

Methane Emissions in Ukraine's Energy Sector: Underestimated Challenge and Opportunity

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Opinions expressed in this publication are those of the author(s) alone.

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Executive Summary

Methane is a short-lived but highly potent greenhouse gas. When assessed using a 20-year global warming potential (GWP20), methane represents over half of Ukraine's near-term climate impact. Methane's climate impact is defined by its short atmospheric lifetime and extremely high near-term warming power. Although it remains in the atmosphere for only about a decade, methane is over 80 times more potent than CO₂ over a 20-year horizon. This makes methane mitigation one of the fastest and most cost-effective climate measures available for Ukraine in the critical 2025–2045 window.

Methane accounts for approximately 27% of Ukraine's total greenhouse gas emissions (63 Mt CO₂-eq in 2023 under GWP100), with the energy sector responsible for about 71% of national methane emissions. Oil and gas operations represent the largest source, followed by coal mining and waste management. While absolute methane emissions declined during 2022–2023 due to war-related disruptions, these reductions reflect economic contraction rather than structural mitigation and risk rebounding during post-war reconstruction.

The technical mitigation potential across oil and gas, coal mining, and waste sectors is estimated at approximately 2–3 billion m³ annually, equivalent to 60–85 Mt CO₂-eq per year (GWP100) under pre-invasion levels. Realising this potential could cover up to 20% of Ukraine's natural gas demand, reduce import dependence, and generate up to €750–1100 million annually at current European gas prices. Total investment needs are estimated at €2.4–3.6 billion over ten years, with many measures offering short payback periods.

The oil and gas sector offers the fastest deployment opportunities through leak detection and repair (LDAR), equipment upgrades, and operational improvements. Waste sector projects (landfill gas and wastewater biogas) and coal mine methane recovery require higher capital intensity but deliver substantial long-term benefits. Importantly, methane mitigation could also become a security of supply tool, decreasing both natural gas consumption, import needs and the financial burden related to paying for them.

Alignment with the EU Methane Regulation (Regulation (EU) 2024/1787) is strategically important for Ukraine as an EU candidate country and Energy Community member. Early transposition will strengthen regulatory credibility, reduce market-access risks, improve monitoring and verification systems, and support integration into the EU gas market.

Initial efforts in Ukraine are confronted with a number of significant barriers: incomplete MRV systems, limited institutional capacity, weak economic incentives, and subsidy structures that discourage capital investment in abatement technologies.

Methane mitigation should therefore be embedded into Ukraine's reconstruction strategy. By integrating measurement-based MRV, economic incentives, international climate finance, and

modern infrastructure standards into post-war recovery, Ukraine can convert current disruption into long-term structural gains in climate performance, and EU accession readiness.

Fundamentally, addressing methane means addressing the majority of Ukraine's actual contribution to near-term global warming, with technologies and approaches that are proven, economically viable, and immediately deployable. Delaying the capture of Ukraine's fugitive methane means lost opportunities for urgent near-term climate change mitigation and risks slowing down the country's EU accession readiness.

List of Abbreviations

- AMM – Abandoned Mine Methane;
- CCAC – Climate and Clean Air Coalition;
- CMM – Coal Mine Methane;
- EEA – European Environmental Agency;
- ESA – European Space Agency;
- EU – European Union;
- GHG – Greenhouse Gas;
- GMP – Global Methane Pledge;
- GWP – Global Warming Potential;
- IEA – International Energy Agency;
- IFI – International Financial Institution;
- IMEO – International Methane Emissions Observatory;
- IPCC – Intergovernmental Panel on Climate Change;
- ITMO – Internationally Transferred Mitigation Outcome;
- LDAR – Leak Detection and Repair;
- LULUCF – Land Use, Land-Use Change and Forestry;
- NASA – National Aeronautics and Space Administration;
- NDC – Nationally Determined Contribution;
- NID – National Inventory Document;
- MRV – Monitoring, Reporting and Verification;
- OGI – Optical Gas Imaging;
- OGMP2.0 – Oil and Gas Methane Partnership 2.0;
- SLB – Sustainability-Linked Bond;

UNFCCC – United Nations Framework Convention on Climate Change;

US – United States;

VAM – Ventilation Air Methane.

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1. Why addressing methane emissions is critical for Ukraine

1.1 Methane: a potent, short-lived climate forcer

Methane (CH₄) is one of the most powerful greenhouse gases, responsible for about one-third of global warming since the Industrial Revolution. Over a 20-year period, its warming potential is more than 80 times greater than that of carbon dioxide. Yet, because methane remains in the atmosphere for only about a decade, reducing its emissions can deliver rapid climate benefits and slow the global temperature rise within the lifetime of current political decisions.

Beyond climate change, methane emissions impose significant economic costs in Ukraine. Methane, the dominant component in natural gas, is a valuable fuel.¹ Uncontrolled methane release thus creates a dual impact, harming both the global climate and the national economy; preventing these leaks is therefore a matter of resource efficiency as much as environmental stewardship.

Anthropogenic methane is released to the atmosphere during coal mining, oil and gas extraction, oil processing in refineries, and natural gas transmission through pipelines. It also escapes from abandoned wells and mines. In addition, it is generated by chemical processes in landfills, wastewater treatment plants and in agriculture, especially livestock farming. The current analysis focuses on three sectors responsible for nearly 90% of anthropogenic methane emissions in Ukraine: oil and gas, coal mining, and the waste sector (excluding agriculture).

The country's coal mining, oil, and gas sectors are among the largest sources of methane emissions in Europe. Capturing methane from these sources could provide a valuable energy resource and reduce losses in domestic gas systems. Moreover, effective mitigation aligns Ukraine with the requirements of the EU Methane Regulation, which is one of the key legislative acts of the European Green Deal. Thus, for Ukraine, addressing methane emissions is both an environmental necessity and a strategic opportunity.

1.2 Ukraine and Global Methane Pledge

Ukraine is a signatory of the Global Methane Pledge (GMP) initiative, launched at COP26 in 2021. The pledge brings together 159 participating countries and covers more than 50% of global methane emissions from human activity. Participants have committed to jointly reduce global methane emissions by at least 30% from 2020 levels by 2030.

IEA warns that while high-level pledges of GMP signatories call for a 55% reduction in oil and gas methane emissions by 2030, existing policies as of 2025 would deliver only about a 25% reduction.

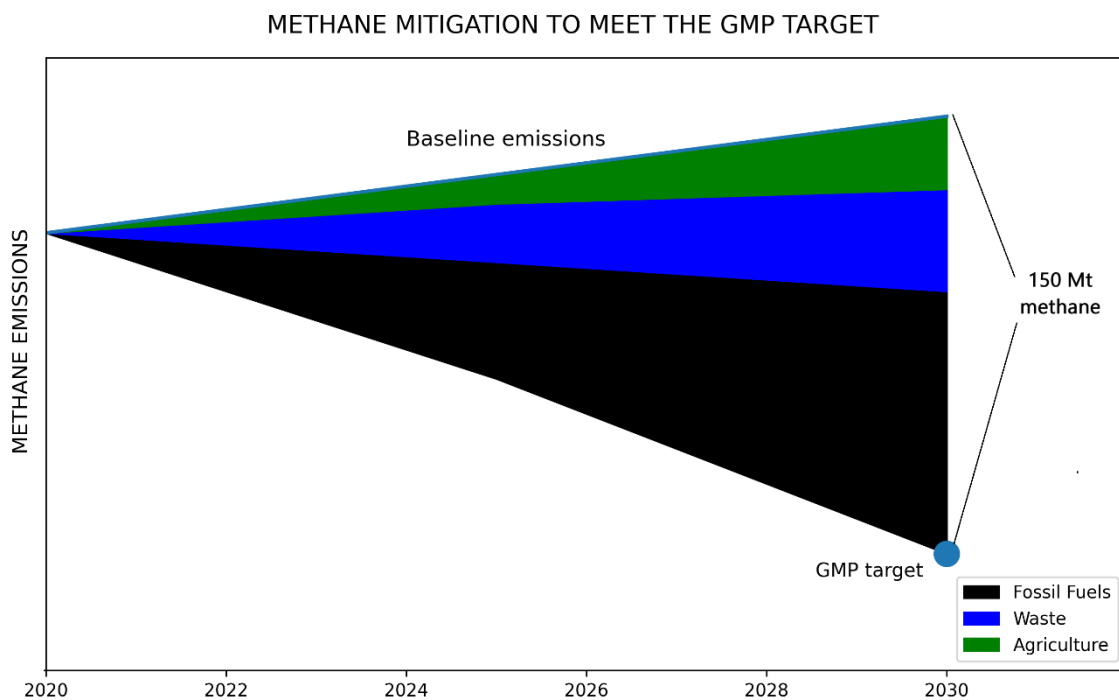
¹ EU pipeline gas contains about 90-97% methane.

The gap is even wider in the coal sector, where current measures would reduce emissions by just 15% by 2030 (IEA, 2025a).

At the same time, the impact of methane mitigation on overall climate outcomes remains underappreciated in many national policy frameworks. According to IEA analysis for Ukraine, a 30% reduction in domestic methane emissions relative to 2020 levels would deliver a larger reduction in total greenhouse gas emissions (expressed in CO₂-equivalent using GWP100) than that implied by the country’s current Nationally Determined Contribution under the Paris Agreement, highlighting methane as a disproportionately effective mitigation lever within existing international commitments (IEA, 2025a).

In addition to the Global Methane Pledge, Ukraine has also been a member of the Climate and Clean Air Coalition (CCAC) since 2020, which recognizes the reduction of short-lived climate pollutants as a priority. Hereby, CCAC envisages that more than half of the methane mitigation by 2030 will come from the fossil fuels sector (Climate & Clean Air Coalition, 2024).

Figure 1: GMP-consistent methane emissions reduction pathway to 2030.



Source: Climate and Clean Air Coalition - Methane Roadmap Action Programme.

1.3 Ukraine’s methane mitigation efforts

In Ukraine, methane emissions account for 27% of the country’s total greenhouse gas output, measured in CO₂-equivalent. This share is significantly higher than in the European Union, where methane accounts for 12% of total GHG emissions (EEA, 2025).

By Order No. 607-p of 7 July 2023, the Cabinet of Ministers of Ukraine approved a *Plan of Measures to implement Ukraine’s climate policy within the framework of participation in the Global Methane Pledge*, committing the country to reduce its anthropogenic methane emissions by 30 percent by 2030 compared to 2020 levels (Cabinet of Ministers of Ukraine, 2023). The Plan focuses primarily on the oil and gas sector, which accounts for most of Ukraine’s methane emissions, and sets out coordinated actions for 2023–2030 involving relevant ministries and state companies, including Naftogaz. The Plan assigns clear responsibilities and reporting deadlines: all involved actors must submit annual progress reports by 30 April, and the responsible ministry (currently Ministry of Economy, Environment and Agriculture of Ukraine) must provide a consolidated report to the Cabinet by 31 May each year. These efforts demonstrate progress, but mitigation remains poor in coal mining and upstream oil and gas sectors.

ACTIONS TAKEN IN THE OIL AND GAS SECTORS

Ukrgezvydobuvannya created 3 mobile laboratories to detect and measure methane emissions, two of which are fully equipped. Leak detection is carried out by an optical gas detector (thermal imager) SATIR V90. Measurements of quantitative indicators of methane leaks are carried out by HI FLOW SAMPLER.

Operator of Gas Transmission System of Ukraine (OGTSU) operates 4 mobile laboratories for detection and elimination of gas leaks. Each mobile laboratory is equipped with Inspecta Laser GAZOMAT, Bacharach Flow Sampler and EveGAS 2.0 for rapid identification of methane leaks. In 2023 OGTSU developed a draft Methodology for determining the volume of natural gas losses during transmission.

Ukrtransgaz (SSO operator) deployed 2 mobile laboratories. These laboratories are equipped with Hi Flow Sampler BACHARACH, Gasurveyor 0-500 and portable gas analyser Inspectra Laser.

OGTSU introduces technologies for repairing gas pipelines under pressure to reduce methane venting. The company also uses nitrogen installations during repair works to reduce natural gas consumption for purging gas pipelines.

Ukrgezvydobuvannya is applying an updated Procedure for reporting on greenhouse gas emissions for oil and gas companies, developed in 2023 and based on the requirements of international standard Greenhouse Gas Protocol.

1.4 EU Regulatory framework and policy alignment

The EU Methane Regulation (Regulation (EU) 2024/1787), adopted in May 2024, establishes binding rules for measurement-based monitoring, reporting, and verification (MRV) of methane emissions from the oil, gas, and coal sectors. It also introduces measures to prevent and mitigate such emissions across the entire energy supply chain. The Methane Regulation complements the EU’s Climate Law (Regulation (EU) 2021/1119), which makes the goal of climate neutrality by 2050 legally binding, and contributes to the Fit-for-55 package — a comprehensive policy framework to reduce greenhouse gas emissions by at least 55 % by 2030. Under this framework, methane mitigation in the energy sector is

seen as one of the fastest and most cost-effective ways to achieve climate targets while improving energy efficiency and security of supply.

A central feature of the Regulation is its measurement-based approach. Operators must implement source-level and site-level quantification of methane emissions, conduct regular leak detection and repair (LDAR) programmes, and undergo independent third-party verification. Venting and flaring are prohibited except in strictly defined exceptional circumstances, and obligations also extend to inactive and abandoned assets.

The Regulation closely aligns with the Oil and Gas Methane Partnership 2.0 (OGMP 2.0) framework (see the requirement details in Annexe 1), developed under the auspices of the United Nations Environment Programme. OGMP 2.0 is currently regarded as the most robust international framework for methane MRV in the oil and gas sector. Its five-tier structure provides a stepwise pathway from generic emission-factor reporting to fully measurement-based, independently verified inventories reconciled with site-level and atmospheric data. It also applies to inactive or abandoned assets and introduces phased requirements for imported fuels, linking compliance to EU market access.

The EU Methane Regulation has an external dimension that directly affects third countries. It introduces phased transparency and reporting requirements for imported fossil fuels into the EU, with specific obligations and potential restrictions subject to implementing acts and future Commission decisions. From 2025 onwards, importers must provide information on monitoring measures; from 2027, they must demonstrate equivalence with EU MRV standards in the source jurisdiction; from 2028, they must report methane intensity; and by 2030, imported fuels will have to comply with maximum methane-intensity values to be defined by the European Commission. Non-compliance may lead to significant financial penalties.

By embedding this approach, the EU promotes comparability, transparency, and continuous improvement while accommodating different starting capacities across operators and countries. For Ukraine, alignment with this framework implies a transition from predominantly emission-factor-based reporting in the National Inventory Report toward a measurement-based MRV system. This requires upgrading technical capacity, institutional coordination, and verification procedures. While such adjustments demand investment and regulatory reform, they would significantly enhance the credibility of Ukraine's methane data and strengthen the effectiveness of mitigation policies.

1.5 Implications for EU accession and market integration

As an EU candidate country and a Contracting Party to the Energy Community Treaty, Ukraine is expected to transpose and implement relevant EU energy and climate legislation. Methane Regulation forms part of this broader alignment process and is particularly relevant under Cluster 4 (Green Agenda and Sustainable Connectivity) of the EU enlargement methodology.

Beyond EU enlargement conditionality, methane mitigation is also embedded in the Energy Community Decarbonisation Roadmap, which explicitly encourages contracting parties to introduce

EU-consistent methane rules and develop mitigation financing structures. Compliance, therefore, supports both accession-related and Energy Community obligations.

For Ukraine, early alignment with these requirements reduces regulatory risk and strengthens its position as a reliable partner in the European gas market. Transparent, measurement-based methane management enhances predictability for European partners and investors, particularly in the areas of gas transit, storage, and cross-border trade. Given Ukraine's substantial underground gas storage capacities, regulatory equivalence may reinforce its role in regional gas balancing and commercial integration with EU markets. Approaching full integration into the EU gas market, Ukraine can attract investment, and generate new revenue streams by offering seasonal gas storage services to European companies.

Beyond market considerations, methane policy alignment serves as a governance test within the accession process. Ukraine's current methodology for methane accounting, largely based on default emission factors in its National Inventory Report, does not meet the tier 3 measurement-based standards promoted by the EU and the United Nations Environment Programme's International Methane Emissions Observatory (IMEO). Upgrading monitoring capacities through regular leak detection and repair (LDAR) procedures, aerial surveys, and data sharing will strengthen the credibility of Ukraine's emissions reporting and facilitate alignment with EU standards.

At the same time, alignment entails substantial institutional and financial effort. Establishing comprehensive inventories of abandoned mines and orphaned wells, upgrading monitoring infrastructure, and ensuring independent verification capacity will require sustained coordination across ministries and state-owned enterprises. However, these investments contribute not only to regulatory compliance but also to modernising infrastructure, reducing avoidable gas losses, and strengthening long-term integration into the European climate and energy policy framework.

2. Ukraine's methane emissions profiles

2.1 Key Messages

- Methane accounted for approximately **27% of total GHG emissions** (excluding LULUCF) in 2023 in Ukraine.
- The **energy sector dominates methane emissions (≈71%)**, primarily from oil and natural gas operations.
- The sharp decline in methane emissions after 2022 reflects **war-induced disruption**, not structural mitigation.
- Under the conventional **GWP100 framework** (used by UNFCCC reporting), methane appears as a major but secondary contributor.
- Under **GWP20**, methane becomes Ukraine's **largest near-term climate driver**, accounting for over 50% of total climate impact.
- Without targeted methane regulation and investment, emissions are likely to **rebound during reconstruction**.

2.2 Methane in the structure of Ukraine’s GHG emissions

Methane emissions in Ukraine are currently accounted for through several parallel systems: the national GHG inventory prepared for UNFCCC under international reporting obligations, air emissions data submitted by operators to the State Statistics Service, and industry-level bottom-up calculations based on technical standards and methodologies. Each of these approaches serves a distinct purpose, ranging from international reporting to regulatory compliance and operational management, but they differ in scope, accuracy, and methodologies. As a result, inconsistencies and data gaps persist, particularly regarding measurement-based reporting. Over time, these systems should be aligned with EU legal, regulatory, and technical requirements, including MRV standards under the EU Methane Regulation, to ensure coherence, transparency, and comparability. The analysis in this paper is based primarily on data from Ukraine's greenhouse gas inventory.

According to Ukraine’s 2025 National Inventory Document submitted to the UNFCCC, methane emissions in 2023 amounted to 2.2 Mt CH₄, equivalent to 63 Mt CO₂-eq (GWP100). This represents approximately 27% of total GHG emissions (excluding LULUCF), which stood at 233 Mt CO₂-eq (Ukraine National Inventory Document, 2025).

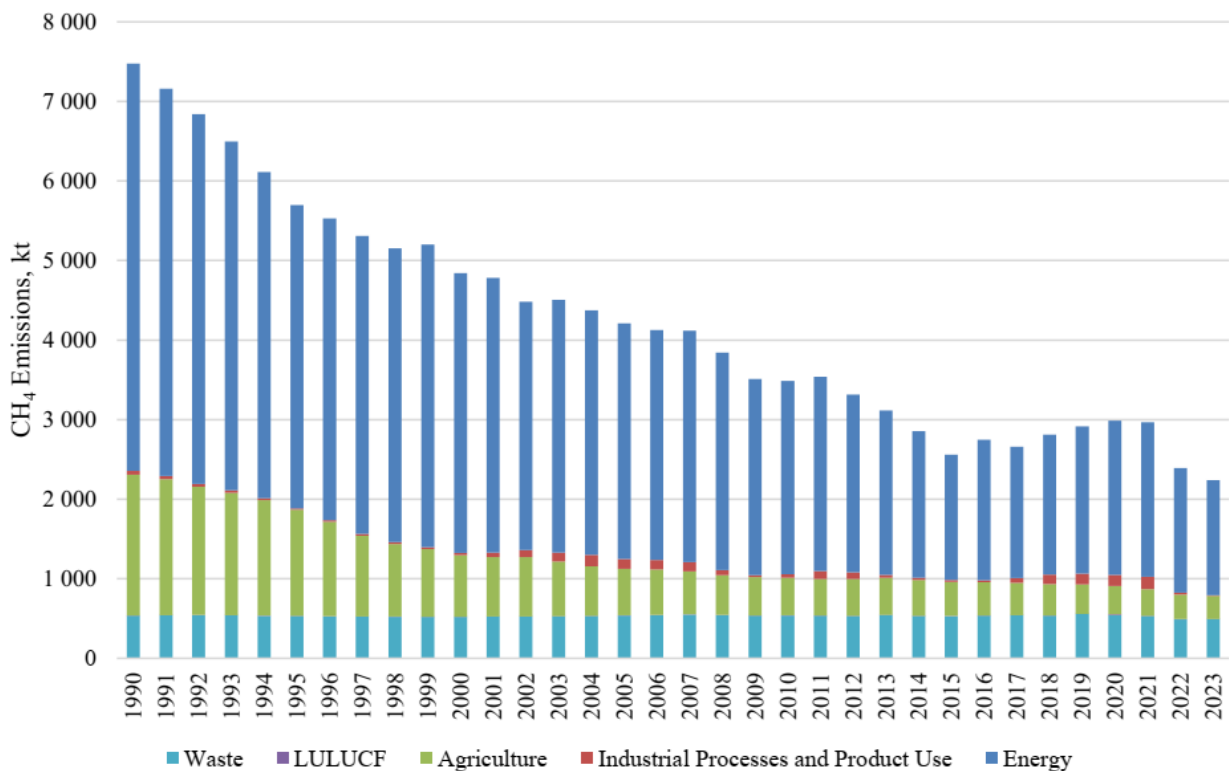


Figure 2: Methane emissions in Ukraine 1990-2023.

Source: Ukraine 2025 National Inventory Document.

The energy sector dominates methane emissions in Ukraine, accounting for approximately 71% of the total, followed by waste management (approximately 19%) and agriculture (approximately 10%).

Within the energy sector, fugitive emissions from oil and natural gas operations account for the dominant share, while emissions from coal mining constitute a smaller but persistent component. In wartime inventories, overlaps between subsectors and widened uncertainty ranges—particularly for occupied territories and damaged infrastructure—can result in apparent inconsistencies between aggregated energy-sector totals and individual subsector estimates. These differences reflect methodological constraints rather than contradictory trends.

Using national inventory data, this section analyses sectoral methane emissions for the 2017-2021 pre-invasion period and documents war-induced changes through 2024. Throughout this section, pre-invasion trends (2017–2021) and war-period estimates (2022–2024) are discussed separately to avoid conflating structurally driven emission dynamics with temporary, conflict-induced disruptions. Comparisons across these periods should therefore be understood as illustrative of direction and scale, rather than as evidence of continuous or policy-driven trends.

Between 2017 and 2021, Ukraine’s reported methane emissions ranged 2.6-2.9 million tonnes (Table 1). Based on global warming potential over 100 years (GWP100), these methane emissions are equivalent to 74.5-83.0 Mt CO₂-eq annually.² Hence, methane emissions comprised 23-27% of Ukraine's total greenhouse gas emissions under the established GHG accounting methodology for national GHG inventory reports. The inventory is built on generic calculations that use sectoral activity data and default emissions factors.

Ukraine's total GHG emissions in 2023 declined to approximately 233 Mt CO₂-eq (excluding LULUCF), with methane contributing approximately 63 Mt CO₂-eq. However, this apparent increase in methane's relative share compared to 2021 primarily reflects proportionally greater declines in CO₂ emissions.

Table 1. Methane Emissions in Ukraine (2017-2023)

Year	Methane emissions, Mt CH ₄	Methane Emissions, (Mt CO ₂ -eq, GWP100)	% of Total GHG (excluding LULUCF)
2017	2.7	75	23%
2018	2.8	79	23%
2019	2.9	82	24%
2020	3.0	84	26%
2021	3.0	83	25%

² Values for global warming potentials of GHGs including methane are set in AR5 in accordance with the guidance provided by the UNFCCC Decisions 18/CMA.1 and 6/CP.27.

2022	2.4	67	28%
2023	2.2	63	27%

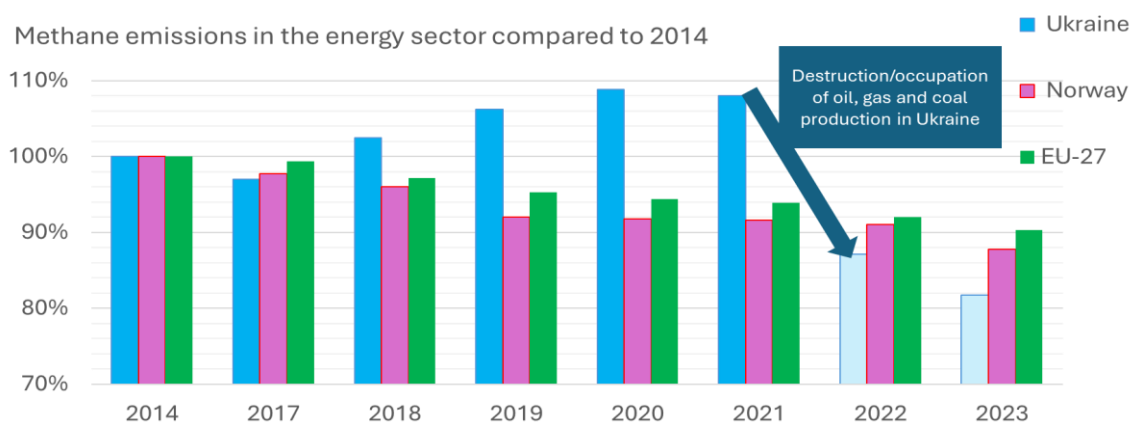
Data source: Ukraine 2025 National Inventory Document.

Ukraine’s methane emissions in 2023 were approximately 25% lower than in 2020, the baseline year of the Global Methane Pledge. While this brings Ukraine numerically close to the 2030 Global Methane Pledge target, the reduction is predominantly the result of extraordinary wartime disruptions rather than implemented mitigation policies. Without targeted regulatory action and investment, there is a substantial risk that methane emissions will rebound during post-war reconstruction.

Based on national inventory data, the energy sector dominated Ukraine's methane emissions throughout the pre-invasion period. The sectoral distribution for 2021, representing the last pre-invasion year with complete data, reveals the overwhelming role of energy-related sources. The energy sector contributed approximately 71% of total methane emissions, amounting to roughly 59 Mt CO₂-eq. Within this total, fugitive emissions from oil and natural gas operations accounted for approximately 53 Mt CO₂-eq, while fugitive emissions from solid fuels, primarily coal mining, contributed approximately 6 Mt CO₂-eq.

The 2017-2021 period showed a general increasing trend in energy-related methane emissions in Ukraine (see Figure 3). In addition to increasing gas production, this can be attributed to several other factors, including ageing infrastructure, underinvestment in maintenance, and limited regulatory oversight. During this period, fugitive emissions from gas production, transmission, and distribution systems played a significant role, as Ukraine's extensive gas network—much of it dating back to the Soviet era—experienced increasing leakage due to deferred modernisation and inadequate LDAR practices. This contrasts with the declining trajectory of CO₂ emissions during the same years, reflecting challenges in managing fugitive emissions from aging energy infrastructure, but also representing a low hanging fruit in mitigation.

Figure 3: Relative dynamics of energy sector methane emissions in Ukraine, Norway and EU-27.



Source: compiled by authors based on data from the European Environmental Agency and National GHG Emission Inventories of Ukraine and Norway.

The impacts of Russia’s full-scale invasion has brought a sharp decline in absolute methane emissions from 2021 levels with 19% overall decrease in 2022 and 24% in 2023, mostly due to reductions in coal mining activity, destruction of industrial assets and reduced gas consumption. On the other side, Russian attacks on Ukraine’s gas infrastructure have led to accidental methane emissions due to uncontrolled leaks, ruptured pipelines, and emergency venting from damaged facilities. In the long term, however, the destruction of legacy infrastructure may accelerate system modernization and emissions reduction.

Methane's relative share in total GHG emissions increased during the war period (from 25% in 2021 to 27% in 2023), primarily because CO₂ emissions declined proportionally more due to industrial shutdowns and energy sector disruptions. Distinguishing between absolute emission trends and relative shares is essential for interpreting Ukraine’s climate profile during the wartime period and for avoiding misleading conclusions about mitigation performance.

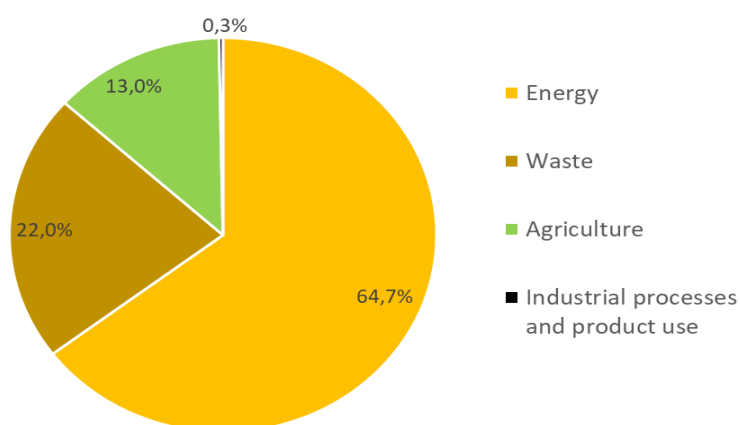


Figure 4: Structure of methane emissions in Ukraine by sector in 2023.
Data source: Ukraine 2025 National Inventory Document.

The waste sector represented approximately 19% of total methane emissions, contributing roughly 16 Mt CO₂-eq in 2021. Solid waste disposal on land, primarily from municipal and industrial landfills, represented the largest component at approximately 14 Mt CO₂-eq. Wastewater treatment and discharge contributed approximately 2 Mt CO₂-eq to the waste sector total.

According to EDGAR data, Poland had about 40% higher methane emissions from waste than Ukraine in 1990. According to the same estimates, by 2024, Poland managed to substantially reduce its corresponding emissions to about half of those in Ukraine³.

Solid waste disposal represents the largest waste-related methane source in Ukraine, accounting for approximately 85-90% of waste sector emissions. Municipal solid waste landfills represent the primary contributor, with organic waste undergoing decomposition under anaerobic conditions within the landfill mass. The biochemical processes in these oxygen-depleted environments produce methane-rich landfill gas, typically containing 45-60% methane by volume.

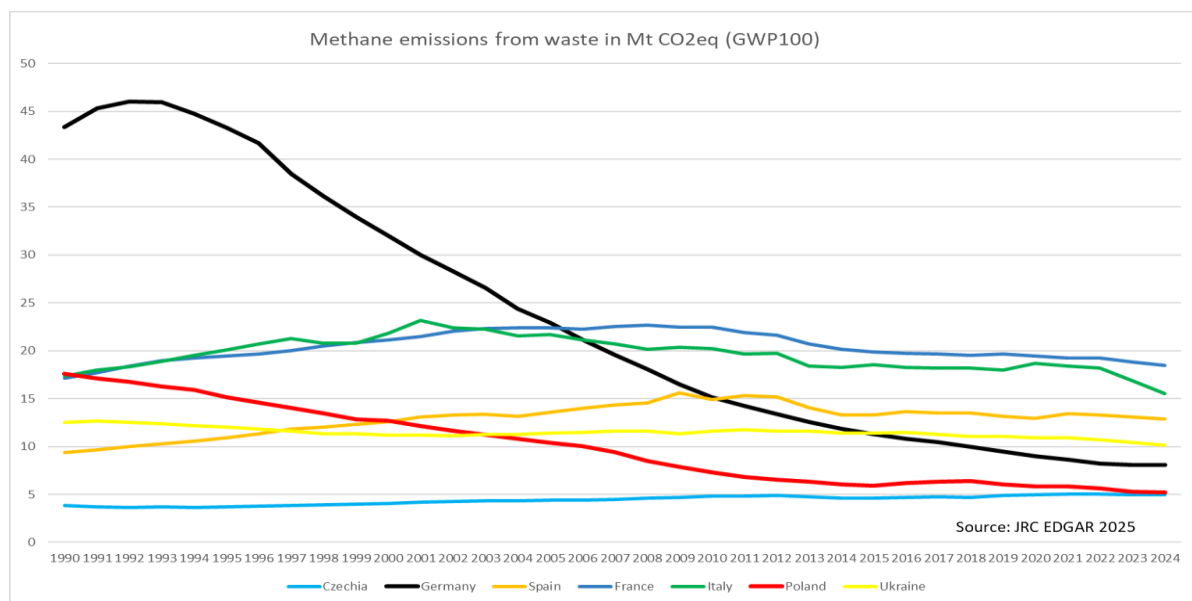


Figure 5: Methane emissions from the waste sector in Ukraine and selected EU countries.

Source: Emissions Database for Global Atmospheric Research

Limited landfill gas capture infrastructure represents a critical gap, with such systems present only at a few waste disposal facilities. The high organic content in Ukrainian municipal waste, reflecting consumption patterns and limited source separation programs, creates substantial methane generation potential which can be captured for energy use. Extended decomposition periods for waste deposited over decades mean that landfills continue producing methane long after waste deposition ceases, creating a long-term emission legacy that persists even if waste management practices improve.

³ Emissions Database for Global Atmospheric Research, 2025 report https://edgar.jrc.ec.europa.eu/report_2025

The agriculture sector accounted for approximately 10% of total methane emissions, contributing roughly 8 Mt CO₂-eq in 2021. Enteric fermentation - the natural digestive process of livestock, primarily cattle, in which microbes break down plant matter, accounted for approximately 5.5 Mt CO₂-eq, while manure management systems - the handling and storage of animal waste - contributed approximately 2.5 Mt CO₂-eq.

Enteric fermentation represented approximately 65-70% of agricultural methane emissions in Ukraine. Cattle, including both dairy and beef animals, serve as the primary source through their digestive processes. Other ruminants, including sheep and goats, contribute to this source category but represent minor contributors in Ukraine's agricultural context. Non-ruminants such as swine and horses produce minimal methane emissions due to their fundamentally different digestive physiology.

Livestock numbers declined continuously throughout 2017-2021, reflecting multiple economic and structural pressures on Ukrainian animal agriculture. The cattle population decreased from approximately 3.5 million head in 2017 to 3.0 million head in 2021. This decline resulted from multiple factors including reduced profitability in the cattle sector, ongoing restructuring of agricultural enterprises following post-Soviet privatization, competition from imports, and changing consumption patterns with growing popularity of healthy plant-based diets.

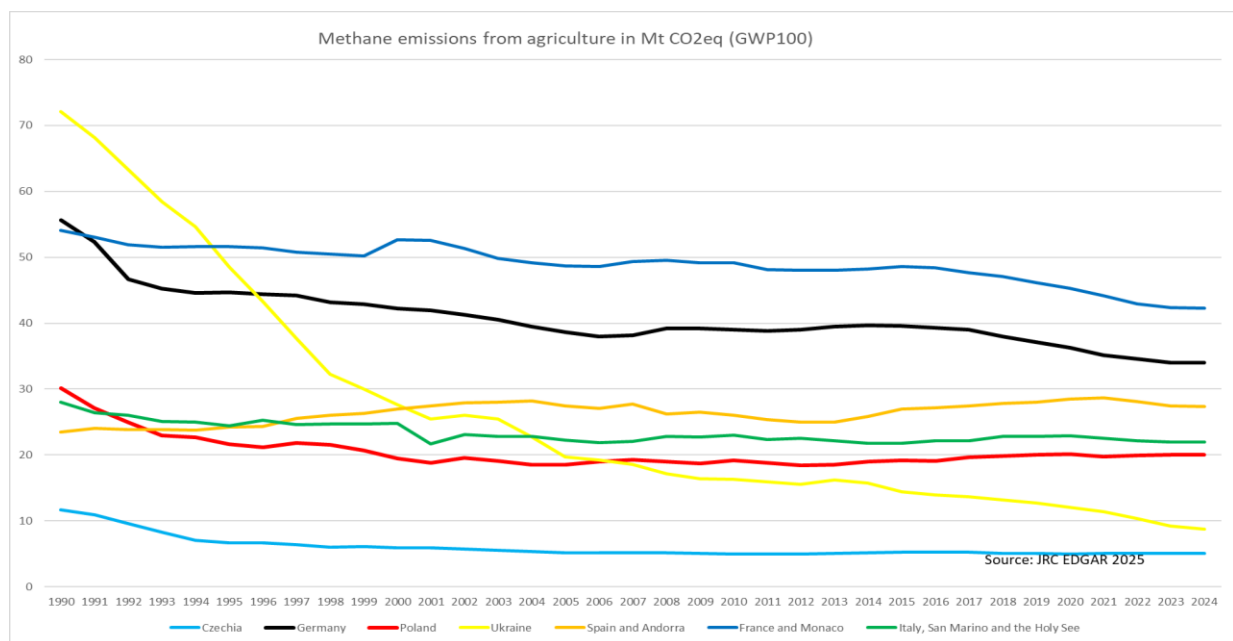


Figure 6: Methane emissions from the agricultural sector in Ukraine and selected EU countries.

Source: Emissions Database for Global Atmospheric Research

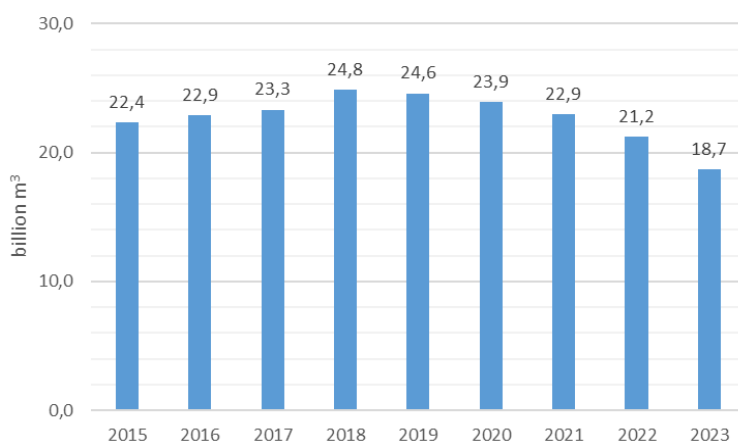
2.3 Detailed profile of energy sector methane emissions in Ukraine

The Ukrainian energy sector is the dominant source of methane emissions. Between 2017 and 2021, it represented 70-72% of the country's total methane emissions. It is thus key for any comprehensive methane mitigation strategy.

Fugitive emissions from oil and natural gas represented the largest single source category, accounting for approximately 88-90% of energy-related methane emissions in Ukraine. This subsector encompasses multiple emission pathways across the entire value chain. Oil extraction activities generate methane through venting, incomplete flaring, and leakage from wellheads and processing facilities. Natural gas production contributes through venting during well completion and workover operations, gas processing losses, and incomplete flaring of associated gas that cannot be economically recovered. The gas transportation system in Ukraine comprises over 38,000 km of pipelines, including high-pressure transmission pipelines for long-distance transport. The gas transmission system, with its extensive network of pipelines spanning the country, experiences losses through pipeline leaks, compressor station emissions, and venting during maintenance operations. Gas distribution through urban networks adds further emissions from leakage in local distribution systems and meter station releases.

Natural gas production in Ukraine averaged 23-24 billion m³ annually during 2017-2021 and fell to about 18-19 billion m³ in 2023/2024 (Figure 7). In 2025, Ukraine's key gas production facilities were targeted by several waves of Russian drone and missile attacks, and were temporarily disabled or had to reduce output. As a result, domestic gas production declined further. State-owned company Ukrigasvydobyvannya (part of the Naftogaz Group), which is responsible for 70% total production, aims to repair damage and ramp up production as soon as possible.

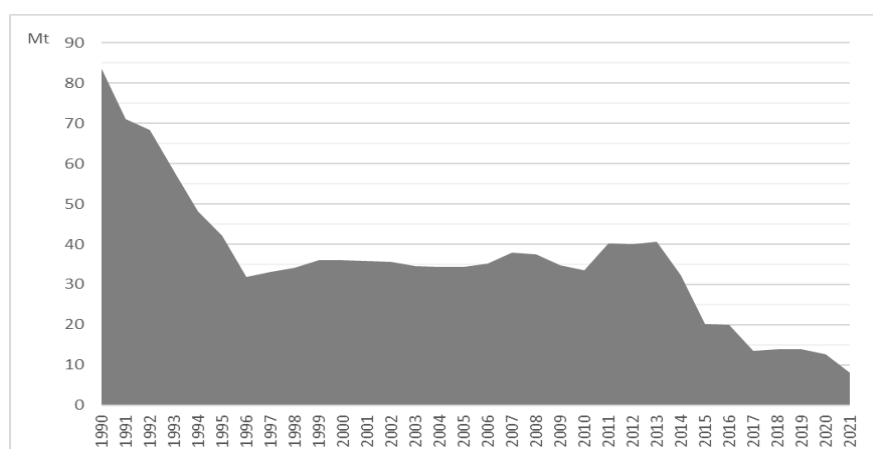
Figure 7: Natural gas production in Ukraine 2015-2023.



Data source: International Energy Agency.⁴

Fugitive emissions from solid fuels, primarily coal mining, according to the national inventory, contributed 10-12% of energy-related methane emissions in Ukraine during 2017-2021.⁵ Coal production during this period showed an accelerated decline (see Fig.8). Ukraine's coal industry underwent continuous contraction following the 2014 occupation of Donbas, resulting in the loss of access to approximately 60% of pre-2014 coal production capacity, primarily concentrated in Donetsk and Luhansk oblasts, where the most productive and gassy mines were located.

Figure 8: Production of hard coal in Ukraine 1990-2021.



Source: IEA Energy Balances 2023.

Active coal mines are emitting ventilation air methane (VAM) that must be continuously extracted to maintain safe working conditions and to prevent reaching dangerously high concentrations of methane in the mine - a safety hazard associated with underground fires and explosions. Post-mining emissions continue from closed and abandoned mines, where methane continues to migrate through geological formations and reach the surface.

Methane emissions intensity in Ukraine's energy sector significantly exceeded European averages during the pre-invasion period. Specific emissions from oil and gas operations are estimated at 1.5-

⁴ <https://www.iea.org/countries/ukraine/natural-gas>

⁵ Ukraine's inventory calculations are based on generic emissions factors and activity data (annual volumes of coal production) that do not account for emissions from abandoned coal mines. The IEA's Global Methane Tracker estimate provides for higher values for Ukraine's coal mine methane, comparable to oil and gas methane emissions, as the IEA methodology is more granular and encompasses emissions from both active and abandoned mines.

2.0% of total natural gas production, compared to 0.02% in Norway and approximately 0.3% for the EU average along the entire supply chain (Savytskyi & Diachuk, 2025).

This disparity reflects problems associated with ageing Soviet-era infrastructure, limited deployment of modern monitoring technologies, absence of mandatory MRV for the oil and gas sector and low environmental taxation rates (0.04 EUR/tCO₂-eq in Ukraine versus 65 EUR/tCO₂-eq in Norway).

2.4 Role of methane emissions: standard and alternative views

Through the conventional GWP100 lens, Ukraine's 2023 greenhouse gas emissions present the following distribution: Total GHG emissions stood at 232.9 million tonnes CO₂-equivalent, with methane contributing 62.8 Mt CO₂-eq, or 27% of the total (Figure 9, A). Breaking this down further, emissions from oil and gas sector methane accounted for 29.92 Mt CO₂-eq (13% of total), other methane sources contributed 32.88 Mt CO₂-eq (14%), while all non-methane greenhouse gases—primarily CO₂—represented 170.1 Mt CO₂-eq (73% of total emissions).

THE SHORT-TERM CLIMATE URGENCY OF METHANE: WHY THE 20-YEAR PERSPECTIVE MATTERS

Under the conventional 100-year Global Warming Potential (GWP100) framework—used in official UNFCCC reporting and established by IPCC methodology—methane is assigned a value of 28 (IPCC AR5) or 21-25 (in earlier IPCC assessments). This metric averages methane's warming effect over a century-long timespan.

When we shift to the 20-year framework, the picture transforms dramatically. Using the IPCC AR6 value of GWP20 = 82.5, methane's contribution increases by a factor of approximately three compared to the standard GWP100 = 28. The reason is that methane in the atmosphere has a more than 100 times larger climate effect - but its atmospheric lifetime is only about 10 years before it decomposes into water and CO₂.⁶

In 2021, before the full-scale invasion disrupted Ukraine's economy and energy infrastructure, the proportions were similar: total emissions of 333.5 Mt CO₂-eq included 43.64 Mt CO₂-eq from oil and gas methane (13%), 39.36 Mt CO₂-eq from other methane sources (12%), and 250.5 Mt CO₂-eq from other greenhouse gases (75%). Under this standard accounting framework, carbon dioxide dominates Ukraine's climate footprint, with methane appearing as a significant but secondary concern, representing roughly one-quarter of total emissions. Differences between oil and gas methane emission estimates presented in this section and those reported elsewhere in the paper arise from the use of alternative metrics and aggregation approaches. Values cited under the GWP100 framework are consistent with national inventory reporting conventions, while higher figures under the GWP20 framework reflect the reweighting of methane's near-term climate impact rather than an

⁶ Decomposition of one ton of CH₄ thereby results in 2.75 tons of CO₂.

increase in physical emissions. These perspectives are analytically complementary but not directly additive.

Applying alternative metric based on GWP20 to Ukraine's emissions reveals a radically different view (Figure 9, B): methane emissions from oil and gas operations in 2023 account for 88.2 Mt CO₂-eq (25% of total), other methane sources contribute 96.9 Mt CO₂-eq (27%), while CO₂ and other non-methane greenhouse gases account for 170.1 Mt CO₂-eq (48%). The total becomes 355.2 Mt CO₂-eq.

Most significantly, with GWP20 optics used for CO₂-eq accounting, methane becomes Ukraine's dominant greenhouse gas, representing 52% of the country's total climate impact when measured over the critical next two decades. This dominance under the GWP20 perspective reflects methane's short-lived but intense climate forcing over the next two decades and does not imply a reduction in the long-term importance of carbon dioxide mitigation. Rather, it highlights the complementary role of methane abatement as a near-term climate stabilisation strategy alongside sustained CO₂ reductions.

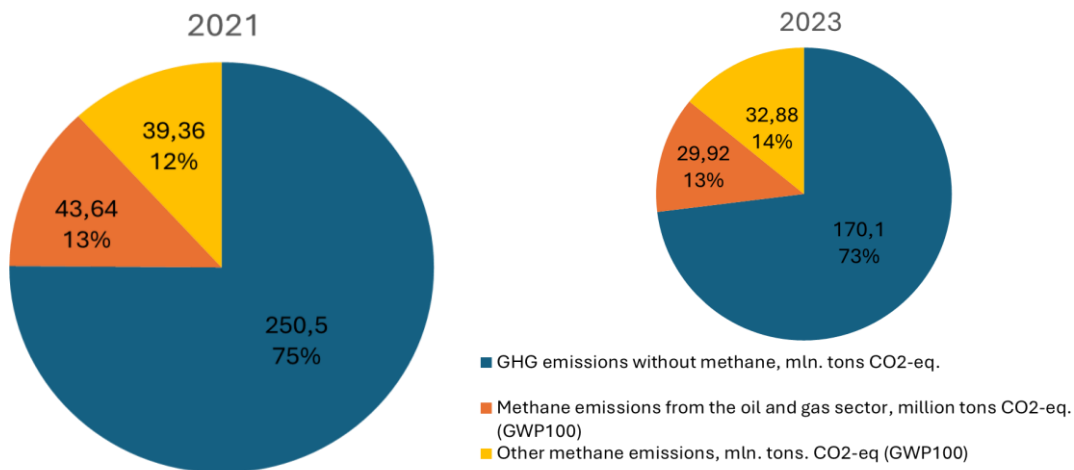
Oil and gas sector methane alone—at 88.2 Mt CO₂-eq or 25% of total GHG emissions under alternative accounting—eclipses the combined contributions from the transportation sector (50 Mt CO₂-eq) and industrial processes and product use (21.1 Mt CO₂-eq).

The contrast between these two perspectives has profound implications for climate policy and investment priorities in Ukraine, while the country is facing both reconstruction needs and EU accession requirements. Applying a 20-year Global Warming Potential (GWP20) does not alter Ukraine's formal reporting obligations under the UNFCCC or EU climate law, which remain based on GWP100. However, it provides an analytically useful perspective for assessing near-term climate impacts and policy priorities. When emissions are evaluated over a 20-year timeframe that reflects methane's short atmospheric lifetime, methane mitigation emerges as a central element of Ukraine's climate strategy for the critical 2026–2045 period, complementing—rather than replacing—long-term CO₂ reduction objectives.

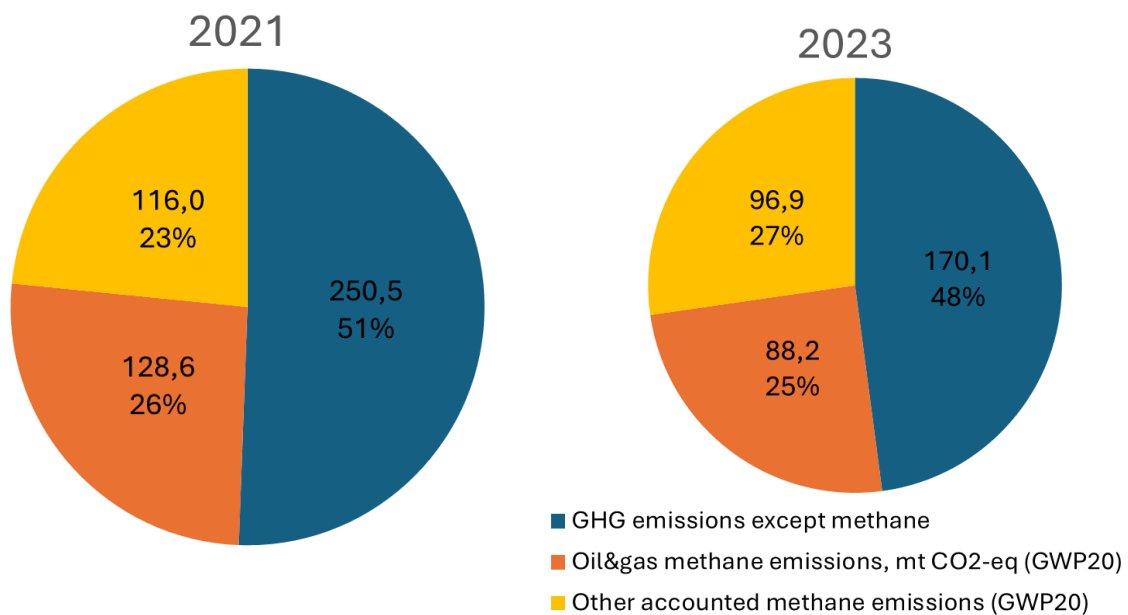
This recognition carries urgent implications. Every year of delay, especially in measures aimed at capturing Ukraine's oil and gas sector methane, means lost opportunities for urgent near-term mitigation. Climate forcing of methane released today will occur precisely during the critical 2026–2045 window when humanity must achieve rapid emissions reductions to preserve livable climate conditions.

From any standpoint, be it standard or alternative, capturing and utilising Ukraine's existing methane emissions is essential for climate change mitigation efforts at the national level, as CO₂ emissions have significantly reduced due to the occupation of territories and the destruction of industrial assets in the Russo-Ukrainian war.

Figure 9: Shares of methane in total GHG emissions in Ukraine calculated with GWP100 and GWP20.



A) Standard accounting with GWP value for methane at 28.



B) Alternative calculation with GWP value for methane at 82,5.

Source: Ukraine 2025 National Inventory Document data, own calculations.

2.5 Impacts of full-scale invasion on the oil & gas sector

Ukraine's 2025 NID documents that the energy sector methane emissions in 2023 were significantly impacted by the full-scale invasion, though the complexity of attribution and measurement challenges makes precise quantification difficult.

The occupation of gas-producing regions in Kharkiv, Luhansk, and Donetsk oblasts eliminated Ukrainian access to substantial production capacity. Natural gas production fell to 18.7 billion m³ in 2023, down from 20.5 billion m³ in 2021, representing an 8.8% decline. The loss of access to fields representing 3-4 billion m³ of potential annual production fundamentally altered Ukraine's domestic gas supply balance.

Infrastructure damage compounded these production losses. Targeted attacks on gas processing facilities and compressor stations disrupted normal operations, requiring emergency shutdowns and protection measures. Damage to pipeline infrastructure from military operations created both immediate emission events and longer-term structural integrity concerns. The disruption of maintenance and repair activities in conflict zones meant that routine leak repairs were delayed or became impossible to perform.

Monitoring and reporting challenges emerged as critical constraints on emission quantification. The inability to conduct measurements in occupied territories, comprising approximately 20% of Ukraine's territory, created fundamental data gaps. The physical destruction of monitoring infrastructure, offices, and data archives eliminated historical records and measurement capabilities in affected areas. Personnel displacement and reduced institutional capacity diminished the technical workforce available for emission monitoring and inventory compilation. Security restrictions limiting access to border regions and frontline areas prevented routine monitoring activities.

The 2025 NID indicates that despite production declines, emission intensity factors may have increased due to several war-related factors. Emergency shutdowns and safety venting procedures, implemented more frequently during attacks and infrastructure damage events, released gas that would otherwise have been captured and utilized. Damage-induced leaks required extended repair timeframes because of security constraints, equipment supply disruptions, and personnel limitations. Reduced maintenance capacity and delayed repairs meant that minor leaks progressed into major emission sources. The complete inability to implement LDAR programs in active conflict zones eliminated what would normally be routine emission reduction measures.

The 2025 NID estimates that fugitive emissions from oil and natural gas in 2023 were approximately 45-48 Mt CO₂-eq, compared to approximately 53 Mt CO₂-eq in 2021. This represents a decline proportional to or slightly less than the production decline, suggesting that emission intensity per unit of production remained stable or potentially increased during the war period.

Russian attacks on the oil and gas sector infrastructure, which have intensified since the fall of 2025, created multiple challenges and contributed to increased methane intensity. Damage to pipelines, compressor stations, and storage facilities leads to uncontrolled releases, while emergency response measures, such as infrastructure protection protocols that allow pre-emptive venting under the threat of aerial kinetic attack, add further complexity and uncertainty to methane emissions accounting in the sector. These conditions challenge conventional approaches and reduce the reliability of standard reporting systems. As a result, there is a growing need to develop dedicated methodologies, regulatory provisions, and operational protocols to accurately account for war-related methane emissions.

2.6 Impacts of full-scale invasion on coal mining

The coal mining sector experienced unprecedented environmental damage that the 2025 NID acknowledges represents one of the war's most severe long-term environmental consequences.

Mine flooding events reached catastrophic proportions in the early months of the full-scale invasion. Approximately 10 Ukrainian coal mines were flooded during the first months of military operations in 2022, as power supply interruptions disabled pumping systems that normally prevent water infiltration. An additional 26 mines in occupied territories were progressively flooded since 2014, as economic collapse, occupation administration neglect, and systematic dismantling of industrial infrastructure eliminated the continuous pumping operations required to keep deep mines dry. Among the flooded facilities, the Yunkom mine holds particular concern as the site of a 1979 underground nuclear explosion conducted during the Soviet period's experimental non-military nuclear test programme. The flooding of this site raises radiological concerns in addition to methane emission issues.

Production collapse followed logically from mine flooding and occupation. Coal production fell to approximately 18-20 million tonnes in 2022-2023, representing an approximately 80% reduction from 2021 levels. Remaining operational mines are concentrated in Dnipropetrovsk Oblast and scattered facilities in Western oblasts, far from the traditional Donbas heartland of Ukrainian coal mining. The complete loss of access to Donbas mining facilities, which historically represented the core of Ukrainian coal production and included the deepest and most gassy mines, fundamentally restructured the geography and character of whatever coal industry survives.

Controlled ventilation emissions decreased proportionally with the dramatic production decline, as fewer operating mines and reduced production volumes meant less ventilation air requiring processing. However, uncontrolled emissions from flooded mines partially offset these reductions, as water flooding does not immediately eliminate methane migration through geological formations and may even alter gas flow patterns in ways that increase surface emissions in some locations. Post-mining and abandoned mine methane (AMM) emissions continued from inaccessible territories, though reliable monitoring became impossible. The combination of these factors creates significant uncertainty in emissions from occupied territory mines, making the 2025 NID's emission estimates for this category subject to particularly wide error bounds.

The 2025 National Inventory Document reports fugitive methane emissions from solid fuels at approximately 4–5 Mt CO₂-eq in 2023, compared to around 6 Mt CO₂-eq in 2021. This reduction is substantially smaller than the roughly 80% decline in coal production over the same period. The divergence reflects the persistence of methane emissions from flooded, closed, and abandoned mines, which continue to emit methane largely independently of current production levels and complicate the interpretation of production-based emission indicators.

3. Estimation of methane utilisation potentials

3.1 Key messages

- **Substantial recoverable methane exists across sectors:** Post-war technical potential totals approximately 2.15–3.08 billion m³ annually, comprising: oil & gas (1.3–1.8 bcm), coal mines (0.5–0.8 bcm), landfills (0.3–0.4 bcm), and wastewater biogas (0.05–0.08 bcm). Fully deploying this potential could meet 10–15% of Ukraine’s natural gas demand, improving energy security and reducing import dependence.
- **Significant climate mitigation opportunity:** Capturing this methane could avoid 60–85 Mt CO₂-eq annually (GWP100), with near-term climate benefits even greater under GWP20 metrics. Methane mitigation is a high-impact lever in the critical 2026–2045 climate window.
- **Cost-effective and revenue-generating measures are available:** Many interventions, especially in the oil & gas sector (LDAR, maintenance, equipment upgrades), have near-zero or negative net cost due to immediate gas value. Payback periods range from <1 year (oil & gas) to 1–4 years (CMM, landfill gas), with IRRs of 15–30%. The total 10-year investment needs across all sectors are €2.4–3.6 billion, with annualized costs of €245–370 million.
- **Sectoral priorities differ by ease of deployment and urgency**
 - Oil & gas sector: fastest, largest, and most cost-effective near-term reductions.
 - Coal mines: medium-term potential constrained by flooded mines and industry restructuring.
 - Waste sector: lower volume but provides additional energy and GHG co-benefits; EU accession standards will drive upgrades.
- **Systematic, staged implementation is essential.**
A four-stage roadmap (2025–2040+) ensures success:
 - 2026–2027: pilots, regulatory framework, and capacity building;
 - 2028–2031: scale-up in accessible regions;
 - 2032–2039: full deployment including recovered territories;
 - 2040+: continuous optimisation and technology upgrades.

3.2 Coal mine methane recovery potential

According to assessments by UNECE and Global Methane Initiative, Ukraine's pre-war coal mine methane (CMM) emissions were estimated at approximately 1.2-1.5 billion m³ of methane annually.

Before the full-scale invasion, 18 coal mines had implemented methane capture projects that generated heat and electricity and qualified for carbon credits under international mechanisms. Approximately 50% of economically viable methane was being recovered at operational facilities, suggesting room for substantial improvement even with existing technology and economic conditions. Technologies employed included pre-mining degasification systems that extract gas from coal seams before mining advances into gassy zones; drainage systems during active mining that capture gas through boreholes drilled from mine workings; CMM power generation units using gas engines or turbines to generate electricity from captured gas; and VAM oxidation systems for treating low-concentration methane in ventilation air streams where concentrations are too low for direct energy recovery.

The current status as of 2024 presents a dramatically altered landscape. Most implemented projects were located in Donbas and are now inaccessible or destroyed, with equipment damaged or removed and technical documentation lost. Remaining potential is concentrated in the Lviv-Volyn coal basin and scattered facilities in government-controlled territory, a much smaller resource base than existed pre-war. The estimated remaining economically viable potential stands at approximately 0.5-0.8 billion m³ annually, less than half the pre-war assessment. The corresponding estimated GHG mitigation potential is 10-16 Mt CO₂-eq. Post-war reconstruction will need to reassess potential accounting for flooded mines that may never be dewatered, the altered structure of whatever coal industry survives the energy transition, and the changed economics of CMM recovery in a reduced-production environment.

Case studies of CMM capture and utilisation projects in Ukraine supported by the Global Methane Initiative and referenced by the United Nations Economic Commission for Europe indicate a cost range of 400–900 EUR/tCH₄ when annualised (15–20 years, 8–10% WACC). Provided that 1 tCH₄ equals ~1,36 thousand m³ and taking a lower estimate of the remaining mitigation potential (0.5 bcm), the investment needs for CMM capture projects could be between 300-600 million EUR over the next 10 years.

3.3 Oil and gas sector potential

International studies by expert organizations including the International Energy Agency, the U.S. Environmental Protection Agency, and academic research institutions consistently suggest that 60% of methane emissions from oil and gas operations can be reduced cost-effectively through established technologies and operational practices. For Ukraine, this finding suggests substantial mitigation potential.

LDAR programs represent the most cost-effective and rapidly deployable mitigation approach, offering 30-40% reduction potential. Regular inspections using optical gas imaging (OGI) cameras, commonly called infrared cameras, allow operators to visualize methane leaks invisible to the human eye. The quantification of detected leaks is usually performed by hi-flow samplers. Acoustic leak detectors identify leaks through sound signature analysis, useful for buried pipelines and inaccessible equipment. Smart pressure monitoring systems use pressure drop analysis to identify and locate

leaks in pipeline networks. Together, these technologies enable systematic detection and prioritization of repairs. At pre-war activity levels, Ukrainian LDAR programs could achieve an estimated reduction of 16-21 Mt CO₂-eq annually or 0,8-1,0 billion m³ of prevented gas leakages.

Equipment upgrades and replacements offer 15-20% reduction potential through systematic infrastructure modernization. Replacing pneumatic devices that use high-pressure gas to operate control systems with low-bleed or no-bleed alternatives eliminates a major routine emission source. Installing vapour recovery units (VRUs) at storage tanks, loading facilities, and other liquid hydrocarbon handling points captures 90-95% of vapours that would otherwise be vented. Upgrading compressor seals and rod packing addresses fugitive emissions from compressors in Ukraine's gas system. Modernizing gas processing equipment with current-generation technology incorporating better sealing and lower-emission designs provides systematic improvements. This category could deliver an estimated reduction of 8-11 Mt CO₂-eq annually at pre-war activity levels convertible to 0,4-0,5 billion m³ additional commercial volumes of gas.

Operational process optimization provides 5-10% reduction potential through improved practices that often require minimal capital investment. Reducing venting during well completions and workovers through green completion techniques and improved planning eliminates major episodic emission events. Minimizing gas flaring through better planning, infrastructure investment to enable gas capture, and regulatory requirements addresses a visible and quantifiable emission source. Optimizing compressor operations through improved scheduling, maintenance, and control strategies reduces both emissions and energy consumption. Improving pipeline integrity management through enhanced inspection, prioritized repair, and replacement programs addresses the distributed leak sources throughout the gas system. This category could achieve an estimated emissions reduction of 3-5 Mt CO₂-eq annually and bring savings of 0,1-0,3 billion m³ of natural gas.

The total oil and gas sector mitigation potential thus reaches 27-37 Mt CO₂-eq annually at pre-war production levels or 1,3-1,8 billion m³ in saved natural gas. Based on industry benchmarks, average annual costs necessary to realise this mitigation potential can be estimated at 155-220 mln Euro. At the initial stages, annual costs can be toward the higher end of the estimated range and decline as the practices mature.

Table 2. Top-down estimate of oil and gas methane mitigation potential and associated investment costs in Ukraine’s oil and gas sector.

Mitigation measures	Benchmark costs, ⁷	Mitigation potential		Annual investment need, mln €	Saved volumes, billion m ³
	€/t CH ₄	Mt CO ₂ -eq	kt CH ₄		
LDAR	140	16-21	568-757	80-106	0,8-1,0
Equipment upgrades	200	8-11	284-379	57-76	0,4-0,5
Process optimisation	200	3-5	95-189	19-38	0,1-0,3
			Total:	155-220	1,3-1,8

Current implementation barriers include wartime security constraints and access limitations that prevent routine monitoring and maintenance in conflict areas; limited investment capacity during the conflict period, with capital scarce and risk premiums high; disrupted supply chains for monitoring and mitigation equipment, with many items requiring international procurement subject to logistical challenges; absence of a mandatory regulatory MRV framework, though development is underway; and competing reconstruction priorities as limited resources must address immediate security, humanitarian, and survival needs before environmental improvements.

However, the post-war period offers unprecedented opportunity. Reconstruction provides a chance to build modern, low-emission infrastructure rather than simply restoring aging Soviet-era systems, incorporating best practices and current technology from the design stage. International climate finance may be available for mitigation projects through various green climate funds, bilateral climate finance mechanisms, and multilateral development banks. EU Methane Regulation requirements will drive improvements as a condition of market access, with low-emission natural gas commanding premium prices. Norway and EU technical assistance partnerships can accelerate deployment by transferring proven technologies, operational practices, and regulatory approaches through targeted cooperation programs.

3.4 Waste sector energy recovery potential

The pre-war assessment of landfill methane recovery potential identified the largest 50 landfills as having a combined utilization potential of 220-295 kt CH₄ (0,3-0,4 billion m³) annually. In energy

⁷ Indicative values (OPEX + annualised CAPEX) based on Rystad Energy and Environmental Defence Fund reports <https://www.edf.org/sites/default/files/documents/Methane%20Tracking%20Technologies%20Study%20Oct%2018%202023.pdf>

terms, this represents 240-320 MW of firm⁸ electrical power generation capacity, sufficient to power a medium-sized city. Heat production potential reaches 600-800 MW thermal, that might be used for district heating systems or industrial process heat. The GHG reduction potential of 6-8 Mt CO₂-eq annually accounts for avoided methane emissions as the largest benefit, while it can also substitute significant amounts of natural gas or coal in power generation and district heating, making Ukraine less dependent on unreliable fossil fuels.

Wastewater treatment potential centres on biogas capture from anaerobic digesters at wastewater treatment plants. Estimated potential reaches 50-80 million m³ of methane annually across Ukraine's municipal and industrial wastewater treatment infrastructure. This represents 40-65 MW of continuous electrical power generation capacity. The GHG reduction potential of 1-1,5 Mt CO₂-eq annually comes primarily from avoided methane emissions, with additional benefits from displacing fossil-generated electricity.

Pre-invasion implementation remained limited, with only a dozen of major facilities having landfill gas capture and utilization systems. Most landfills lacked basic gas management infrastructure such as collection wells, piping networks, and flare systems. Municipal financial constraints limited investment, as local authorities responsible for landfills faced competing priorities and limited budgets. The lack of an enabling regulatory framework and incentives meant no systematic drivers for investment existed.

Table 3. Top-down estimate of waste sector methane mitigation potential and associated investment costs

Mitigation measures	Potential capacity, MW	Benchmark costs ⁹ , million €/MW	Investment need, mln €	Mitigation potential, Mt CO ₂ -eq
Landfill gas utilization	240-320	2,2	528-704	6,1-8,2
Biogas plants at wastewater treatment facilities	40-65	2,5	100-163	1,0-1,6
Total:			628-867	7,1-9,8

⁸ LFG power generation units typically run in base-load mode, but also can provide dispatchable flexibility.

⁹ Based on estimates by the Bioenergy Association of Ukraine <https://uabio.org/biogas-and-biomethane/>

Post-war opportunities include EU waste management standards that will require improvements as a condition of accession, compelling systematic upgrading of landfill management. Circular economy initiatives can reduce organic waste to landfills through composting, anaerobic digestion of source-separated organic waste, and waste-to-energy facilities, simultaneously reducing future methane generation potential. Modern waste-to-energy facilities can be incorporated in reconstruction plans, particularly for major cities, providing both waste management and energy supply benefits. International development banks have expressed interest in supporting waste sector projects, viewing them as combining environmental, energy, and municipal infrastructure benefits.

3.5 Estimated total recoverable methane resource value (post-war scenario)

Aggregating across the three examined sectors and assuming full implementation over a 10-15 year timeframe, the following potential emerges. The annual recoverable methane volume totals 2.15-3.08 billion m³, comprising oil and gas sector reductions equivalent to 1.3-1.8 billion m³; landfill gas at 0.3-0.4 billion m³; wastewater biogas at 0.05-0.08 billion m³ and coal mine methane at 0.5-0.8 billion m³ (reduced from pre-war due to flooded mines and altered coal industry structure).

Fully realising this methane capture potential could cover up to 10–15% of Ukraine’s natural gas demand, which is expected to return to pre-2022 levels and range between approximately 20 and 30 billion m³, reducing reliance on expensive imports and easing pressure on public budgets that subsidise heating and essential services. The precise contribution will depend on post-war demand recovery, pricing, and the pace of infrastructure rehabilitation. These projects can be deployed within months, providing rapid relief to communities facing wartime energy shortages and helping stabilise the grid. The oil and gas sector offers the fastest and most impactful mitigation opportunities that deserve priority attention.

The corresponding greenhouse gas reduction potential is 60-85 Mt CO₂-eq annually (accounted with the standard 100-year global warming potential of methane). Considering that the presence of methane in the atmosphere is short-lived, and its strong near-term climate forcing effect, climate benefits are very substantial.

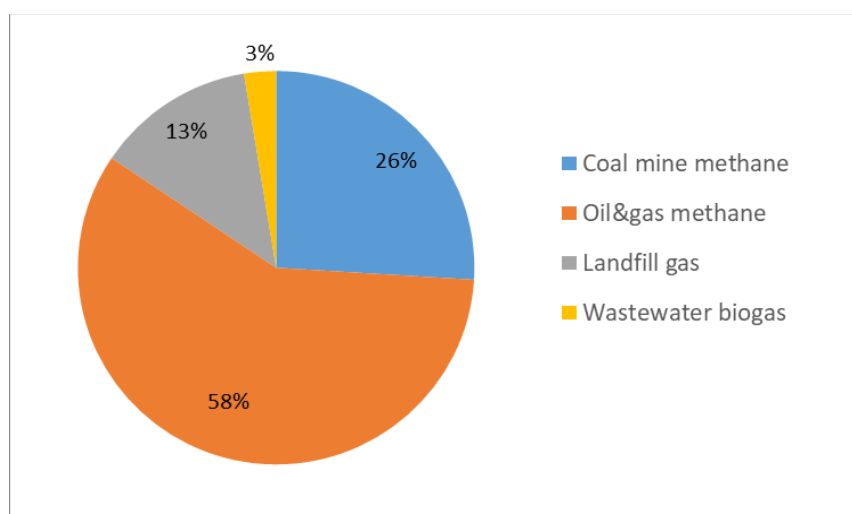


Figure 10: Total recoverable methane by sector (higher estimate).

Economically, methane mitigation pays for itself within short timeframes. Many abatement options in Ukraine have near-zero or even negative costs because the captured gas has immediate market value. Measures in the oil and gas sector (such as LDAR, maintenance improvements and equipment upgrades) can pay back in less than a year. More capital-intensive projects—whether landfill gas-to-energy or coal mine methane utilisation—deliver payback periods of one to four years, with internal rates of return often exceeding 15–30%. This makes methane abatement one of the rare climate measures that generates net revenue for operators while reducing fiscal risks for the state. Project deployment also creates new employment opportunities in coal regions and industrial towns, supporting a just transition during wartime and reconstruction.

At 2025 European average wholesale natural gas prices (0,36 EUR/m³), the recovered gas economic value of recovered gas is estimated at 750-1100 million EUR annually or up to 11 billion EUR in the next 10 years. The eventual result will depend on the speed of the deployment of methane mitigation projects. The total estimated costs for implementation across all analysed sectors over the next 10 years range from 2,4 to 3,6 bln EUR (See Annexe 2 for details).

Annual costs of mitigation efforts (including LDAR, investments in equipment upgrades and process optimisation) are estimated at 155-220 million EUR in the oil and gas sector, 60-90 million EUR for capital investments in the waste management sector and 30-60 million EUR for coal mine methane (scaled over a 10-year period and including post-mining mitigation).¹⁰

For methane mitigation projects to fruitfully materialise in Ukraine, a consistent and systematic approach is needed across four consecutive stages over the next 20 years:

¹⁰ Values aggregated from Tables 2 and 3 and Section 3.1.

- first stage (2026-2027) must focus on regulatory framework development, pilot project deployment, and capacity building to establish foundations;
- second stage (2028-2031) accelerated and large-scale deployment in accessible regions as financing mobilizes and supply chains establish;
- third stage (2032-2039) should aim for achieving full implementation, including projects at recovered territories as security situation normalizes;
- fourth stage, spanning beyond 2040, should pursue continuous optimisation and technology upgrades as next-generation solutions emerge.

The ultimate question is not whether to prioritize methane mitigation in Ukraine's post-war energy transition, but rather how quickly comprehensive methane capture and utilization programs can be designed, financed, and implemented at scale. A systematic, phased 20-year strategy with regulatory, technical, and financial enablers is essential to realize the full potential.

4. Policy recommendations

Ukraine faces a structural methane challenge. Although its emissions declined during the war, this reduction reflects economic contraction rather than sustained mitigation. Without targeted policy reform, emissions may rebound during reconstruction. Methane mitigation presents a convergence of climate, and EU accession interests, and offers a major opportunity. Realising it requires coordinated regulatory, fiscal, and investment reforms.

In economic terms, the legacy support mechanisms in the energy sector do not deliver commensurate public value: they preserve uncompetitive industries, perpetuate environmental externalities, waste a valuable resource (methane as energy carrier), and shift long-term liabilities to society in the form of impacts of climate change, degraded air quality, and remediation costs for abandoned/unmanaged sites.

Success can be built on the consistent coordinated actions organised along the next five pillars:

1. Establishing a measurement-based regulatory framework

- Transpose Regulation (EU) 2024/1787 into national law.
- Designate a competent authority.
- Introduce mandatory Tier 3+ MRV and LDAR programmes.
- Create a transparent national methane database.
- Integrate satellite monitoring for inaccessible territories.

The regulatory framework must include mandatory measurement-based MRV for oil, gas, and coal mine operations currently absent from Ukrainian requirements, LDAR program for all energy facilities establishing routine leak detection and repair, landfill methane management standards bringing waste facilities up to EU norms, and integration into EU Methane Regulation compliance pathway positioning Ukraine as a competent climate protection interlocutor.

2. Reform fiscal incentives and state support in the energy sector

- Introduce an explicit tax on methane specifically (instead of the current implicitly defined rate under category “hydrocarbons”) with an initial rate equivalent to approximately 50 EUR/tCH₄ (≈0.6 EUR/tCO₂-eq using GWP20 to scale the CO₂ tax rate), replacing the current negligible rate (~0.04 EUR/tCO₂-eq).
- Phase in the predictably growing methane emissions tax gradually between 2026 and 2028.
- Ring-fence at least 60% of revenues for methane mitigation investments.
- Review and reform state support schemes in the energy sector that cover operational costs but fail to incentivise methane abatement investments.

The current structure of state support for Ukraine's extractive industries typically covers operating expenses but not capital expenditures for methane abatement. This structural bias, along with lax taxation, encourages firms to defer or avoid investment in emission-reducing infrastructure, as the short-term profitability threshold is satisfied by state subsidies.

Review and re-design of fiscal instruments should include economically meaningful methane taxation, based on GWP20 and consistent with the CO₂ tax. Reinvestment mechanisms directing revenues to mitigation infrastructure would ensure that taxation serves environmental improvement. Removal of counterproductive subsidies that inadvertently encourage emissions should accompany positive incentives.

3. Prioritise the deployment of high-impact measures

- Facilitate LDAR rollout across all upstream oil and gas facilities.
- Modernisation of high-leak infrastructure during reconstruction.
- Mandatory landfill gas capture at all new and reorganised solid waste disposal sites.
- Assessment and phased recovery of coal mine methane in accessible regions.

Significant methane leaks in Ukraine's upstream oil and gas sector result in lost commodity value (vented/flared gas) and weakens the country's domestic energy supply base. In a resource-scarce and reconstruction-intensive Ukrainian context, methane mitigation presents a strong opportunity — both economically (increase domestic production) and fiscally (increase state income from taxes and royalties).

4. Mobilise blended finance for methane mitigation projects

- Access EU pre-accession and reconstruction funds.
- Engage IFIs for concessional lending.
- Issue green and sustainability-linked bonds.
- Leverage Article 6 ITMO mechanisms.

Investment mobilization demands an estimated 2.4-3.6 billion EUR total through 2035 across the analysed sectors (see Annexe 2 for details). Leveraging international climate finance from dedicated climate funds, IFI lending from development banks offering concessional terms, EU pre-accession funds linked to accession preparation, and engaging private sector through carbon markets and green bonds can collectively meet this need. Integrating methane mitigation into post-war reconstruction planning would ensure that environmental goals align with broader recovery efforts.

5. Integrate methane mitigation into the reconstruction economic development strategy

Post-war reconstruction presents a unique opportunity to build modern, low-emission energy infrastructure rather than restoring the architecture of outdated Soviet-era systems that would lock in high emissions for decades. The capital investments required for reconstruction must occur regardless; the question is whether they incorporate best available technologies and practices from the outset or merely replicate the problems of the past.

Therefore, new methane standards must be embedded in new infrastructure design early on to prevent lock-in of high-emission systems.

5. Conclusion: time to turn the challenge into an opportunity

Ukraine's path forward must navigate the dual challenges of wartime emergency management, with its focus on immediate survival and longer-term institutional development, building systems for the future. The Norwegian and broader EU experience demonstrates that economic development and methane mitigation are compatible goals when supported by appropriate regulatory frameworks, fiscal instruments, and technological investments in a partnership between the state and industry.

For the EU, supporting methane reductions in Ukraine is both a climate and geopolitical priority. Post-war reconstruction offers “low-hanging” methane abatement opportunities that can be quickly realized. International support, including EU pre-accession funds, IFI concessional financing, and Article 6 carbon market tools (voluntary or transition credits), can accelerate implementation. Each mechanism has specific trade-offs and should be carefully assessed to maximize climate and economic co-benefits.

Prioritising methane mitigation in Ukraine's post-war recovery is therefore not a question of ambition, but of sequencing and implementation. Establishing robust MRV systems, aligning regulation with EU requirements, and redirecting public support away from emission-intensive practices can ensure that reconstruction leads to structurally lower methane emissions rather than a rebound. Timely action during the recovery phase will determine whether Ukraine converts current disruption into lasting climate, energy-security, and EU accession gains.

Annexe 1: MRV frameworks under ETS Directive and EU Methane Regulation

The EU Methane Regulation and the EU Emissions Trading System (ETS) Directive both establish robust frameworks for MRV, but they differ in scope, methods, and regulatory purpose. The ETS focuses on carbon dioxide (CO₂) and other selected GHGs emitted by large industrial installations, applying market-based compliance through the surrender of emission allowances. Under the ETS MRV framework the emissions are typically calculated using activity data and emission factors, and verified annually by accredited bodies. In contrast, the Methane Regulation introduces a separate MRV regime specifically targeting methane emissions across the oil, gas, and coal sectors. It emphasizes measurement-based data, regular and frequent observations under leak detection and repair (LDAR) programs, and timely reporting of events like venting or flaring, with the aim of improving transparency and driving direct mitigation.

Despite their differences, these MRV systems are complementary. Methane emissions from installations covered by the ETS are often not comprehensively addressed within the ETS framework, making the Methane Regulation a critical addition. Both systems require independently verified reporting and contribute to improving the accuracy of national greenhouse gas inventories under the UNFCCC. Data collected under both MRVs inform EU-wide databases managed by the European Environment Agency (EEA) and Eurostat, ensuring consistency across climate statistics, compliance tracking, and policy evaluation. The integration of high-resolution methane data from the Methane Regulation helps shift national inventories from generalized assumptions to source-level estimates, aligning with international best practices. Together, these systems reinforce each other, supporting both effective regulation and high-quality emissions accounting at EU and Member State levels.

The Methane Regulation references OGMP 2.0 standard as a best practice model and promotes the use of its five-tier MRV framework to guide how operators report emissions across oil and gas activities. The tiers are:

- Tier 1 – Generic emission factors applied to company-wide activity data (e.g. using IPCC defaults).
- Tier 2 – Company-specific emission factors, often derived from internal studies or models.
- Tier 3 – Source-level emission factors, based on measurements that use direct quantification (e.g. on-site instruments, portable analyzers).
- Tier 4 – Quantification with site-level or system-level measurements (e.g. drone, aerial, satellite campaigns).
- Tier 5 – Reconciliation of bottom-up and top-down methods to ensure inventory completeness.

Tier 3 MRV reporting, as defined under the OGMP 2.0 framework and promoted by the Methane Regulation, marks a critical shift from estimated to directly measured methane emissions. It requires operators to quantify emissions at the level of individual sources—such as valves, flanges, pneumatic controllers, or vent stacks—using on-site, measurement-based methods as a basis to produce source-

specific specific emission factors. Unlike lower tiers that rely on generic or company-specific emission factors, Tier 3 emphasizes the use of empirical data collected through certified instruments and standardized procedures as a basis for MRV.

Measurement tools commonly used under Tier 3 include high-flow samplers, portable methane analyzers, bagging techniques, and optical gas imaging devices equipped with quantification capabilities. These tools must be calibrated and operated according to rigorous protocols that account for variables like temperature, pressure, and background concentrations. Operators are expected to conduct measurements regularly, document methodologies, and ensure the traceability and reproducibility of results.

Importantly, Tier 3 data must be verifiable by third parties and linked to specific assets or components, allowing for precise identification of emission sources. By prioritizing this level of detail, Tier 3 enables operators to target high-emitting equipment for repair or replacement, and supports the development of more accurate, facility-level methane inventories. This tier forms the cornerstone of modern methane MRV and reflects a strong commitment to transparency and operational accountability.

The Methane Regulation makes Tier 3 and higher tiers the expected benchmark for emissions reporting. Operators must implement standardised LDAR programs, submit site-level emission reports, and—where feasible—use direct measurement methods, particularly for high-priority sources (compressor stations, gas processing facilities, underground coal mines, etc.). The goal is to improve the transparency, granularity, and reliability of methane data reported to Member States and the European Commission.

Annexe 2: Approach for estimation of investment needs

The total estimated investment requirements for methane mitigation projects in Ukraine of 2.4-3.6 billion EUR in the next 10 years provided in this study represent high-level approximations derived through a top-down comparative approach rather than a detailed bottom-up engineering cost analysis. The estimates were constructed by scaling international benchmarks to Ukraine's methane mitigation potential across four applications: oil and gas operations, coal mining, landfills and wastewater treatment.

Oil and gas infrastructure modernisation costs (1.55-2.2 billion EUR) were estimated by applying benchmark costs from European and North American methane abatement projects to Ukraine's technical mitigation potential of 2.15-3.08 billion cubic meters annually. This includes LDAR equipment deployment across hundreds of oil and gas facilities, pipeline integrity upgrades spanning thousands of kilometers, compressor station modernization and construction of new ones. The estimate is linked to current market prices for optical gas imaging cameras, costs of continuous monitoring equipment, and costs of satellite data processing and software integration, which can reduce over time and increasing scale of deployment.

These estimates drew conceptually from IEA Global Methane Tracker cost assumptions and international best practices documented by EPA and the Global Methane Initiative, but lack Ukraine-specific cost data and detailed facility-level engineering assessments.

For coal mine methane utilisation projects, an indicative cost range of 400–900 EUR/tCH₄ was applied, consistent with historic data. For landfill gas utilisation and biogas plants at wastewater treatment facilities, national benchmark costs of 2.2-2.5 million €/MW per unit of installed power generation capacity were applied based on Ukrainian Bioenergy Association reports.

Rigorous investment planning will require facility-by-facility engineering assessments with site-specific cost estimates; procurement studies incorporating Ukrainian labour rates, equipment prices, and construction costs; war damage assessments and reconstruction cost multipliers for affected regions; comparative analysis of similar projects in Central and Eastern European countries; financial modelling including capital costs, operating expenses, and revenue streams from recovered methane; and stakeholder consultations with Ukrainian operators, equipment vendors, and international financial institutions. Development of these evidence-based estimates should be prioritised to support credible policy planning and international financing proposals.

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