

Water in the War in Ukraine: between Mobilization and Collapse

by Sophie Lambroschini

Ukraine's water networks have been mobilized since the start of the war in 2014. Infrastructure workers are some of the last to leave settlements attacked by the Russian army. Water systems and people resist but are approaching the limits of their capacity to adapt to violence and disruptions.

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The risk of societal collapse in the event of a total blackout has focused international attention on the consequences of Russian strikes on energy networks rather than on water. By June 2024, 73% of Ukraine's thermal power plants and 20 hydroelectric generation installations were not functioning because of extensive damage (HRMMU 2024). Water supply is of course directly dependent on power so any attack on a power plant has a severe effect on the water sector ; less than 15% of Ukraine's water supply has the generator capacity to function independently from the power grid for extended periods (WASH cluster 2024). Yet water supply crises are also caused by direct attacks on water installations and by indirect and long-term effects.

The critical situation around water has brought entire conurbations to critical thresholds since the start of the Russian war in Ukraine in 2014.

I was visiting the Voda Donbasu utilities company's subdivision in Avdiivka on the frontline separating Ukrainian controlled territories from the Moscow-backed separatist Donetsk Popular Republic. Artillery rumbled in the background. It was October 2021, a few months before the full-scale invasion. I was speaking with Olena¹, a female technician in charge of a wastewater collector of a local water utilities company in embattled Donbas. She was checking the pressure gauges as part of her hourly control protocol. The installations had recently suffered a bout of artillery fire and a colleague had been killed. 'As long we are here it means the city hasn't fallen yet'. Her words expressed determination; the turn of phrase mimicked the lyrics of the Ukrainian national anthem: 'Ukraine hasn't perished yet.'²

Water technicians are indeed some of the last municipal employees to leave a town under attack. That's because water is a need that can't be replaced by anything else: civilians need local water as the fighting around them makes outside supply more difficult; wastewater collection and treatment are critical to avoiding epidemics; fires started by missile and drone strikes on buildings need to be put out with water or more people might die; lack of water is as certain to cause death as a lack of ammunition.

So, when in March 2024, Svitlana's hometown of Avdiivka was taken by the Russian army after months of battle, she and colleagues from the Voda Donbasu company were among the last to leave. Their employer resettled them and their families further back to towns like Dobropillie and Pokrovsk. Where they soon found themselves once more under attack by the Russian advance. Located at a strategic juncture in eastern Ukraine, Pokrovsk has been a strategic objective in the war with dramatic consequences on urban water supply. When the town was cut off from the Donbas water supply route the company's engineers found an alternative: they pumped the water that accumulates in defunct coal mines, and then filtered it through a portable filter installation powered by generators. The use of polluted mine water had been a desperate improvisation but it worked until October when even this alternative source was damaged in the fighting. Now the remaining sources of water

¹ The names have been changed and trajectories anonymized sufficiently to avoid identification. While some respondents requested anonymity many infrastructural workers were proud to state their names. I nevertheless chose to anonymize them under the 'Do-not-harm' principles taking into consideration the uncertainty of future political and security developments.

² She said (in Ukrainian): 'misto shshe ne vmerlo'. The lyrics of the anthem are 'Ukraine hasn't perished yet'.

are individual wells. While well water may appear to save the day (providing there is energy for the pumps) the economy of water in war is in fact far more complex than simply filling containers with drinking water.

How do water systems operate in war and continue to provide this public service? I try to answer this question based on observations and interviews during visits to water facilities since 2017 in the unoccupied areas of Donbas during the first phase of the war in the east, and since 2022 throughout the country.³ Following a general overview of the technical and geographic constraints on how water is produced and circulates in Ukraine, the article shows how the water is mobilized – through people, aid, and innovations, and partly transformed. The goal of this article is not to analyze the strategic role of water in conflict as a weapon or military objective in itself, but to understand how water operates in a context of military violence. How have drinking water supply companies changed in wartime, what are the mechanisms, the players and their strategies, but also the limits of their capacity to absorb the economic, technical and social shocks following the Russian offensive?

Water, energy and modern urban life in wartime

The water-energy nexus is connected to how we perceive modernity and urban civilization. The loss of water and/or power puts that perception in doubt. A technician from the Chernihiv water supply company who had remained with 300,000 compatriots trapped in the city besieged by the Russian army in the spring of 2022 told me: ‘Two days after the destruction of the electrical installations in Chernihiv, there I was, digging a septic tank in the courtyard of our building. On the sixth floor there was no light, no water, no heating and no toilet. There was no point in having an apartment.’¹

Hydraulic power and the indispensable water cooling in the nuclear power generation process remind us how water systems are inextricably linked to energy systems. The supply of water to populations and businesses requires energy at all times: pumping in urban systems, wastewater treatment, central heating. The vast

³ The essay draws on research conducted in Ukraine (Donetsk oblast, Izmail district, Odessa oblast, Chernihiv, Chernivtsi) in 2017-24, and on digital ethnography such as the monitoring of Telegram channels of utilities companies, as well as both in-person and online conversations with representatives of water utilities in Ukraine, representatives of humanitarian agencies, local and national officials as well as ordinary consumers.

majority of energy installations have been affected since the large-scale war launched by Russia in February 2022 complicating water supply and treatment. While the water sector has often successfully succeeded in making repairs, the state of vulnerability is extreme. Between 73 and 87 per cent of water and wastewater plants say they don't have backup generation solutions in case of blackouts (WASH cluster 2024). Throughout the country, water quality has deteriorated. One third of drinking water does not meet European standards. 10 million people - more than a quarter of the population - lack safe access to water, according to UNICEF. The constant direct and indirect strikes on installations, particularly near the front line, are to blame. The lack of upkeep due to war lets the already run-down Soviet-era hardware deteriorate further. Sometimes innovative solutions bring immediate relief but no long-term solutions. For example, after the city of Mykolaiv was cut off from its watershed, the river Dnipro, following heavy fighting in the spring of 2022, the local utilities company built a system to pump water from the Black Sea nearby. This improvised pipeline built under fire in record time. It was an engineering feat but won't operate for very long because the salt is corroding the pipes.

Water as connecting people and territories of conflict in Ukraine

Many repairs are carried out underground, in their everyday work the maintenance workers manipulate the piping that underpins urban environments, by water professionals, technicians and engineers. These men, women are called upon to adapt, to be 'resilient' – i.e. flexible – whereas the 'hardware' itself is made of pipes, bolts, cables, conduits that are not. This is a core characteristic of 'piped' infrastructure networks such as water, gas and, electricity. They cannot be moved at the whim of changing needs and fluctuating security. The constant tension between flexible people and inflexible hardware is both a source of vulnerability and of strength. It is compounded by conventional warfare waged in an industrialized, urban country.

The adaptability and limits of large-scale water networks in Ukraine is shaped by geophysical, physical, and human environments. Geographers sometimes refer to such infrastructural networks as 'socio-technical systems' to underline how sociological dynamics interact with hardware across space (Hughes 1983, Monstadt, Nauman 2005, Rouillé-Kielo, Le Visage and Flaminio 2022). The related concept of

'hydrosocial territory' emphasizes that water infrastructure systems are spaces of cooperation but also of conflict (Boelens et al. 2016). These notions are useful for analyzing the wartime dynamics of water supply systems as integrating broader socio-economic, historical, and geophysical contexts.

The Dnipro as a strategic water web

In Ukraine, about 70% of the population rely on surface water such as lakes and rivers for drinking. Europe's fourth longest river, the Dnipro, carries 80% of Ukraine's water. Two-thirds of the population depend on it directly or indirectly as a source of drinking water (OECD 2013). The river rises in Russia, meanders through Belarus and then crosses Ukraine from north to south, flowing into the Black Sea. The river's role in energy, water, and transport infrastructure makes it into a vital part of Ukrainian sovereignty and a strategic target for the Russian army. The Dnipro basin is key to domestic water ecology and explains the country's human, economic and military geography. The river's geo-economic importance is matched by its historical and cultural significance (Cybriwsky 2018).

Seen from the air, the hydraulic system of the Dnipro, an anthropocene river *par excellence*, resembles a spider's web whose threads are woven by tributaries, canals and a multitude of urban supply and irrigation networks. This system was initiated by the Soviet government in the 1920s and developed over decades. Control of the river was intended to fuel the country's industrial modernization helped by the construction of six hydroelectric power stations, dam lakes, major irrigation systems and river ports to transport metallurgical and agricultural production. The Zaporizhzhia nuclear power plant draws its cooling water from the river. The river's hydraulic complexes supply the large metallurgical industries of Marhanets, Dnipro, Zaporizhzhia and Kriviy Rih. Through this system the waters of the Dnipro actually penetrate deep and far, hundreds of kilometers away from the river itself. For example, a canal connects the Dnipro to the narrow Siverskiy Donets river that feeds water into the industrial Donbas to the east, and another canal to the south that is meant to carry water to the Crimean Peninsula.

While the Ukrainian army controls most of the river, the river's ecological and technical situation can still be controlled by the enemy. Downstream, close to the Dnipro estuary, the Russian army took control of the Kakhovka hydroelectric station,

giving it decision-making power over electricity distribution. The explosion of the dam while under Russian control in June 2023 caused economic, humanitarian and ecological destruction unparalleled in Europe both on Russian-controlled territories and in Ukraine (UN 2023).

Water management during the first phase of the Russian war in Ukraine, the Donbas and annexed Crimea (2014-22)

Russia's war in Ukraine was already disrupting water infrastructure before the February 2022 full-scale invasion. In the Donbas the Ukrainian army was pushing back Moscow-backed separatists installed in territories bordering with Russia. The fighting damaged hardware and endangered professionals because the demarcation line established by two cease fire agreements in 2014 and 2015 was violated on a weekly basis by both sides, splitting the region in two. Meanwhile, the arid Crimean peninsula that had been forcibly annexed by Russia in 2014 depended on water pumped from Ukrainian controlled territory that Kyiv decided to cut off in an attempt at pressuring the invader. Back in the Donbas, water supply operated across the frontline shows how social, security and technological aspects of water supply are interdependent. The survival of the infrastructure network was a major humanitarian and economic issue during the first phase of the conflict between 2014 and 2022. It also foreshadowed what followed the large-scale Russian invasion attempt in 2022.

In May 2014 the violent breakthrough of separatist fighters into the Donbas, established their control over territory taken from Ukraine, and over part of the water supply network. The front line has fractured road networks, communities and water supplies throughout the region. The Donbas mining industries and the urban centers that developed there during the 20th century (Europe's largest coking plant in Avdiivka, the Azovstal steelworks in Mariupol...) require intensive use of water but region has few localized water resources. Consequently, the water supply lines for industry and urban consumption were developed through large-scale networks tapping into the Siverskiy-Donets river and then distributing southwards to the Azov sea.

A water company (Voda Donbasu, 'Donbas Water') managed the water supply. The system was developed in the Soviet period, its network expanding with the industrial development of the region. Water for the system came from the Siverskiy

Donets in the north and zigzagged across the front line via a series of canals, pumping stations and filtration plants to Mariupol on the Sea of Azov, 300 km to the south. This water was crucial to power several small hydropower dams, provide water to water hungry metals industry, improve irrigation, and supply drinking water to about 6 million people before 2014, and 600000 after local populations fled occupation and violence. While steel, coal, and grain were the most profitable outputs of the region, it was the water industry that nourished them all. With 11,000 employees, Voda Donbasu had been the largest single employer in Donetsk oblast, more than the coking plant in Avdiivka – the largest in Europe at the time – that it provided with water. The supply of water depended on plumbers and technicians who exposed themselves to the risk of artillery fire to repair installations straddling the front line. Their only protection were local ceasefires negotiated sometimes over months. In the no-man’s land it could take half a year to access a broken pipe (Lambroschini 2019).

Voda Donbasu’s employees were the first in Ukraine to work under fire. Olena was a young hydro technician and one of two shift workers checking on the pressure valves at the Avdiivka pumping station in 2017-18. She had recently graduated from a vocational school. Her parents had worked locally for one of the coal mines and had little money to invest in higher education, so she decided to stay close to home and train at the Donetsk technical school for a repetitive and simple job. Within four months she had weathered two air raids and watched as her neighbors queued for water near the pumping station which was hit by a missile. The first employees died in the summer of 2014. Voda Donbasu’s workers were the first to develop strategies to adapt to these wartime conditions: they built makeshift shelters in cellars, taped up their windows to protect against shrapnel, and developed relationships with international humanitarian relief organizations.

Also, during this first phase of the war, Kyiv, hoping to put pressure on the Russian aggressor, gave the order to cut off the water supply to the Crimean Canal, between the Dnipro and the arid, saline lands of northern Crimea. This move led to an agricultural crisis in Crimea, a weakening of the chemical industry and the importation of resources by the Russian occupation forces.

Direct and indirect impacts on supply since 2022: domino effects on interconnected systems

Since the Russian invasion, the Ukrainian government has ceased to publish statistical data that were classified as defense secrets. It is therefore difficult to get an overall picture of the situation, which is moreover fluid according to strikes and repairs. According to the monthly monitoring carried out by the UNICEF-led WASH cluster, in March 2024 alone, i.e. before the new wave of attacks targeting critical infrastructure in April 2024, 1.6 million Ukrainians received emergency assistance. The cost of the damage is estimated by experts at 4 billion euros. Strikes on energy systems lead to water shortages and rationing, as in Kharkiv, Dnipro, Kriviy Rih and Odessa following Russian strikes this spring, which were particularly destructive in terms of their intensity and the depletion of anti-aircraft ammunition.

The collapse of the dam at the Kakhovka hydroelectric power station on the lower Dnipro dam lake caused flooding downstream, with the water carrying and dispersing landmines, armaments and chemical pollutants over large areas, while upstream of the gutted dam lake, the water sources for the towns of Zaporizhzhia, Marhanets, Kriviy Rih had dried up. There was no water for populations but also not for the Zaporizhstal steelworks that supplied the military industry and no irrigation for grain and other crops. The damage to the Dnipro hydro system is 'unprecedented' in recent history (Gleick, Vyshnevskiy, & Shevchuk 2023).

This vulnerability is particularly significant in urban areas (Graham 2009). Three-quarters of Ukrainians live in cities, often in multi-story apartment blocks, and depend on centralized water supplies for taps, heating and wastewater treatment. This urbanization limits access to alternative, autonomous resources (wells, etc.) should they be put out of action. 80% of the city of Kharkiv depends on water transported from a source 140 kilometers away: a direct hit on the pipe or its source of electricity not only destroys access to water for two million people and the urban economy, but also risks creating a massive population drain.

As for the Donbas water network highlighted above, it doesn't exist anymore as an integrated system. It was attacked so many times since February 2022, that its canals, pipes, generators, and filter stations were damaged extensively with little time, spare parts, and secure conditions for workers to make repairs. The Siversky-Donets

watershed became an embattled hotspot of the war. Towns like Volnovakha and Avdiivka connected to the Donbas water web were heavily damaged in battle and then taken by the Russian army. Other places like Pokrovsk, as already stated in the introduction, haven been cut off by upstream damages to infrastructure and the nearing of Russian troops since the summer of 2024.

But it's not just the supply systems exposed near the front line or in towns under missile and drone attack that are suffering the consequences of the conflict. Even close to Europe's borders, the effect on water system maintenance is being felt. Since the start of the offensive in February 2022, western regions more sheltered from Russian raids have become a refuge for five million people who have fled the fighting. These displaced people put additional pressure on already dilapidated infrastructures. The modernization projects undertaken in recent years have been partial and unsystematic, resulting in multi-speed operations where automation rubs shoulders with wheelbarrows. The structural crisis in the sector, which has been underfunded for several decades, exacerbates wartime pressures. According to UNICEF, 40% of facilities are in critical condition, and water losses reach 42%.⁴

Warfare exposed the vulnerability of water hardware in ways that are not always obvious in other crises: the expansive and open-air characteristics of water hardware systems means they can't be moved and are difficult to protect. The interdependence of socio-technical networks makes them vulnerable also in a less visible way through the effect on transport and value chains. Wartime violence disrupted the production and supply chains of a number of components necessary to the water production process. For instance, water purification products, coagulants and spare parts were produced locally or imported from Russia. With the war these circuits had to be rethought and reorganized, sometimes several times over, by the directors of the water utilities' management boards, often in collaboration with emergency humanitarian organizations. For example, as soon as the war in the Donbas began, imports of Russian chlorine were suspended and replaced by products imported from Romania, posing both transport and cost problems. Demonstrations by EU farmers against competition from Ukrainian products in 2023-24 led to blockades at the Polish, Slovakian and Hungarian borders, hampering the delivery of spare parts

⁴ Data provided by the UNICEF office in Kyiv, based on the report Evidence Synthesis: Water Supply and Sanitation (WSS), November 2023.

to water boards in central Ukraine, explains an engineer at a water board. ‘We had to make a detour via Moldova. Since the war, the fastest routes are no longer direct.’⁵

This dislocation of trade and transport routes transforms hydro-social territories. Distances are distorted, and new boundaries emerge as a result of the particular experience of the conflict: zones close to the front lines in the Donbas in the east and southeast, zones occupied and then liberated and under reconstruction around Kyiv, zones liberated but under intensive attack as in Kherson, and territories in the southeast affected by the explosion of the Kakhovka dam.

Practices of resilience rooted in past experiences of crisis

Professionals in the water sector – like those working in all critical infrastructures (Lambroschini 2022) – have become experts in repairing at a moment's notice. The water infrastructure workers draw on know-how inherited from past crisis – the Soviet shortage economy and the post-Soviet 1990s traumatic reforms - and from contemporary lessons learned from the expectations of integrating European standards and the language of international donors, as the following examples illustrate.

In March 2022, fighting cut off the water supply to the southern town of Mykolaiv, which drew its water directly from the Dnipro River. In the space of a month, the local water company set about connecting the town to the Black Sea and pumping water from there – salty water, but water nonetheless.

In Chernihiv, the local plumber made his own clamps from scratch, a skill he learned in the Soviet period when spare parts were hard to find.

The explosion of the Kakhovka dam, which caused the lake to burst affected the water supply of communities dozens of kilometers away, triggered a race against time as the water receded from the lake. A new 90-kilometer pipe had to be laid from an upstream dammed lake on the Dnipro River. The project involved several government agencies, European Union aid, NGOs, private subcontractors and dozens of handlers, drivers and plumbers. Working on land soaked by receding waters was unprecedented. ‘We were on totally uncharted territory, every day there were new

⁵ Interview with a former water utility engineer from Voda Donbasu water utilities, March 23, 2024.

disasters,' Oleksiy told his colleagues in the sector at an experience-sharing meeting⁶: first a crane operating on the bottom of the drying lake was swallowed up by the sludge, then workers were sent to the front, parts ordered that didn't meet standards, unpaid wages. In the end a new pipeline was laid out despite these difficulties.

The Soviet shortage economy, followed by the collapse of the centralized, planned system, left public utilities to slowly decline over the years 1990-2000. The dilapidation of the water sector caused by decades of under-investment left a material base that was already fragile even before the war. These structural problems created a work context that required adaptation.

In 1991, water management collapsed from centralized management to disjointed laissez-faire as regional and local authorities floundered to configure new governance systems outside the command economy and Soviet social state. Public services became a local, disjointed and fragmented affair resulting in decades of underinvestment and poor maintenance. Even before the invasion the sector was estimated to be in a critical state with 40% needing critical rehabilitation and water losses (through leakages) estimated up to 45%, according to a study by the World Bank in 2020.⁷ Energy inefficiency of water installations generate high operating costs and create vulnerability, especially in wartime

While the Soviet state-controlled public sector model has collapsed, it still leaves an imprint today.

Water utilities draw on corporatist traditions and the Soviet vocabulary of the 'kollektiv' to ensure that solidarity and loyalty relationships are maintained among their employees: food subsidies, odd jobs arranged for spouses, evacuations arranged for women and children.⁸ It's also a whole body of know-how learned 'on the job' that makes day-to-day repairs in Ukraine possible: identifying a leak with a divining rod requires a sensitive hand, explains a technician in Chernihiv who has been wielding the instrument for almost 20 years. Repetition over long periods teach a bulldozer or crane driver to guide the blade so that it uncovers a pipe without damage, adjusting to the soil, the seeping water, and watching out for forgotten mines.

⁶ International Water Forum, February 14-15, 2024, Yaremche, Ukraine, organized by Ukrvodokanalekologia/UNICEF.

⁷ World Bank (2020): Ukraine Water Supply And Sanitation Policy Note Toward Improved, Inclusive, And Sustainable Water Supply And Sanitation Services, Policy Note, 1, 2020

⁸ Interviews with managers of water utility companies in Ukraine 2018-24

In the heat of war, it's these professionals, rooted in their companies and familiar with the company's equipment down to the smallest bolt, who make decisions on a day-to-day basis and mobilize well-established crisis practices. The need to cope with the Soviet scarcity economy, then the post-Soviet economic collapse of the 1990s and 2000s, has nurtured the improvisational and creative qualities of this 'do-it-yourself society' (Chuikina 2009, Morris 2011). The self-made clamps, subsidies, informal relationships constitute aspects of this know-how. Much of the workers' practical skills are the result of years of repetition of everyday gestures, adapting them to the situation at hand. The value of such skills only becomes visible (and valued) when the infrastructure ceases to function (Star 1999, Jackson 2014). Dependence on these practices in wartime underlines the value of know-how acquired through experience that is untransferable through formal teaching.

Local solidarity networks and the emergence of new forms of sociability

Ihor, 52, is an ordinary plumbing technician employed in the Avdiivka subdivision of Voda Donbasu. Trained at the local technical institute, he joined a brigade with which he has faced the difficulties of everyday professional and personal life for a decade or more, then climbed the ladder to become an engineer. Lacking even uniforms and appropriate boots, his employees carry on the same difficult and often risky work, exposed to strikes and mines. Invisible workers *par excellence*, they are exceptions because of their local ties, as economic migration has been a survival strategy for many Ukrainians.

The local roots of the men and women who stayed behind were invaluable in finding generators, diesel and trucks through personal networks... In times of crisis, local players – industries, service stations, supermarkets – organize themselves to meet the needs of the water company. The mobilization of informal relations with local economic authorities to organize supplies of chlorine or spare parts is particularly important. So is the 'in-kind' assistance provided by international organizations in the water sector, such as UNICEF, or the NGOs People in Need and ACTED, which have been present in the Donbas almost since the war began.

The relationship between consumers and critical services can create a sense of 'infrastructural citizenship' (Lemanski 2022) through meter reading and bill payment, but also through the risky work of municipal employees in the service of the community. Given the vital nature of their work for civilians and the army, water company employees, the heroes of everyday life, were among the last to leave cities under attack, such as Avdiivka. The Ukrainian authorities – and also the water companies – are urging people to pay their bills as an expression of 'patriotism'. Indeed as 'arteries of society', infrastructure networks are not only powerful civilizational symbols (van Laak 2018), but also social consolidators that reveal themselves under threat.

Dilapidated infrastructure eroded by the war and the debates around reforms

The resilience of Ukraine's infrastructure is limited by the economic and structural conditions under which it was built. The disregard for the Soviet social state model, the local disengagement from the management of critical services, and the haphazard integration of 'market' models have led to chronic under-investment. This obsolescence makes repairs more complex today. The exasperation of the Oleksiy, the engineer working to reestablish water supply after the Kakhovka dam explosion, also points to the systemic dysfunctions of water infrastructure.

Virtually no modernization has taken place on installations that are at least half a century old. Nearly 52,000 kilometers of water mains need to be replaced, according to experts. Two-thirds of wastewater is discharged untreated. In Chernivtsi, a western city largely untouched by missiles, some pipes date back to the Austro-Hungarian period, and water treatment capacities have only been modernized piecemeal. What's more, the energy inefficiency of the Soviet era (when cost competitiveness was not an issue) is imposing a double penalty on war-torn Ukraine: not only are energy-hungry systems expensive with expenditures that have to be somehow covered, they are also more at risk of power cuts.

The water sector is partly dependent on a centralized administrative management system but also disjointed. Water supply is fragmented among water

suppliers with different forms of ownership: private companies (or individual entrepreneurs), public utilities owned by municipalities, regional administrations, the central state, and as utilities with mixed ownership. Today, there are 52 mostly public, regional or municipal utility companies in Ukraine, but in fact more than 2,000 public and private enterprises are involved in the sector. Most water utilities are owned by the municipality which appoints the director and oversees strategy and pricing. No fewer than a dozen ministries, agencies and commissions oversee the sector at various levels. A central state water regulation agency fixes the price for water supplied by large utilities but the prices at which smaller utilities sell water are set by the municipalities who own them. Operations and development are dragged down by conflicting regulatory regimes, by institutional inertia and the absence of a systemic reform approach. International aid and development agencies are crucial but involved case by case.

The debates about the need for market-driven efficiency indicators versus maintaining principles guided by public interest are still being debated. Development plans for the water sector steer clear of outright privatization of utilities but do include principles of public-private partnerships. The discussions within the water sector reflect broader conflicting narratives in Ukraine about economic models of development for the country but which don't fulfill the specific characteristics of public services. The model of the Soviet welfare state is mostly rejected. But the management of hardware and employees established under the Soviet welfare state is still the backbone of many public services: when the state collapsed after 1991, many public services carried on. While the market-driven model is largely unfeasible in the water sector given the high investment costs and long-term returns, the model of civic society involvement through charities prevalent in other state sectors such as health and education is not coherent for large-scale complex infrastructural systems. Many of the directors of public utilities who hope to find solutions to their problems do find the free-market ideas that have been promoted since 1991 attractive. As a result, Soviet-type directors of water utilities are being replaced by managers recruited from the private sector but who lack the managerial know-how to run a public sector company. The war has made these issues even more critical as infrastructure recovery and reconstruction plans are being debated at an international level.

In 2023, for example, many water utilities called for a substantial increase in water rates for consumers, which are mainly regulated by the state. The government blocked the measure, claiming a wartime exception to spare the population. Another demand from the water sector concerns employment. Low wages – sometimes paid with months delay – rationalization measures, and the risk of missile attacks have caused the skilled workforce to leave the water sector but is also a general issue in Ukraine (Central Bank of Ukraine 2024). Although many technicians are willing to ‘serve’ on what they call the ‘water front’, the utilities are short of hands, sometimes to a critical degree. The mobilization of men for the frontline has reinforced the trend. The director of a water company supplying a city in central Ukraine, whose pumping installations initially had only two handlers out of a dozen, noted not without irony that it was the lack of men, not the Russian strikes, that risked bringing the water supply to a halt.⁹

In addition, the war has created an organizational imperative, reinforced by the program of reforms to comply with European standards. These processes led to the emergence of new players. The Ukrvodokanalekologia association of municipal utilities, is a relatively new organization. It was set up on the initiative of the Kyivvodokanal (Kyiv waterworks), the capital’s water utilities, in order to organize reforms in the national water sector and implement international and European Union water quality standards and economic regulation. Following the 2022 invasion, however, Ukrvodokanalekologia's management radically re-thought its role. It gradually became a conduit for sharing local coping practices, a lobbyist of the water sector’s demands to Ukrainian authorities, a centralizer of data about needs across the country, and a source of information on the sector. The experience of civic involvement gained since the Maidan have also fueled environmental mobilizations in the water sector. Civil society initiatives increasingly wish to influence a system dominated by traditional players - central or municipal authorities, public utilities, and dominant industries. In particular, the Kakhovka disaster became as a key moment to rethink the Dnipro economy in terms of ecosystem and circular economy (Hubareva 2024).

⁹ International Water Forum, February 14-15, 2024, Yaremche, Ukraine, organized by Ukrvodokanalekologia/UNICEF.

The water sector's impossible dilemma: how to simultaneously make repairs under fire and plan modern infrastructure for the future?

Since the first international conference about the reconstruction of Ukraine held in Lugano in July 2022 the philosophy of international donors – fully supported by the Ukrainian government – is to focus on modernization (rather than identical reconstruction) driven by a private sector motivated by profitable investment.

But this vision often clashes with the realities of a country at war. How can private capital be convinced to invest without proper insurance? Where is the workforce and expertise in engineering and European standards to conceptualize modernization plans? 'We're just managing to repair what's been destroyed and to find alternative solutions under the bombardments', I'm told by Voda Donbasu's management, for example, such as using water from the idle coal mines. Between fighting and occupation, little remains of the network of 11,000 employees who overcame the difficulties of the Donbas war.

Humanitarian aid professionals and scholars warn of the risk, in a long-term war, of a total and irreversible collapse of essential services as the result of a negative 'staircase' process of gradual degradation (ICRC 2015). According to this model, critical infrastructure exposed to violent conflict is at risk of being sucked into a downwards spiral of insecurity, damages, revenue loss, and lack of manpower, leading to the collapse of the integrated set of urban services not as a direct result of, say bombings, but as a chain reaction.¹⁰ Water utilities in Ukraine now struggle to avoid triggering such a spiral. But they are also asked to simultaneously fulfill mid-term and long-term goals developed from the top-down. They must plan to improve safety over the short-term through energy modernization and they are expected to implement guidelines for Ukraine's reconstruction and EU integration based on ecological and economic efficiency benchmarks. But how constructive and realistic is it to demand economic efficiency and ecological ideals when the more immediate risk of system collapse is very real? This is a question that Ukrainian institutions and the

¹⁰ See below for a diagram of this staircase degradation, *ICRC 2015*, 'Urban services during protracted armed conflict: a call for a better approach to assisting affected people', *International Committee of the Red Cross*, Geneva.

international community that draws up recovery and reconstruction plans should address. The water sector is on the frontline and is already overstretched.

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