

3. Təkmilləşdirilmiş qərar vermə.
4. Daha az insan səhvləri.
5. 24x7 mövcudluq.
6. Azaldılmış fiziki risklər.

DOI 10.70286/ISU-15.10.2025.011

REDUCTION OF HARMFUL EMISSIONS INTO THE ATMOSPHERE IN UKRAINE AND THE EUROPEAN UNION COUNTRIES

Mysak Stepan

PhD in Technical Sciences, Associate Professor
Chief Specialist, PJSC “LvivORGRES”

Shapoval Stepan

Doctor of Technical Sciences, Professor
Professor of the Department of Heat and Gas Supply and Ventilation
Lviv Polytechnic National University

Kuznetsova Marta

PhD in Technical Sciences, Associate Professor
Associate Professor of the Department of
Thermal Power Engineering, Thermal and Nuclear Power Plants

Gyvlud Anna

PhD in Technical Sciences, Associate Professor
Department of Environmental Safety
and Environmental Protection Activities

Due to global climate change associated with a 1°C increase in temperature compared to pre-industrial levels — changes that have become particularly evident in recent years — and in light of the alarming forecasts issued by the United Nations (UN) regarding threats to safe living conditions in the near future, countries around the world have faced the urgent need to pursue sustainable development. This approach aims to meet the needs of the present without compromising the ability of future generations to meet their own.

In response, the Paris Agreement (also known as the Paris Climate Agreement) was adopted in 2016 under the UN Framework Convention on Climate Change (UNFCCC). It replaced the Kyoto Protocol, serving as a new framework for global efforts to reduce carbon dioxide (CO₂) levels in the atmosphere starting in 2020. The Agreement's main objective is to keep the rise in average global temperature well below 2°C above pre-industrial levels and to pursue efforts to limit it to 1.5°C. Achieving this target is expected to mitigate adverse effects on ecosystems, human

health, and overall well-being, thus supporting the attainment of the UN Sustainable Development Goals.

Each participating country defines its own pathway to contribute to the global objective through a nationally determined contribution (NDC)—a commitment to reduce greenhouse gas (GHG) emissions. Nations are required to report on their progress and update or enhance their NDCs every five years.

In 2022, prior to the 27th session of the UNFCCC Conference of the Parties, the Intergovernmental Panel on Climate Change (IPCC) released updated scientific findings [1]. According to this report, the existing commitments made by the parties to the Paris Climate Agreement are projected to increase global greenhouse gas (GHG) emissions by 10.6% by 2030 compared to 2010 levels. If this trend continues, global temperatures could rise by approximately 2.5°C by the end of the century. Therefore, the IPCC emphasized the urgent need for decisive measures to reduce global GHG emissions by 43% by 2030 relative to 2019 levels.

Following the conference, it was concluded that to fulfill the goals of the Paris Agreement, governments must revise and strengthen their Nationally Determined Contributions (NDCs) by setting more ambitious targets. In particular, they should accelerate the phase-out of coal, eliminate inefficient fossil fuel subsidies, and promote a rapid, fair transition to renewable energy sources (RES).

At the end of 2019, the European Commission, in alignment with the commitments under the Paris Agreement, revised the European Union's energy policy to create an energy union that ensures households and businesses have access to secure, sustainable, competitive, and affordable energy. As part of this initiative, the Commission introduced the European Green Deal — a comprehensive roadmap for achieving sustainable economic development and transforming Europe into a carbon-neutral continent by 2050.

To reach climate neutrality, the plan envisions a wide range of measures across all sectors of the economy, including support for industrial innovation, investment in environmentally friendly technologies, expansion of clean and affordable transportation, decarbonization of the energy sector, enhanced building energy efficiency, and cooperation with global partners to strengthen environmental standards. Consequently, the efficient use of heat-generating units [2] and the effective integration of alternative energy sources [3], [4] have become essential components of this transition.

According to the Energy Strategy of Ukraine until 2035 titled Security, Energy Efficiency, Competitiveness, Ukraine aims to address the challenges of decarbonization and pollutant emission reduction through several key measures. These include decreasing the energy intensity of GDP, reducing total pollutant emissions, partially decommissioning thermal power plants, introducing a greenhouse gas emission trading system, establishing restrictions for major GHG emitters, and creating legislative mechanisms to finance investments in gas-cleaning equipment.

The assessment of greenhouse gas (GHG) and pollutant emissions was conducted excluding the sector of land use, land-use change, and forestry (LULUCF).

Within the Integrated National Energy and Climate Plans (NECPs) for 2021–2030, which every EU member state submits to the European Commission for evaluation and progress reporting (every two years) and updates (every five years) in line with the European Climate Law, countries outline strategies to address five key priorities:

At the end of 2020, guided by a comprehensive assessment of the social, economic, and environmental impacts and emphasizing the practical feasibility of implementation, the European Commission amended the proposed European Climate Law ahead of the 26th session of the UNFCCC Conference of the Parties. It introduced a new EU Nationally Determined Contribution (NDC), setting a target to reduce GHG emissions by at least 55% by 2030 compared to 1990 levels. This heightened ambition provides a balanced trajectory toward achieving climate neutrality by 2050.

An initial step involved analyzing both the achieved and projected reductions in GHG emissions relative to 1990 levels (see Fig. 1).

According to [5], Ukraine's national target for 2030 envisions a 34.8% reduction in GHG emissions compared to 1990 levels. However, projections indicate that emission levels will remain nearly unchanged from 2020, accompanied by a slight increase in energy consumption within the economy. As a result, international experts have deemed Ukraine's nationally determined contribution (NDC) insufficient and inconsistent with the goals of the Paris Climate Agreement. Without structural reforms in the energy and economic sectors, and unless the hostilities cease, significant additional reductions in emissions are unlikely to occur.

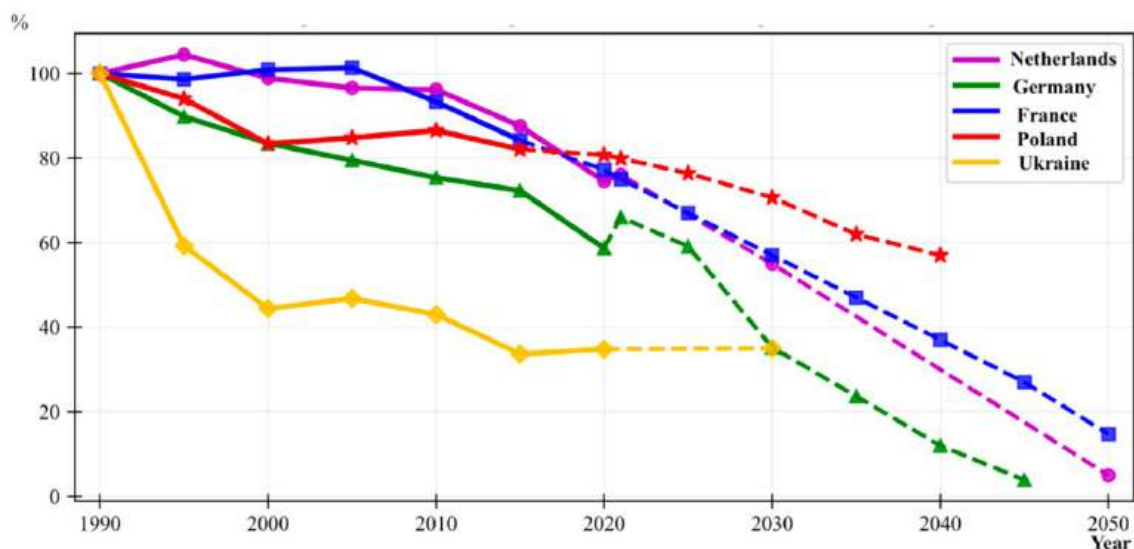


Fig. 1. Relative reduction of greenhouse gas emissions, %, in Ukraine and EU countries from the 1990 level.

As shown in Figure 1, between 1990 and 2020, Ukraine recorded the largest reduction in greenhouse gas (GHG) emissions among the analyzed countries. This decline was primarily driven by the collapse of the industrial sector following the dissolution of the USSR, as well as severe economic crises and war in the Donbas region.

In contrast, Germany is expected to demonstrate the strongest long-term progress in GHG reduction. According to , due to ambitious and decisive energy policies, Germany aims to cut emissions by 65% by 2030, 88% by 2040, and achieve climate neutrality by 2045, maintaining GHG emissions at only 3.9% of 1990 levels. Similarly, France targets a 43% reduction by 2030, 63% by 2040, and climate neutrality by 2050, with projected emissions around 14.7% of 1990 levels.

Unlike Ukraine, the European Union enforces strict regulations to curb greenhouse gas (GHG) emissions by implementing high carbon taxes and continuously reforming the Emissions Trading System (EU ETS) to encourage industries to modernize and adopt cleaner technologies. In addition, the member states' commitment to the European Green Deal and the use of a flexible credit mechanism — which provides grants or partial reimbursements for purchasing energy-efficient equipment and optimizing production processes — help attract financing on favorable terms for sustainable projects.

In contrast, Ukraine's leading position in reducing CO₂ emissions compared to 1990 levels is largely the result of a decline in industrial activity during periods of deep economic crisis rather than from systemic environmental reforms. The country forecasts a 71.4% reduction in emissions by 2030. However, despite the overall decrease in industrial output and energy consumption, sulfur dioxide (SO₂) emissions in Ukraine remain among the highest, reaching 28.2% of the 1990 level as of 2020.

References

1. ClimateChange2022:MitigationofClimateChange.TechnicalSummary.IPCC,2022.
2.https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_TechnicalSummary.pdf (accessed on: 2023-03-15)
2. Pistun Y., Mysak S., Kovalenko T., Lys S. (2017) Development of the analytical method for determining the armor wear of the drum ball mill. Eastern-European Journal of Enterprise Technologies, 5(1-89), 45-50. doi: 10.15587/1729-4061.2017.109629.
3. Mysak, Y., Pona, O., Shapoval, S., Kuznetsova, M., Kovalenko, T. (2017) Evaluation of energy efficiency of solar roofing using mathematical and experimental research. Eastern-European Journal of Enterprise Technologies, 3(8-87), 26-32. doi: 10.15587/1729-4061.2017.103853.
4. Venhryn, I., Shapoval, S., Voznyak, O., Datsko, O., Gulai, B. (2021) Modelling of optical characteristics of the Thermal Photovoltaic Hybrid Solar Collector. International Scientific and Technical Conference on Computer Sciences and Information Technologies, 1, 255-258.
5. Ukraine Ecology and Natural Resources Ministry. Ukraine 2050 Low Emission Development Strategy 2018. Report on the determination of the second national determined contribution of Ukraine to the Paris Climate Agreement. Center for Economic Recovery (UBTA). Kyiv, June 2021(in Ukrainian); https://ubta.com.ua/files/20210713/Annex_1.pdf (accessed on: 2023-03-15)