonatal intensive care unit (NICU), emergency, surgical, trauma, or oxygen-dependent treatments affected.

54. The loss of electricity can cause failures to climate control, fire suppression, and security systems, which are needed to preserve and secure cultural heritage; For more, see: Human Rights Watch, *Destroying Cultural Heritage: Explosive Weapons' Effects in Armed Conflict and Measures to Strengthen Protection*, April 2024; International Centre for the Study of the Preservation and Restoration of Cultural Property's *First Aid to Cultural Heritage in Times of Crisis - Handbook*, 2018.

55. The indicators concerning flooding, hazardous waste, and radioactive contaminants are adapted from environmental degradation indicators found in: Alfredo Malaret Baldo Francesca Batault, *Second Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas*, UNIDIR, 2022.

56. For more details on interviewee and team safety, see: Office of the High Commissioner for Human Rights, "Interviewing," *Manual on human rights monitoring* (HR/P/PT/7/Rev. 1), 2011.