National Energy and Climate Plan of Ukraine
2025-2030

[Draft]

List of Abbreviations and Acronyms

ENTSO-E	European Network of Transmission System Operators for Electricity (ENTSO-E)
LNG	Liquefied Natural Gas (LNG)
LPG	Liquefied Petroleum Gas (LPG)
SAIDI	System Average Interruption Duration Index (SAIDI)
WAM	Scenario with additional policies and measures
WEM	Scenario with existing policies and measures
NPP	Nuclear power plant
GDP	Gross domestic product
RES	Renewable energy sources
WPP	Wind power plant
PSP	Pumped storage plant
HPP	Hydropower plant
GDS	Gas distribution systems
GTS	Gas transmission system
ICE	Internal combustion engine
IEF	Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine
ESU	Energy strategy of Ukraine until 2050
LULUCF	Land use, land-use change and forestry
CUF	Capacity utilization factor
PTL	Power transmission line
IEA	International Energy Agency
mln	Million
NES	National Economic Strategy for the period up to 2030
NECP	National Energy and Climate Plan until 2030
NERP	National Emissions Reduction Plan from Large Combustion Plants
NDC	Ukraine's Nationally Determined Contribution
IPS(U)	Integrated Power System of Ukraine
CIF	Critical Infrastructure Facilities
UN	United Nations
TIMES-Ukraine	Ukraine's energy system-wide model

TSO	Transmission System Operator
DSO	Distribution System Operator
GHG	Greenhouse Gases
VAT	Value Added Tax
UGS	Underground Gas Storage
UNFCCC	United Nations Framework Convention on Climate Change
NSDC	National Security and Defense Council of Ukraine
SPP	Solar power plant
TPP)	Thermal power plant
CHP	Combined Heat and Power Plant
toe	Ton of oil equivalent
ESS	Energy storage system

SECTION A. NATIONAL PLAN

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1. Executive summary

i. Political, economic, environmental, and social context of the plan

The National Energy and Climate Plan of Ukraine (hereinafter referred to as NECP) is a strategic document aimed at coordinating energy and climate policies to ensure sustainable development and economic recovery of Ukraine.[1]

The preparation of NECP is Ukraine's obligation under the Treaty establishing the Energy Community, in accordance with the requirements of Regulation (EU) 2018/1999 and the relevant methodological recommendations of the European Commission. The document was also supposed to be prepared in accordance with the orders of the President of Ukraine dated November 8, 2019, No. 837/2019[2] and March 23, 2021, No. 111/2021.[3] In addition, the development and approval of NECP is a condition for the distribution of financial assistance from the EU under the future Ukraine Facility.[4]

NECP is prepared in accordance with the clear requirements of Regulation (EU) 2018/1999, as well as taking into account the experience of preparing similar documents by EU Member States and Energy Community Contracting Parties and previous drafts.[5] The development of the draft NECP is carried out by a group of leading experts associated with DiXi Group think tank and the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine, with the support of the Embassy of United Kingdom (project "Ukrainian national development and preparation for the implementation of the energy and climate plan") and the US initiative Net Zero World.

The Ministry of Economy of Ukraine is responsible for coordinating the development of NECP on behalf of the Ukrainian government. The resolution of the Cabinet of Ministers of Ukraine dated August 19, 2023, No. 924 establishes an Interdepartmental Working Group on the preparation of proposals and recommendations for the development of the National Energy and Climate Plan, which includes all key ministries and agencies.[6]

The war by Russia against Ukraine has a serious impact on Ukraine's economy, particularly the energy sector. One of the most important aspects is the destruction of energy facilities due to hostilities, which can cause significant disruptions in electricity and gas supply. Attacks on power plants, gas pipelines, and other facilities can lead to an exacerbation of the energy crisis and limited access to key resources. Additionally, the war affects the availability of workforce and the operation of enterprises.

According to the information from the Ministry of Energy,[7] from October 10, 2022 to March 9, 2023, 271 hits on energy infrastructure objects were recorded as a result of mass attacks using missiles and UAVs.

[1] https://www.energy-community.org/legal/acquis.html

[2] https://www.president.gov.ua/documents/8372019-30389

[3] https://www.president.gov.ua/documents/1112021-37505

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0001.01.ENG

[5] https://www.lowcarbonukraine.com/uk/%D1%83%D1%80%D1%8F%D0%B4%D1%83-%D0%BF%D0%B5%D1%80%D0%B5%D0%B4%D0%B0%D0%BB%D0%B8-%D0%BF%D1%80%D0%BE%D1%94%D0%BA%D1%82-%D1%96%D0%BD%D1%82%D0%B5%D0%B3%D1%80%D0%BE%D0%B2%D0%B0%D0%BD%D0%BE%D0%B3%D0%BE/

[6] https://zakon.rada.gov.ua/laws/show/924-2023-%D0%BF#Text

[7] https://www.kmu.gov.ua/news/500-dniv-viiny-enerhetyka-na-linii-frontu

During the period from November 2022 to February 2023, electricity supply was limited on average to 3.8 million consumers, and the maximum number of consumers affected by shelling during a systemic accident in the power system of Ukraine reached 13.5 million.[8]

Overall, from the beginning of the full-scale aggression to the end of the autumn-winter period of 2022/2023, approximately 50% of the available generating capacity and transformer substations of the transmission system (Ukrenergo) were temporarily lost (damaged and occupied).[9] As a result of the full-scale invasion since February 2022, natural gas consumption has significantly decreased (-28.7% in 2022 compared to 2021) as well as electricity consumption (-30-35%), and natural gas extraction has decreased (-6.7% in 2022 compared to 2021).

With the start of full-scale war, the number of cyber attacks has significantly increased - in just the first 47 days, 200,000 cyber-events were recorded[10], and from January 2022 to September 2023, CERT-UA identified nearly 4,000 cyber incidents[11]. The majority of cyber attacks occur in the energy sector. E.g., the hacker group Sandworm, associated with Russian special services, intensified the effect of mass rocket attacks on Ukraine's energy system on October 10 and 12, 2022.[12]

As of the beginning of 2024, an approximate calculation of the environmental damage exceeded 56 billion euros with over 3300 documented court cases. 280 criminal cases related to ecocide and ecological warfare are being investigated by the prosecution authorities.[13]

Thus, the main problems of developing and implementing NECP are:

- Continuation of the war and the need to take into account its consequences, uncertainty regarding the scale of destruction and the pace of recovery, which directly affect the possibility of implementing specific policies and measures, the pace of their implementation, and their success.
- Economic downturn and the associated energy poverty, which lead to a political unwillingness to apply market mechanisms for pricing energy resources and related services;
- Weakened capacity of state institutions to simultaneously manage crises in the conditions of war and fulfill their key functions in the development and implementation of public policy in the energy and climate sectors, especially considering the challenge of their reform in accordance with EU legislation;
- Accumulated significant debt in the natural gas and electricity supply chains, which requires comprehensive handling at the state level.

ii. Strategy relating to the five dimensions of the Energy Union

Ukraine has a developed system of legislation and regulation, as well as a wide range of policies and measures in the fields of energy, climate, and related areas. Both at the national and regional level (within the Energy Community), Ukraine has set key goals for 2030, including:

- Reducing greenhouse gas emissions by 65% compared to the 1990 level
- Climate neutrality of the energy sector by 2050

[8] https://mev.gov.ua/sites/default/files/field/file/proekt-rozporyadzhennya.pdf

[9] https://www.undp.org/ukraine/publications/ukraine-energy-damage-assessment

[10] https://www.kmu.gov.ua/news/z-pochatku-vijni-shchodnya-fiksuyemo-v-serednomu-ponad-4-tisyachi-sprob-kiberatak-u-sferi-energetiki-farid-safarov

[11] https://home.treasury.gov/news/press-releases/jy1922

[12] https://www.mandiant.com/resources/blog/sandworm-disrupts-power-ukraine-operational-technology

[13] https://president.gov.ua/news/andrij-yermak-i-margot-valstrem-proveli-pyate-zasidannya-miz-88149

- Share of renewable energy sources in the structure of gross final energy consumption not less than 27%
- Primary energy consumption not exceeding 72,224 thousand tons of oil equivalent, final energy consumption - 42,168 thousand tons of oil equivalent
- Expected energy savings in government buildings not less than 24.9 GWh/year
- Reducing the level of import dependence (gross imports in total primary energy supply) to 33%
- Deepening the diversification of sources and routes of energy supply - no more than 30% from one supplier
- Full and comprehensive integration of Ukraine's electricity and natural gas markets with the European market
- Competitive pricing in energy markets with mechanisms to support vulnerable consumers
- Development and financing of innovations and research in the field of clean technologies, renewable energy, and low-carbon production
- Increasing competitiveness

At the same time, issues of completeness (adequacy), relevance, and harmonization of policies and measures aimed at achieving key strategic goals, especially in terms of the need to build a comprehensive climate governance architecture, come to the forefront. Specifically, the NECP is aimed at coordinating energy and climate policies, filling gaps, and adjusting the content of individual measures to achieve defined goals.

A detailed overview of key energy and climate policies and measures related to the five dimensions of the Energy Union is presented in section 1.2.ii. The scenarios modeling was carried out in accordance with the requirements of Regulation (EU) 2018/1999, taking into account the specificities of public administration in Ukraine (see ANNEX 1 for more details).

iii. Overview table with key objectives, policies and measures of the plan

Dimension	Objectives	Existing policies and measures (WEM)	Additional policies and measures (WAM)	Planned policies and measures (including some additional measures, WAM+)
Decarbonization	● Reduction of GHG emissions by 65% by 2030 compared to 1990 levels ● Climate neutrality of Ukraine's energy sector by 2050 ● Climate neutrality (for the economy as a whole) by 2060 ● Phasing out coal generation by 2035 ● Reduction of methane emissions by 30% by 2030 from the 2020 level ● Enhancing the adaptive capacity and resilience of social, economic, and ecological systems to climate change ● The share of renewable energy sources in the total final energy consumption should be at least 27% by 2030 ● Indicative targets for RES in gross final energy consumption by 2030: - Heating and cooling - 35% - Electricity - 25.4% - Transport - 14% ● The share of generation from RES in the total electricity generation at the level of 25% by 2030 ● The share of alternative energy sources (renewable energy sources and secondary energy resources) in the production of thermal energy by objects in the heating sector in 2025 - 30%, in 2035 - 40% ● Increasing the level of application of alternative fuels (biofuels or their mixture with traditional fuels) and electricity (generated from both traditional and renewable sources) in the transport sector to 50% by 2030	PM_D_WEM_01 Carbon tax PM_D_WEM_02 Feed-n tariff for electricity producers from RES PM_D_WEM_03 Incentive tariff for heat energy from RES PM_D_WEM_04 Tax benefits for imported equipment operating on RES PM_D_WEM_05 Exemption from customs duties for agricultural equipment operating on biofuels PM_D_WEM_06 Exemption of bioethanol from excise tax PM_D_WEM_07 Tax incentives for electric transport PM_D_WEM_08 Stimulating the development of electric charging infrastructure PM_D_WEM_09 Stimulating the development of low-carbon municipal transport	PM_D_WAM_01 Carbon tax reform PM_D_WAM_02 National plan for reducing emissions from large combustion plants PM_D_WAM_03 National Emissions Trading System PM_D_WAM_04 Action Plan for the Implementation of Ukraine's Climate Policy within the Global Methane Pledge PM_D_WAM_05 Promoting Minimal Tillage Technologies PM_D_WAM_06 Promoting Organic Farming Development PM_D_WAM_07 Use of nitrogen fertilizers with slow or controlled release of nutrients PM_D_WAM_08 Use of information and communication technologies in crop production PM_D_WAM_09 Use of food additives that contribute to the reduction of GHG emissions from enteric fermentation of livestock PM_D_WAM_10 Scaling up reusing components of MSW PM_D_WAM_11 Scaling up recycling of MSW PM_D_WAM_12 Scaling up composting of organic components of MSW PM_D_WAM_13Scaling up of thermal treatment of MSW (with energy recovery) PM_D_WAM_14 Increasing the volume of utilization (recovery and flaring) of landfill gas at MSW landfills PM_D_WAM_15 Introduction of methane utilization (recovery and flaring) practices in wastewater management facilities PM_D_WAM_16 Auction system for the allocation of support quotas for RES PM_D_WAM_17 Market premium	

			mechanism for RES electricity producers (feed-in premium) PM_D_WAM_18 Direct contracts for the purchase and sale of electricity between producers and end energy consumers (corporate PPAs) PM_D_WAM_19 Guarantees of origin for electricity from RES PM_D_WAM_20 State target program for the just transformation of coal regions of Ukraine until 2030 PM_D_WAM_21 Strategy for environmental security and climate change adaptation until 2030	
Energy efficiency	Primary energy consumption in 2030 should not exceed 72,224 thousand toe, and final energy consumption - 42,168 thousand toe. The cumulative amount of end-use energy savings for 2021-2030 should be at least 16,405 thousand toe. The expected energy savings in government buildings is at least 24.9 GW·h/year.	PM_EE_WEM_01 Activities of the Energy Efficiency Fund PM_EE_WEM_02 State Decarbonization and Energy Efficiency Transformation Fund PM_EE_WEM_03 Energy service in the public sector PM_EE_WEM_04 Minimum energy performance requirements of buildings PM_EE_WEM_05 Energy performance certification of buildings PM_EE_WEM_06 Exemplary role of buildings of state authorities PM_EE_WEM_07 Energy Management in Government Authorities PM_EE_WEM_08 Energy Management in Local Self-Government Authorities PM_EE_WEM_09 Local Energy Plans PM_EE_WEM_10 Regional Decarbonization and Energy Efficiency Offices PM_EE_WEM_11 Energy Efficient Procurements PM_EE_WEM_12 Energy Labelling and Eco-design PM_EE_WEM_13 Experimental project aimed at fostering favorable conditions for efficient electricity consumption in Ukraine PM_EE_WEM_14 Energy audits of large enterprises	PM_EE_WAM_01 Energy efficiency obligations scheme PM_EE_WAM_02 State target economic program for buildings' thermal modernization support until 2030 PM_EE_WAM_03 Nearly zero-energy buildings PM_EE_WAM_04 Assessment of the energy efficiency potential of the gas transportation system, electricity transmission system, gas distribution system, and electricity distribution system PM_EE_WAM_05 Assessment of the potential for the application of high-efficiency cogeneration and efficient district heating PM_EE_WAM_06 Guarantees of origin for electricity generated by high-efficiency cogeneration units PM_EE_WAM_07 Incentivizing high-efficiency cogeneration PM_EE_WAM_08 Implementation of the State Targeted Economic Program for Energy Modernization of Heat Energy Producing Enterprises in State or Municipal Ownership, for the period up to 2030	PM_EE_WAM_01 Energy efficiency obligations scheme PM_EE_WAM_02 State target economic program for buildings' thermal modernization support until 2030 PM_EE_WAM_03 Nearly zero-energy buildings

		PM_EE_WEM_15 Smart metering PM_EE_WEM_16 Regulation of combined heat and power generation (cogeneration) PM_EE_WEM_17 Heat supply schemes PM_EE_WEM_18 Qualification of cogeneration units PM_EE_WEM_19 Heat energy metering		
Energy security	● Reducing the level of import dependence (gross imports in TPES) to 33% ● Deepening the diversification of energy resource sources and supply routes from third countries - ensuring diversification of supplies at a level not exceeding 30% from a single supplier, - reducing the share of a single supplier in the nuclear fuel market to 60% ● Increasing flexibility of the national energy system ● Eliminating restrictions or disruptions in the supply of energy resources in order to increase resilience	PM_ES_WEM_01 Development of routes for the import of petroleum products and natural gas PM_ES_WEM_02 Creation of facilities for the production of fuel assemblies to meet at least 50% of the needs of Ukrainian NPPs PM_ES_WEM_03 Creation of gas reserves (filling of gas storage facilities) PM_ES_WEM_04 Creation of coal and backup fuel (fuel oil) reserves PM_ES_WEM_05 Implementation of N-1 Standard, behavior standards for gas suppliers PM_ES_WEM_06 Implementation of minimum criteria for the security of electricity supply PM_ES_WEM_07 Creation of a national system for the protection of energy sector CIF PM_ES_WEM_08 Experiment on the construction, repair, and other engineering measures for the protection of CIF	PM_ES_WAM_01 Incentives for increasing gas production for maximum self-sufficiency PM_ES_WAM_02 Restoration of oil refining and/or construction of a new complex PM_ES_WAM_03 Creation of capacities for the production of fuel assemblies to meet all the needs of Ukrainian NPPs PM_ES_WAM_04 Development of uranium production PM_ES_WAM_05 Creation of minimum reserves of crude oil and petroleum products PM_ES_WAM_06 Implementation of EU rules on the security of electricity and gas supply PM_ES_WAM_07 Ensuring physical, engineering-technical and cyber protection of 100% energy CIF PM_ES_WAM_08 Creation of backup power sources for CIF, including those using distributed RES generation	
Internal energy market: electricity	● Interconnectivity of Ukraine's power system with ENTSO-E at a level of 10% by 2030 ● Full-scale and comprehensive integration of Ukraine's electricity market with the European market ● Free market-based prices for energy carriers for all consumers with effective mechanisms to support vulnerable consumers; ensuring the absence of debt burden on energy market entities ● 25% RES in the electricity mix by 2030 ● Adequacy and flexibility of the power system ● Implementation of smart metering and	PM_IME_WEM_01 RAB regulation of distribution system operators (RAB tariffs) PM_IME_WEM_02 Support for active consumers through self-generation/consumption mechanism (net billing) PM_IME_WEM_03 Simplification of permitting procedures for distributed generation facilities PM_IME_WEM_04 Prioritization of RES dispatching PM_IME_WEM_05 Compensation for curtailments of RES producers (under the "green" tariff) during redispatching PM_IME_WEM_06 Harmonization of price	PM_IME_WAM_01 Implementation of the Concept of Smart Grids in Ukraine until 2035 PM_IME_WAM_02 Development of aggregation PM_IME_WAM_03 Application of pilot projects and demand-side management programs PM_IME_WAM_04 Development of energy storage facilities PM_IME_WAM_05 State economic program to stimulate the development of distributed generation of electricity from renewable energy sources until 2030 sources until 2030	

	smart grids in electricity ● Reducing power supply interruptions (SAIDI) to 150 minutes in urban areas and 300 minutes in rural areas (by 2050) ● Reducing technological losses in electricity networks by at least 30% by 2030	caps application on wholesale market segments PM_IME_WEM_07 Possibility for RES producers to choose a model of participation in the market and freely switch between them PM_IME_WEM_08 Application of guarantees for purchasing "green" electricity PM_IME_WEM_09 Non-discriminatory integration of demand-side management, energy storage, and aggregation into the energy system and market PM_IME_WEM_11 Application of service quality standards and compensation to consumers for their non-compliance PM_IME_WEM_12 Regulation of retail prices for households PM_IME_WEM_13 Supply of electricity to protected consumers PM_IME_WEM_14 Provision of universal services to consumers PM_IME_WEM_15 Ensuring consumers' access to important information PM_IME_WEM_16 Application of tools to facilitate comparison of commercial offers and consumer choice (price comparison tools) PM_IME_WEM_17 Simplification of the supplier switching procedure PM_IME_WEM_18 Time-bound prices for household consumers PM_IME_WEM_19 Dynamic prices for non-household consumers PM_IM_WEM_01 Targeted monetized subsidies for partial compensation of energy service costs	PM_IME_WAM_06 Contests for the construction of generating capacity and implementation of demand-side management measures PM_IME_WAM_07 Application of long-term contracts for the provision of ancillary services PM_IME_WAM_08 Introduction of real-time prices PM_IME_WAM_09 Integration of spot markets (market coupling) PM_IME_WAM_10 Integration of balancing market PM_IM_WAM_01 Implementation of the TEN-E Regulation PM_IM_WAM_02 Institutional support for the protection of vulnerable consumers PM_IM_WAM_03 Application of online services for consumers (eConsumer) PM_IM_WAM_04 Monitoring and overcoming energy poverty	
Internal energy market: gas (including biomethane, hydrogen, oil)	● Full and comprehensive integration with European gas markets ● Increasing and promoting biomethane production ● Ensuring 100% gas metering ● Accuracy and completeness of	PM_IMG_WEM_01 Development plans for gas infrastructure for the next 10 years PM_IMG_WEM_02 Assessment of market demand for interconnection capacities PM_IMG_WEM_03 Increasing transparency in the issuance of special permits and	PM_IMG_WAM_01 Creating a legal framework for hydrogen and CO2 markets PM_IMG_WAM_02 Legal conditions for optimizing oil and gas infrastructure PM_IMG_WAM_03 Transparency of	PM_IMG_ADD_01 Ensuring the principle of energy efficiency in energy infrastructure planning PM_IMG_ADD_02 Plans for the development of oil infrastructure

	commercial gas metering ● Achievement of adequate volumes of domestic production ● Competitive pricing with mechanisms to support vulnerable consumers ● Achievement of indicators for the functioning of wholesale and retail markets	monitoring their use PM_IMG_WEM_04 Right to alienate / contribute special permits to joint activities PM_IMG_WEM_05 Conducting reserves assessment according to international standards PM_IMG_WEM_06 Digitization of the subsoil use sector PM_IMG_WEM_07 Ensuring transparency in the extractive industries PM_IMG_WEM_08 Rent for new wells PM_IMG_WEM_09 Tax measures during the period of martial law / export bans PM_IMG_WEM_10 Safety requirements during oil and gas extraction PM_IMG_WEM_11 Establishing a technical safety system in the gas market PM_IMG_WEM_12 Commercial product - customs warehouse PM_IMG_WEM_13 Commercial product - short-haul PM_IMG_WEM_14 Legal right to access and connect to gas networks PM_IMG_WEM_15 Easing gas quality requirements for biomethane injection PM_IMG_WEM_16 Approval of the standard for biomethane PM_IMG_WEM_17 Legal prerequisites for reverse gas flow between GTS and GDS PM_IMG_WEM_18 Support for large-scale biomethane production projects PM_IMG_WEM_19 Guarantees of origin PM_IMG_WEM_20 Biomethane registry PM_IMG_WEM_21 Observer status in the	production sharing agreements PM_IMG_WAM_04 Opening natural gas exports to the EU PM_IMG_WAM_05 Opening biogas exports to the EU PM_IMG_WAM_06 Transition to energy units PM_IMG_WAM_07 New commercial products for GTS and UGS PM_IMG_WAM_08 Stimulating tariff formation for DSOs PM_IMG_WAM_09 Setting up effective balancing rules PM_IMG_WAM_10 Launching the biomass market PM_IMG_WAM_11 Financial support for biomethane producers PM_IMG_WAM_12 Ensuring market pricing for gas PM_IMG_WAM_13 Ensuring 100% metering PM_IMG_WAM_14 Analysis of telemetry benefits and costs PM_IMG_WAM_15 Creation of Datahub in the gas market PM_IM_WAM_01 Implementation of the TEN-E Regulation PM_IM_WAM_02 Institutional support for the protection of vulnerable consumers PM_IM_WAM_03 Application of online services for consumers (eConsumer) PM_IM_WAM_04 Monitoring and overcoming energy poverty	PM_IMG_ADD_03 Plans for the development of hydrogen infrastructure PM_IMG_ADD_04 Connection between infrastructure development plans and state sector ownership policy PM_IMG_ADD_05 Integrated planning of energy infrastructure PM_IMG_ADD_06 Integration into EU strategic documents PM_IMG_ADD_07 Integration into EU research projects PM_IMG_ADD_08 Integration into EU infrastructure planning processes PM_IMG_ADD_09 Integration into EU mechanisms for green energy exchange PM_IMG_ADD_10 Demining of occupied territories for gas extraction recovery PM_IMG_ADD_11 Monitoring system, reduction and phase-out of subsidies for fossil fuels PM_IMG_ADD_12 Strengthening suppliers' responsibility for supply security PM_IMG_ADD_13 Determining optimal technical parameters for gas injection into networks PM_IMG_ADD_14 Possibility of storing mandatory gas reserves of the EU in Ukraine PM_IMG_ADD_15 Creating a permanent predictable legal regime for GDS property and its operators PM_IMG_ADD_16 Simplifying conditions for connection to gas networks (in terms of time and cost of connection) PM_IMG_ADD_17 Review of the approach to the legal regulation of reverse compressor

		Association of Issuing Bodies (AIB) PM_IMG_WEM_22 Moratorium on tariff increase for distribution PM_IMG_WEM_23 Moratorium on gas price increases for residential consumers, housing associations and similar consumers PM_IMG_WEM_24 Adoption of REMIT Regulation PM_IMG_WEM_25 Licensing of suppliers PM_IMG_WEM_26 Supplier switching procedure PM_IMG_WEM_27 Basic annual offer PM_IMG_WEM_28 Supplier of last resort function PM_IM_WEM_01 Targeted monetized subsidies for partial compensation of energy service costs		stations PM_IMG_ADD_18 Establishment and application of criteria for the sustainability of renewable/low-carbon gases PM_IMG_ADD_19 Strengthening the requirements for the unbundling of DSOs PM_IMG_ADD_20 Creation of other elements of the gas commercial metering system PM_IMG_ADD_21 Voluntary consumption reduction contractual practice
Research, innovation, and competitiveness	● Development and financing of innovations and research in the field of clean technologies, renewable energy, and low-carbon production ● Implementation of clean energy solutions and low-carbon technologies ● Increasing competitiveness	PM_RIC_WEM_01 Modernization of educational programs to address skills gap in the green transition and renewable energy sector PM_RIC_WEM_02 Accessibility of grant funding for scientific research in the field of renewable energy and climate innovations PM_RIC_WEM_03 Development of corporate investments in the purchase of climate technologies and renewable energy solutions PM_RIC_WEM_04 Competitiveness of the Ukrainian economy against the backdrop of the implementation of European technical regulations	PM_RIC_WAM_01 Development of corporate and international partnerships in the energy and climate sector PM_RIC_WAM_02 Expansion of funding for scientific research in the field of renewable energy and climate innovations PM_RIC_WAM_04 Monitoring, reduction and/or cessation of subsidies for fossil fuels PM_RIC_WAM_05 Active involvement of venture investments in companies in the climate innovation and renewable energy sector PM_RIC_WAM_06 Development of exports of climate technologies and renewable energy technologies	

1.2. Overview of current policy situation

i. National and Union energy system and policy context of the national plan

As a Contracting Party to the Energy Community, as well as in the context of the EU accession process, Ukraine has committed to develop the NECP in accordance with Regulation (EU) 2018/1999 and the relevant methodological recommendations of the European Commission.

Since 2016, Ukraine has been working on the implementation of the Association Agreement between Ukraine and the EU, including the Deep and Comprehensive Free Trade Area. According to the Cabinet of Ministers of Ukraine's assessment as of 2022[14], 72% of the obligations under the Association Agreement have been fulfilled, including 75% in the energy sector, 77% in the environment and civil protection, and 75% in energy efficiency and housing and communal services.

On February 28, 2022, Ukraine officially applied for membership in the European Union on March 1, 2022 The European Parliament adopted a resolution supporting Ukraine's candidate status for EU membership on March 10-11, 2022 At an informal summit of the European Council in Versailles, EU leaders recognized Ukraine's European aspirations and European choice, as stated in the Association Agreement, and supported the EU Council's decision to propose to the Commission to provide its opinion on this application in accordance with the provisions of the relevant treaties on April 17, 2022 Ukraine has submitted responses to the European Commission's Questionnaire on Ukraine's compliance with political and economic membership criteria in the EU, and on May 9 - the second part of the Questionnaire on the compliance of Ukrainian legislation, institutions, and practices with EU law in 33 areas The EU's decision to grant Ukraine official candidate country status was adopted on June 23, 2022

The European Commission in its report within the Enlargement Package"[15], published in early November 2023, noted significant progress of Ukraine in the acquis chapters of the EU. In particular, a good level of preparation in the energy sector and certain progress have been noted, despite the fact that the energy sector operated under extraordinary conditions due to attacks by the Russian Federation on Ukraine's energy infrastructure. There has been a long process of harmonizing legislation, particularly regarding integrity and transparency of the wholesale energy market, renewable energy sources, the gas TSO, and certification of the gas storage operator. However, the measures taken under the martial law have led to a decrease in transparency and independence of stakeholders (including the Regulator). In the areas of environmental protection and climate policy, Ukraine has a certain level of preparation and has achieved good success. Legislation aimed at further harmonization in horizontal issues, water quality, waste management, chemicals, and noise has been adopted regarding the environment. However, progress in climate policy has been limited.

The report on the implementation of obligations under the Energy Community Treaty for 2023[16] contains an assessment of Ukraine's compliance with the Energy Community acquis for the period from November 2022 to October 2023 in 5 main directions (clusters). Ukraine as a whole has achieved some of the highest indicators: progress in implementation in the cluster "Energy Markets and Integration" is assessed at 69%, "Decarbonization of the Energy Sector" - at 44%, "Ensuring Energy Security" - at 61%, "Environmental Protection" - at 52%, "Activities of Regulatory Bodies" - at 76%.

On December 14, 2023, EU leaders made a historic decision to begin negotiations with Ukraine regarding its accession to the EU. The European Commission, without further delay, starts preparing the technical aspects of the negotiations (the so-called negotiating framework).

[14] https://www.kmu.gov.ua/storage/app/sites/1/55-GOEEI/zvit_pro_vykonannya_ugody_pro_asociaciyu_za_2022_rik.pdf
[15] https://neighbourhood-enlargement.ec.europa.eu/system/files/2023-11/SWD_2023_699%20Ukraine%20report.pdf
[16] https://www.energy-community.org/implementation/report.html

At the beginning of 2024, the European Council supported the revision of the EU budget, which will allocate 50 billion euros for macro-financial assistance to Ukraine within the Ukraine Facility program for the period of 2024-2027. The Ukraine Facility program provides for the provision of 39 billion euros to the state budget of Ukraine to enhance macro-financial stability, as well as 8 billion euros through a special investment instrument to cover investors' risks in priority sectors through the EBRD, EIB, and other international institutions. It is expected that the implementation of projects within the instrument will attract an additional 30 billion euros of investment. The Ukraine Facility also includes 3 billion euros for technical support, including funds to cover interest on loans.

Support will be provided quarterly based on the criteria for implementing reforms outlined in the Plan (Ukraine Plan). The Plan for the Ukraine Facility includes implementing structural reforms in the public sector, carrying out a series of economic reforms aimed at developing the business climate and entrepreneurship, as well as taking steps to develop priority sectors that can ensure rapid economic growth.

ii. Current energy and climate policies and measures relating to the five dimensions of the Energy Union

Decarbonisation (reduction of greenhouse gas emissions)

Ukraine ratified[17] the Paris Agreement[18] among the first countries (July 14, 2016). The Agreement entered into force on November 4, 2016, thirty days after its ratification by 55 Parties to the United Nations Framework Convention on Climate Change, accounting for at least 55% of global greenhouse gas emissions.[19]

Under the Paris Agreement, the Parties are obligated to prepare, communicate, and maintain nationally determined contributions for global climate response. The first Expected Nationally Determined Contribution (NDC) of Ukraine was approved by the government on September 16, 2015, which automatically became Ukraine's first NDC after the Paris Agreement came into effect.[20]

According to the first NDC, Ukraine committed to not exceed 60% of greenhouse gas emissions levels in 1990 by 2030[21]. Taking into account that Ukraine's GHG emissions in 2012 were at the level of 375.4 million tons of CO2-equivalent. (including LULUCF[22]), which accounted for 42.9% of the 1990 emissions level, it was expected that Ukraine's GHG emissions could increase by 2030 after the restoration of the country's territorial integrity and economy.

The updated nationally determined contribution of Ukraine to the Paris Agreement[23], approved by the government on on July 30, 2021,[24] significantly strengthened Ukraine's contribution to combatting global climate change. Indeed, the document envisages a reduction of Ukraine's total GHG emissions by 65% by

[17] https://zakon.rada.gov.ua/laws/show/1469-19#Text

[18] https://zakon.rada.gov.ua/laws/show/995_l61#Text

[19] https://zakon.rada.gov.ua/laws/show/995_044#Text

[20] https://zakon.rada.gov.ua/laws/show/980-2015-%D1%80#Text

[21] https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Ukraine/1/150930_Ukraine_INDC.pdf

[22] LULUCF - land use, land-use change, and forestry.

[23] https://www.kmu.gov.ua/news/uryad-shvaliv-cili-klimatichnoyi-politiki-ukrayini-do-2030-roku

[24] The first NDC actually envisaged a 40% reduction in GHG emissions by 2030 from the 1990 level. The updated NDC increased the target for reducing GHG emissions to 65% below the 1990 level.

2030 compared to the 1990 emission levels[25]. This same objective is stated in the Decision of the Council of Ministers of the Energy Community No 2022/02/MC-En.[26]

To achieve the goals of the updated NDC, the Ministry of Environmental Protection and Natural Resources of Ukraine has developed a draft action plan[27], which is currently being discussed with the central executive authorities. In addition, the Ministry is developing a draft Law on the Principles of Climate Policy, which will define the framework conditions for climate policy, the goals of climate neutrality, and the main instruments for their achievement.

Ukraine is a party to the Montreal Protocol since 1988 and faithfully fulfills its obligations. In particular, state policy is being implemented in the field of regulating economic activities with ozone-depleting substances and fluorinated greenhouse gasses. In 2020, the corresponding Law[28] was adopted, which regulates legal relations regarding the production, import, export, storage, use, placement on the market, and handling of ozone-depleting substances, fluorinated greenhouse gasses, goods, and equipment containing or using them, which affect the ozone layer and contributes to global warming, as well as a number of other regulatory acts in this field. The National Environmental Protection Action Plan for the period up to 2025 provides for the creation and maintenance of a Single State Register of Controlled Substances (ozone-depleting substances and fluorinated greenhouse gasses) during 2021-2025.[29]

The Ministry of Environment has developed a draft Law of Ukraine[30] for the ratification of the Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, which was adopted at the Twenty-Eighth Meeting of the Parties to the Montreal Protocol on October 15, 2016 in Montreal, Canada (hereinafter referred to as the Kigali Amendment), regarding the gradual reduction of consumption of fluorinated greenhouse gasses that have a significant impact on climate. After the completion of the ratification process of the Kigali Amendment, the development of a plan of measures to reduce emissions of ozone-depleting substances and fluorinated GHGs is envisaged.

For countries that do not operate under Article 5 of the Montreal Protocol (including Ukraine), the Kigali Amendment provides for a phased reduction in hydrofluorocarbon (HFC) consumption, and the initial phase is a 10% reduction in consumption. There are 5 phases of consumption reduction for such countries: phase 1 (2019) - 10%, phase 2 (2024) - 40%, phase 3 (2029) - 70%, phase 4 (2034) - 80%, phase 5 (2036) - 85%. Taking into account this schedule and the fact that Ukraine plans to ratify the Kigali Amendment in 2024, the target for reducing HFC usage will be set at 40% immediately. For Ukraine, the baseline consumption level is calculated based on the average production/consumption level of HFC in 2011, 2012, and 2013, plus 15% of the baseline production/consumption level of HFC. Currently, a baseline is being calculated for Ukraine, from which the reduction in HFC use will take place.

Decarbonization (development of renewable energy sources)

Increasing the share of RES in the energy balance, developing distributed generation and energy storage facilities are among the main priorities of the state policy in the electricity sector, as defined by the

[25] https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

[26] https://www.energy-community.org/legal/decisions.html

[27] https://mepr.gov.ua/povidomlennya-pro-oprylyudnennya-doopratsovanogo-proyektu-rozporyadzhennya-kabinetu-ministriv-ukrayiny-pro-shvalennya-planu-zahodiv-z-realizatsiyi-onovlenogo-natsionalno-vyznachenogo-vnesku-ukrayiny-d/

[28] https://zakon.rada.gov.ua/laws/show/376-20#Text

[29] https://zakon.rada.gov.ua/laws/show/443-2021-%D1%80#n12

[30] https://mepr.gov.ua/povidomlennya-pro-oprylyudnennya-proyektu-zakonu-ukrayiny-pro-ratyfikatsiyu-popravky-do-monrealskogo-protokolu-pro-rechovyny-shho-rujnuyut-ozonovyj-shar/

Energy Strategy of Ukraine until 2050 (approved by the Cabinet of Ministers of Ukraine on April 21, 2023, No. 373-r).

In addition, the development and a series of measures to stimulate the production of biomethane are planned. Indeed, the NDC implementation plan provides for the creation and operation of a biomethane registry, as well as the development of economic mechanisms to attract investments for the construction of high-efficiency power plants that use biogas/ biomethane from biomass (agricultural waste) during 2023-2025. The draft NREAP includes the development and submission to the Cabinet of Ministers of Ukraine a draft Law of Ukraine on the use of biomethane as a motor fuel, in particular for public transport and agricultural machinery.

Energy efficiency

The energy strategy of Ukraine defines self-sufficiency and consumption efficiency as the top strategic goal. The main document that establishes the legal framework for energy efficiency policy is the Law of Ukraine "On Energy Efficiency". This law transposes most of the provisions of Directive 2012/27/EU into national legislation. The Law "On Energy Efficiency" defines the legal, economic, and organizational principles of relations arising in the field of energy efficiency during production, transportation, transmission, distribution, supply, and consumption of energy . This regulatory act provides for giving preference to energy-efficient measures that reduce energy demand when developing regulatory acts, strategic documents of state policy, and making decisions on financing measures for the development of Ukraine's integrated energy system, gas infrastructure facilities, or facilities in the heat supply sector, if energy-efficient measures are more economically viable (the principle of "energy efficiency first").

Directive 2010/31/EU transposed by the Law of Ukraine "On Energy Efficiency of Buildings". This law provides for the establishment of minimum requirements for the energy efficiency of buildings, energy certification of buildings, inspection of engineering systems, certification of building energy auditors. In accordance with the Law, the Concept of implementing the state policy in the field of ensuring energy efficiency of buildings has been approved, which includes increasing the number of buildings with near-zero energy consumption. The Government has also developed a project of the Long-Term Strategy for the thermal modernization of buildings until 2050, which is in the final stages of coordination before adoption.

In order to fully comply with Ukraine's obligations under the Association Agreement between Ukraine and the European Union and the Treaty establishing the Energy Community, Ukraine is implementing a system of energy labeling and setting requirements for the eco-design of energy-consuming products in accordance with EU legislation. In Ukraine, there are currently 2 framework technical regulations, 24 technical regulations that establish requirements for the eco-design of specific groups of energy-consuming products, and 15 technical regulations for energy labeling.

The main barriers to the implementation of energy-efficient measures are distortions in tariff policy, lack of qualified personnel for project identification and implementation, limited opportunities for financing and high cost of funds, and lack of sustainable state co-financing of energy-efficient measures.

Energy security

The key documents that define both the goals and policies for deepening the diversification of energy sources and supply routes from third countries with the potential aim of reducing dependence on energy imports are the National Economic Strategy for the period up to 2030 (NES)[31] and the Energy Strategy of

[31] https://zakon.rada.gov.ua/laws/show/179-2021-%D0%BF

Ukraine for the period up to 2050[32]. The first one sets the overall target of ensuring diversification of energy supplies at a level not exceeding 30% from a single supplier, while the second one is a supporting strategy for diversification, incentives for domestic production and the development of further value-added elements (including oil and gas processing). It should be noted that ESU2050 - aiming for comprehensive integration with EU energy markets and ensuring the efficient functioning of domestic energy markets - defines the construction of an export-oriented energy sector as one of the indicators.

The National Security Strategy[33] declares the need to diversify sources and routes of energy supply among its goals. The Energy Security Strategy includes incentives for import substitution as one of its priority tasks, particularly through the development of bioenergy, wind energy, and rational increase in energy resource extraction. Specifically for the nuclear industry, a Concept of the State Targeted Economic Program (with a planning horizon until 2026) and the program itself (for the period until 2028) have been developed.

Regarding the increase in flexibility of the national energy system, the aforementioned strategies include the implementation of flexible capacities, in order to ensure the balance reliability of the Ukrainian power system and support further integration of RES.

In terms of addressing constrained or interrupted supply, for the purpose of improving the resilience of national energy system, the main policies and measures include the ESU, the Law on Critical Infrastructure[34], the Cybersecurity Strategy of Ukraine[35], the Law on the Basic Principles of Cybersecurity in Ukraine[36], and specific decisions of the National Security and Defense Council. The target indicator is to ensure physical, engineering-technical, and cyber protection of 100% facilities. It is separately stipulated that in conditions of full-scale war, the protection of critical infrastructure facilities (CIF) is a priority.

The measures to ensure supply security, including the responsibility of the Ministry of Energy to approve rules on the safety of natural gas and electricity supply and the National Action Plan, which is mandatory for all market participants, as well as monitoring of supply security (for electricity - jointly with the Regulator, the transmission system operator and other relevant institutions), are regulated by the laws "On the electricity market"[37], "On the natural gas market"[38] and the corresponding subordinate acts.

Another group of policies is the formation and maintenance of energy reserves - natural gas, coal, fuel oil. Most of them are regulated at the legislative level. At the end of 2022, amendments to the Law "On the natural gas market" established the obligation of the Ministry of Energy to calculate the target for gas storage filling and to create a filling schedule. In 2023, the law "On minimum reserves of crude oil and petroleum products"[39] was adopted, which provides for the creation of reserves equivalent to 90 days of net imports or 61 days of domestic consumption. The creation and maintenance of the minimum necessary reserves of coal and backup fuel (fuel oil) is regulated by the Procedure for forming the forecast

[32] https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text
[33] https://zakon.rada.gov.ua/laws/show/392/2020#Text
[34] https://zakon.rada.gov.ua/laws/show/1882-20
[35] https://zakon.rada.gov.ua/laws/show/447/2021#Text
[36] https://zakon.rada.gov.ua/laws/show/2163-19
[37] https://zakon.rada.gov.ua/laws/show/2019-19#Text
[38] https://zakon.rada.gov.ua/laws/show/329-19#Text
[39] https://zakon.rada.gov.ua/laws/show/3484-IX#Text

balance of electricity of the Integrated Power System of Ukraine[40] and the Rules for the security of electricity supply[41].

Internal energy market (electricity)

Policies and measures implemented by Ukraine for market development are determined by key priorities such as further liberalization of the electricity market and deepening integration of Ukraine's energy systems and markets with the EU countries. In terms of integration, Ukraine aims to strengthen cross-border electricity connections with ENTSO-E countries through the implementation of projects of mutual interest. In particular, Ukraine envisages developing interconnectors and achieving a capacity level of 6 GW with ENTSO-E countries by 2032.

Expanding cross-border infrastructure in combination with the integration of spot and balancing electricity markets will improve competitiveness and liquidity of the domestic market by enhancing international electricity trade, creating better conditions for attracting systemic investments in sector development and the implementation of new energy technologies.

Ukraine is implementing a policy to adopt European rules for international trade in electricity by using joint auctions to allocate available interconnection capacity between national grids, including organizing auctions on the Joint Allocation Office (JAO) platform. The next stage of integration involves the coupling of spot electricity markets (day-ahead market and intra-day market), which includes the use of implicit auctions to allocate interconnection capacity between national grids and joint price formation on the coupled spot markets.

The transformation of the market will occur towards a balanced combination of the advantages of "large" and "small" locally-based energy. The priority is the development of distributed generation based on RES in combination with flexible energy capacities and technologies to ensure resource adequacy, flexibility, operational safety, and system and market stability. In the country's electricity balance by 2030, Ukraine aims to achieve no less than 25% of electricity generated from RES.

To enhance the resilience of the energy system and the competitiveness of the market, Ukraine is implementing policies for the development of distributed generation (primarily based on RES and energy storage systems) and smart grids. These policies involve greater participation of consumers in the market and the use of new market models - self-generation (self-consumption) mechanism, aggregation, demand response, energy cooperatives, etc.

The development of smart grids should be carried out within the framework of the Concept for the implementation of smart grids in Ukraine until 2035.[42] Electricity distribution system operators (DSOs) develop measures for digitalizing networks and include relevant projects in their investment programs as part of their five-year distribution system development plans, which require approval by the Regulator. The funding for programs is provided through tariffs for electricity distribution services, which are applied to the majority of DSOs based on RAB regulation principles (RAB tariffs).

In 2019, Ukraine carried out a radical reform of the wholesale and retail segments of the electricity market, transitioning from a "single buyer" model to a competitive market based on the EU countries' model by introducing the corresponding institutional environment and structural organization of the market, following the provisions of the EU Third Energy Package. Currently, Ukraine is working on

[40] https://zakon.rada.gov.ua/laws/show/z1312-18#Text

[41] https://zakon.rada.gov.ua/laws/show/z1076-18#n17

[42] https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text

creating an institutional environment for the implementation of the provisions of the EU Clean Energy Package. The basic policies and measures for the development of the electricity market include:

- ensuring proper functioning of the market by deepening its liberalization in combination with temporary regulatory measures aimed at stabilizing the market during the immaturity stage of the competitive environment and limited integration with the markets of EU countries and ENTSO-E;
- Development of exchange trading, introduction of market-based pricing in all market segments, including the use of real-time prices, gradual phasing out of cross-subsidization.
- Deepening the market integration of RES producers by ensuring their participation in organized market segments and direct trading of electricity, considering responsibility for imbalances.
- Ensuring the protection of vulnerable consumers through direct monetized subsidies and preferential prices provided through the public service obligation (PSO) mechanisms imposed on individual market participants.

To implement market pricing, there will be a gradual adjustment of electricity prices for households to the market level, with parallel protection of vulnerable consumers and the development of competition in the retail market. Protection of energy-poor consumers will be carried out through targeted monetized support and incentives for improving energy efficiency.

Internal energy market (gas)

The main goals in terms of the development of oil and gas infrastructure are:

- Ensuring sufficient connectivity with the EU/Energy Community for natural gas exports/imports, as well as the development of oil transportation systems;
- Modernization taking into account the requirements for increasing energy efficiency and reducing emissions of harmful substances and optimizing oil and gas infrastructure facilities;
- Prospective repurposing of existing oil and gas infrastructure facilities for new activities within the framework of decarbonization.

Therefore, among the main policies and measures aimed at achieving these goals, it is worth highlighting:

- Implementation of the TEN-E Regulation;
- Planning of gas infrastructure development;
- Creation of a regulatory framework for the formation of future markets and the construction of future energy infrastructure;
- Creation of legal conditions for the optimization of oil and gas infrastructure;
- Establishing systemic involvement of the Ukrainian side in EU processes related to future energy infrastructure.

In terms of integrating natural gas, renewable and low-carbon gas markets, the main objectives are:

- Full and comprehensive integration with European markets;
- Increase and promotion of production of biomethane;
- Achievement of adequate volumes of domestic natural gas production;
- Ensuring 100% metering of gas;

- Reliability and completeness of commercial gas metering;
- Achieving competitive prices;
- Protecting vulnerable consumers and achieving performance indicators of wholesale and retail markets.

Therefore, among the main policies and measures aimed at achieving these goals, it is worth highlighting:

- Ensuring the possibility of exporting gas, both natural gas and biomethane;
- Resolving technical issues related to the quality of gas injected into gas networks and the technical safety;
- Implementation of settlements in energy units;
- Ensuring the attractiveness of using Ukrainian oil and gas infrastructure for EU customers;
- Ensuring effective management of GDSs;
- Setting up effective balancing rules;
- Measures to promote and increase biomethane production;
- Measures to achieve adequate levels of domestic natural gas extraction;
- Consumer protection measures and strengthening competition in retail markets;
- Ensuring 100% metering;
- Establishing a functioning commercial metering system;
- Creating conditions for the use of contractual practices for voluntary gas consumption reduction.

In terms of energy poverty policies and measures, further details are still to be specified. The task is to legislatively define this concept, determine the methodology for calculating the specific group of individuals in a state of energy poverty, and establish a clear list of measures to reduce energy poverty in Ukraine.

iii. Key issues of cross-border relevance

1) The main regulatory barriers to cross-border trade in energy resources:

- **Barriers to natural gas trade**

To a large extent, Ukraine's energy sector during the period 2025-2030 will develop in the direction of meeting the needs of the EU, particularly in natural gas, biomethane, and hydrogen. According to the REPowerEU plan, by 2030 the EU should ensure diversification of natural gas supplies, as well as 10 million tons of domestic hydrogen production and 10 million tons of its import, with support from the European Commission, including for the hydrogen corridor with Ukraine. In addition, by 2030 the EU aims to achieve the supply of 35 billion m3 of biomethane, which is expected to be covered through imports from Ukraine.

Given this, it is critical to have free access to these resources in the EU markets, particularly in the German market, which is projected to have a large market for these resources.

Separately, regulatory barriers to cross-border movement of these goods in relations between Ukraine and the EU should be highlighted. On the one hand, gas exports (both natural and biomethane) are currently prohibited by Ukraine. In this regard, Ukraine needs to establish clear goals for lifting this ban and the measures that need to be taken for this purpose.

On the other hand, there are barriers from the European side. Overall, Article 41(1) of the Treaty establishing the Energy Community (EnC) guarantees the free and duty-free movement of 'network energy', which by definition covers the electricity and gas sectors within the scope of Directives 2003/54/EC and 2003/55/EC. The latest Directive, in addition to natural gas, also applies to gas from biomass (biomethane) (in case its scope is expanded to hydrogen relations, the scope of the mentioned EnC norms should be correspondingly expanded). At the same time, according to the available information today, the import of biomethane transported by pipeline to Germany for use in transportation and other industries is limited.

Other issues to be resolved at the cross-border level include:

requirements for the quality of gas transported across the border with the EU/Energy Community;

availability of long-term guaranteed capacities on interconnections with Poland, Hungary and of their increase on interconnector with Slovakia.

- **Barriers to hydrogen trade**

There is also a risk that planned hydrogen production projects will not meet the criteria for green hydrogen recently adopted in the EU. Yes, according to these rules, hydrogen produced from electricity is considered green hydrogen:[43]

1) generated by isolated facilities that are not connected to the grid or in case of connection with confirmation that the electricity was not taken from the grid (Art.3);

2) taken from the grid according to one of the four options:

Option A: if the average share of electricity from renewable sources within the trading zone where the hydrogen production facilities are located is more than 90%;

Option B: if the emission intensity of the energy system ("emission intensity of electricity") within the trading zone where the hydrogen production facility is located is less than 18 g CO2-eq./MJ and certain other requirements are met;

Option C: if there is specific evidence that the use of electricity for hydrogen production has reduced the need for pre-dispatch of renewable generation facilities;

Option D: if the rules regarding additionality, temporal and geographical correlation are met.

Hydrogen production projects listed in NECP as examples may fall under the first case. However, there is a risk that this case, as well as most options from the second case, cannot be applied to hydrogen based on nuclear generation. It may happen that the only option that meets the criteria is the one that assumes that within the bidding zone / balancing zone, where the hydrogen production facility is located, the electricity system emission intensity is less than 18 g CO2-eq./MJ. Meeting this indicator will become a necessity provided the assumptions are correct and there is an interest in exporting hydrogen to the EU.

2) Specific issues of financing new capacities with the involvement of the EU:

- **Financing projects related to gas and oil:**

[43] Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin.

The new TEN-E Regulation no longer provides for financing projects related to natural gas and oil through the Connecting Europe Facility. However, both this NECP and NECPs of EU member States make it clear that the need for oil will not completely cease by 2030, and to avoid disruptions in supply, construction or other additional measures regarding specific oil infrastructure facilities are necessary. Thus, the project "Brody - Adamova Zastava" remains relevant between Ukraine and Poland, which was previously included in the latest list of projects of the Energy Community interest. A similar situation exists regarding investments in ensuring sufficient capacity for the connection of Ukraine's GTS and other GTS, including Poland and Moldova/Romania.

Accordingly, mechanisms for financing similar projects should be provided, which are necessary in terms of ensuring the security of supply and the livelihoods of the population and the economy.

- **Funding for hydrogen projects:**

In March 2023, the European Commission provided details on the establishment of the European Hydrogen Bank, the idea of which was announced back in September 2022.[44] The proposed activities of this financial mechanism include providing financing in the form of a 'green' premium, which is distributed through auctions, including for hydrogen producers outside the EU. In August 2023, the European Commission published the terms of the first auction, which, however, only applies to future hydrogen producers within the European Economic Area (excluding Ukraine). It was expected that the auction terms for third countries would be announced by the end of 2023.[45]

In this regard, it is advisable to involve the Ukrainian side in the preparation of these conditions, in particular in order to ensure non-discriminatory participation of Ukrainian companies in future tenders.

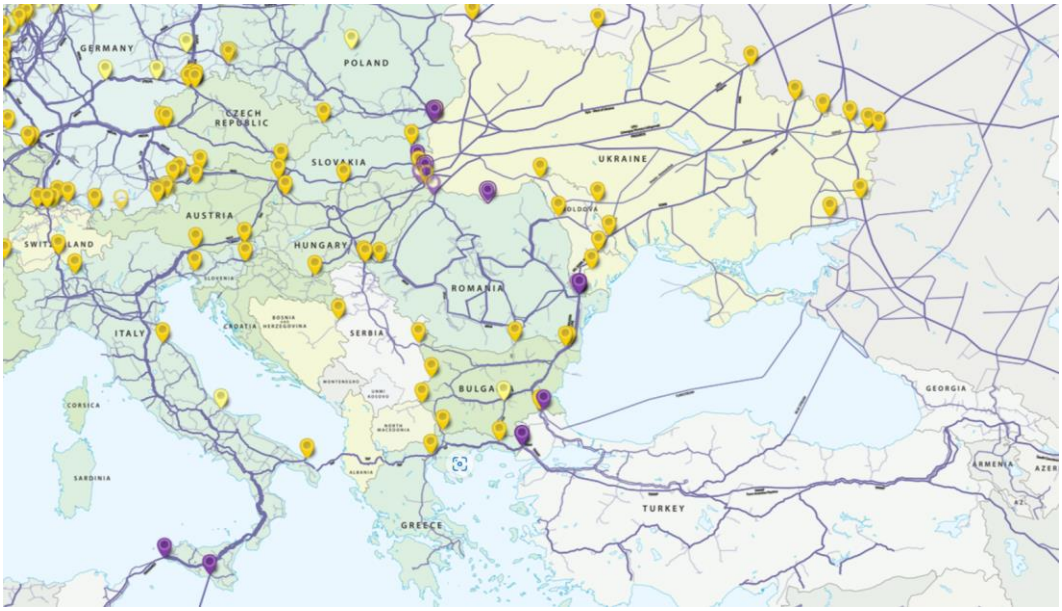
3) The main issues related to infrastructure projects of other countries (natural gas):

After the adoption of the RePowerEU plan, which envisages a gradual phasing out of Russian gas as soon as possible and preferably by 2027, the map of gas flows and gas infrastructure began to undergo radical changes. Moreover, during the period 2025-2030, no transit of natural gas through the territory of Ukraine from russia and belarus to the EU and the Energy Community is expected.[46] In terms of the development of natural gas infrastructure, Ukraine is significantly dependent on infrastructure projects of other countries.

[44] COM/2023/156 final

[45] https://climate.ec.europa.eu/system/files/2023-08/innovationfund_pilotauction_termsandconditions_en.pdf

[46] https://www.radiosvoboda.org/a/news-halushchenko-ukraina-rosiia-prodovzhennia-tranzytu-hazu/32552079.html



Source: ENTSOG Transparency Platform

In general, several directions can be distinguished in which the development of important projects for Ukraine is taking place (both necessary and alternative):

1) Corridor: Turkey-Greece-Bulgaria-Romania-Hungary-Slovakia;
2) Corridor: Germany-Poland;
3) Corridor: Italy-Austria-Slovakia.

Regarding the Turkey-Greece-Bulgaria-Romania-Hungary-Slovakia corridor:

Since Ukraine's independence, natural gas transported through Ukraine was delivered to consumers in Hungary, Slovakia, as well as Romania, Bulgaria, and through it - Greece, Serbia, and Turkey. With the construction of gas pipelines BlueStream (2005) and TurkStream (2019), gas from Russia is transported directly to Turkey. Considering the cessation of transit through Ukraine's territory at the end of 2024, according to the most up-to-date information,[47] there is expected a radical change in gas flows from the south to the north due to a significant increase in regasification capacities, as well as an increase in the possibilities of receiving additional gas from other sources. At the same time, the new gas production in Turkey will most likely be used to cover the country's own growing needs.

Thus, by the end of 2024, the total regasification capacity of Greece should reach 25.7 billion m3/year, which is 5 times higher than the current consumption volume of this country. Greece is also crossed by the TAP gas pipeline, the capacity of which is proposed to be increased to 20 billion m3/year. In addition, Greece is proposed to be the site for the construction of new projects EastMed and Poseidon: the first one will connect new gas sources from Cyprus and the Middle East to the EU, while the second one will provide an underwater connection between Greece and Italy. Both new projects are included in the ENTSOG TYNDP with the initial commissioning date in 2025 (the final commissioning date for the Poseidon project is expected to be in 2028; however, due to a number of political reasons, the projects may require more time for implementation). The EastMed project is included in the list of PCI/PMI

[47] 2022 ENSTOG TYNDP, 11 April 2023; 2023-2032 Ten-Year Network Development Plan of Bulgartransgaz, April 2023; DESFA, Draft Development Plan of the National Natural Gas System 2023-2032, February 2023.

projects under number 15.2.[48] The initial capacity of the projects is 11-12 billion m3 with the possibility of increasing it to 20 billion m3/year.

In the north, Greece is connected to Bulgaria at two IPs. One of them, the IGB gas pipeline with a capacity of 3 billion cubic meters per year (with the possibility of expansion to 5 billion cubic meters per year, which is planned from 2025 according to Bulgartransgaz) started operating in October 2022. The option of expanding the capacity of another IP Kulata/Sidirokastro (planned from 2026 according to Bulgartransgaz) is also being considered; for this purpose, it is also necessary to strengthen the Bulgarian GTS (currently, the corresponding project TRA-N-1140 is included in the ENTSOG TYNDP 2022 with implementation scheduled for 2025).

Like Greece, Bulgaria expects an increase in its role as a gas transit state. In particular, gas coming to Bulgaria from Greece and Turkey will be transported to Serbia,[49] Romania, and then to other countries. In addition to Greece, gas can also enter Bulgaria directly through the territory of Turkey thanks to a recently concluded contract with the Turkish state company BOTAS. The terms of this agreement are confidential and have been criticized by the new Bulgarian government, but it should allow the Bulgarian side to access a regasification capacity in Turkey of 1.5 billion m3 per year; BOTAS is supposed to deliver this volume to the border with Bulgaria. Considering the insignificant volumes of gas consumption by Bulgaria (even with the prospect of increase), the available gas resource will exceed its needs, and therefore it is intended for transit to other countries through Serbia or Romania. The latter covers about 70% of its own needs through its own production, which is planned to gradually increase, so significant volumes of gas for transportation to other countries can be expected at the exit from Romania. Bulgaria is connected with Romania through gas pipelines that were primarily used for gas transit from Russia (Kardam/Negru Voda 1, 2, 3); by 2026, work is planned to strengthen the Bulgarian GTS to increase the gas flow capacity to Romania by 4.7 billion cubic meters per year (the project is included in ENTSOG TYNDP 2022, TRA-N-1124).

According to the NES, full technical, institutional, and legislative integration into European gas transportation networks should be ensured, cooperation with countries in Northwest, South Europe, and other regions regarding the joint implementation of gas supply diversification projects to Central-Eastern Europe should be developed. Thus, further gas flows from Romania are important for Ukraine. Existing capacities of the Trans-Balkan Pipeline can be used for gas transportation from Romania to Hungary or Slovakia. In this context, in January 2024, Ukraine and Moldova joined the Memorandum on the Vertical Corridor, which involves coordination at the operator level with the participation of operators from Greece, Bulgaria, Romania, Hungary, and Slovakia, in order to ensure gas flow from the south to the north of Europe.[50]

Regarding the Germany-Poland corridor:

Since Ukraine's independence, natural gas transported through Ukraine was delivered to consumers in Poland and Germany through Ukraine. After the launch of the Yamal pipeline (2006) and the Nord Stream pipeline (2011), gas from Russia began to be supplied directly to these countries. At the same time, as part of the aggression, Russia reduced the volumes of gas transportation through the territories of Ukraine and Poland.

[48] Commission Delegated Regulation (EU) amending Regulation (EU) No 2022/869 of the European Parliament and of the Council as regards the Union list of projects of common interest and projects of mutual interest, 28.11.2023, C(2023) 7930 final.

[49] By October 2023, a gas pipeline should be built between Bulgaria and Serbia, which will allow for bilateral gas flow of 1.8 billion m3/year (in case of capacity increase of Bulgaria's GTS, expansion of this pipeline capacity to 2.4 billion m3/year is possible). This project has the status of a project of common interest PCI 6.8.3 (according to the latest list of the European Commission).

[50] https://tsoua.com/news/spivpraczya-shhodo-vertykalnogo-korydoru-posylyuyetsya-zavdyaky-pidpysannyu-memorandumu-pro-vzayemorozuminnya-shhodo-uchasti-moldovy-slovachchyny-ta-ukrayiny/

Considering the termination of transit through the territory of Ukraine by the end of 2024, according to the most up-to-date information,[51] a consistently large volume of gas is expected to flow through this corridor (taking into account Germany's significant domestic needs) due to the increase in regasification capacities in Germany and Poland, thus increasing the potential for gas flows from the north to the south. Thus, according to the Ministry of Economy and Climate Protection of Germany in 2025-2030 the capacity of all LNG terminals in Germany will increase from 37 billion m3 to 54 billion m3.[52]

From the Polish side, there are 2 planned projects: one for expanding the capacity of the LNG terminal in Świnoujście from 5 to 7.5 billion m3, which is expected to be completed by the end of 2023; the second one is for launching an FSRU near Gdansk by 2027. Both projects are included in TYNDP 2022 (LNG-F-272; LNG-A-947).

For Ukraine, it is important to ensure sufficient connection between the north and the south of Poland to obtain an additional source of gas supply and export. Historically, Poland's gas transmission system has had issues with gas flow from the north to the south (regarding this, project TRA-F-245 is included in TYNDP 2022 with an expected completion date by 2028).

Regarding the Italy-Austria-Slovakia corridor:

Since Ukraine's independence, natural gas transported through Ukraine was also delivered to consumers in Austria and Italy. Considering the cessation of transit through Ukraine's territory by the end of 2024, according to the most up-to-date information,[53] there is expected a radical change in gas flows from the south to the north along this corridor, which will strengthen Italy's role as a gas transit country between Africa, the Middle East, and Europe.

In 2022-2023, Italy significantly increased its regasification capacity, but these projects did not completely eliminate its dependence on Russia. By 2025, it is expected that this demand will be met through new domestic production, pipeline and liquefied gas supplies, as well as energy savings and the replacement of natural gas with biomethane. To achieve this, it is necessary to strengthen Italy's internal network through the implementation of the Linea Adriatica project. Gas exports to Austria can currently only take place through the Tarvisio/Arnoldstein interconnection point. It is important to note Austria's need to further strengthen its own efforts to reduce reliance on Russian gas.

For Ukraine, the use of the Trans-Balkan gas pipeline (in particular within the framework of the "Vertical Corridor") to meet Austria's additional gas needs, including using the additional advantages of Ukrainian UGS, is important.

4) The main issues related to infrastructure projects of other countries (hydrogen):

Overall, significant volumes of cross-border hydrogen transportation are not expected by 2030. However, both the EU and individual member states predict the arrival of this resource through imports from other countries after 2030. Ukraine competes for this opportunity with countries in North Africa and the Middle East.

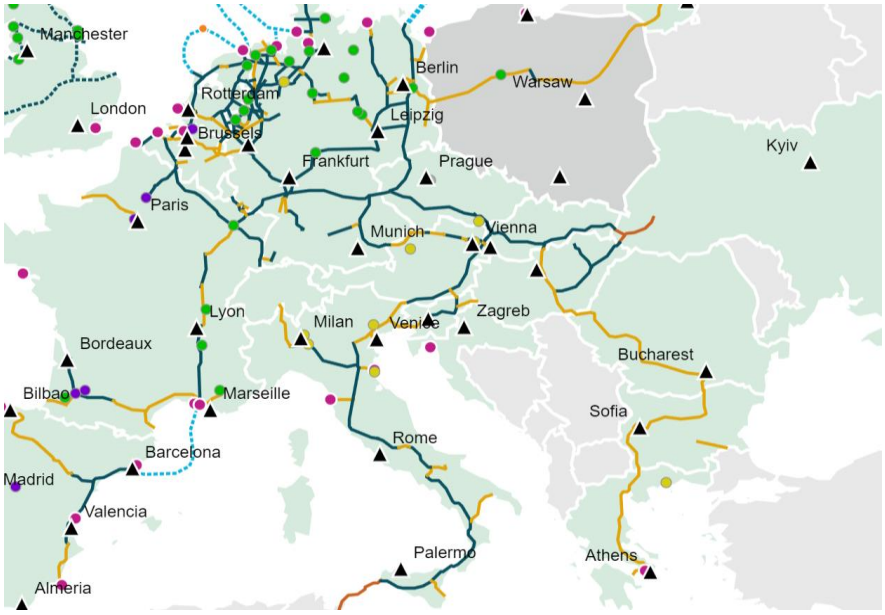
[51] BMWK, Bericht des Bundeswirtschafts - und Klimaschutzministeriums zu Planungen und Kapazitäten der schwimmenden und festen Flüssigerdgasterminals , 03.03.2023, https://www.bmwk.de/Redaktion/DE/Downloads/Energie/20230303-lng-bericht.pdf?__blob=publicationFile&v=2; 2022 ENSTOG TYNDP, 11 April 2023.

[52] Same there

[53] 2022 ENSTOG TYNDP, 11 April 2023; Italian NECP, April 2023.

Source: European Hydrogen Alliance, with reference to the European Commission

To deliver hydrogen to the EU and transport it to consumers, it will be necessary to ensure proper infrastructure. The Central European Hydrogen Corridor (CEHC) project, in which LLC "Operator of the GTS of Ukraine" is a participant, is reflected in the regional gas investment plan of Northwest Europe from December 2022[54] and in the vision for the development of hydrogen networks developed by the European Hydrogen Backbone (EHB) initiative, with which LLC "Operator of the GTS of Ukraine" has been a partner since April 2022.[55]



Source: European Hydrogen Backbone Maps

In addition, processes for planning future hydrogen infrastructure take place within ENTSOG, particularly during the preparation of the ENTSOG TYNDP for gas (which currently covers hydrogen projects).[56] It

[54] https://www.eugastsogrip.eu/wp-content/uploads/2022/12/entsog_GRIP_NW_2022_221208.pdf

[55] https://ehb.eu/#partners

[56] ACER, Opinion No.06/2023 of 14 July 2023 on the ENTSOG draft Ten-Year Network Development Plan 2022, para 26.

should be noted that the inclusion in the TYNDP opens the way to obtain grants from the Connecting Europe Facility, for which Ukraine has also been competing recently.[57]

Source: ENTSOG TYNDP 2022 Map

Thus, from the analysis of the ENTSOG TYNDP 2022 map, it can be seen that operators from other countries near Ukraine plan to create hydrogen infrastructure up to the borders with Ukraine:

- HYD-N-1165 'HU hydrogen corridor HU/UA', connection with Hungary (Beregdarosh - Berehove);
- HYD-N-730 'Coroi – Mediești Aurit modernisation for H2 transmission', connection with Romania (Tekovo);
- HYD-N-640 'Isaccea - Jupa modernisation for H2 transmission', connection with Romania (Orlovka);
- HYD-N-756 'Negru Voda - Isaccea modernisation for H2 transmission', connection with Romania (Orlovka) (referring to the Trans-Balkan gas pipeline).

However, these projects are not included in the latest list of PCI/PMI projects approved by the European Commission at the end of 2023.

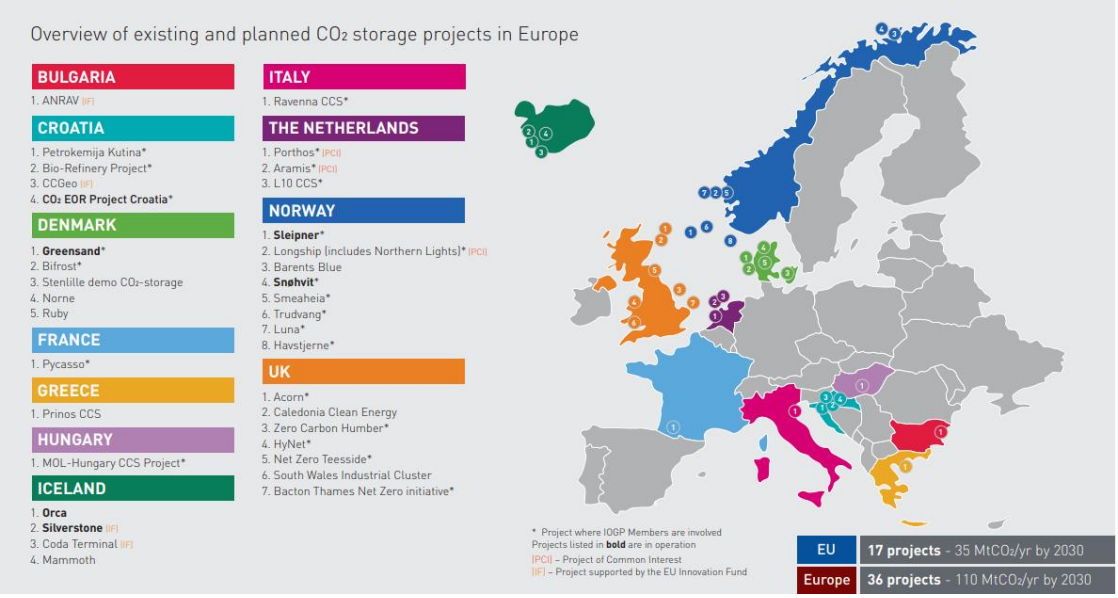
5) Main issues related to infrastructure projects of other countries (CO2):

The EU sets a target to achieve CO2 storage capacity of 50 million tons by 2030. As of December 2023, there are 22 projects related to CCUS technologies within the scope of the EU Innovation Fund.[58] In addition, the latest decision of the European Commission includes 14 CCUS projects in the list of PCI/PMI projects.[59] These projects constitute a part of the CCUS project landscape in Europe.

[57] https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3061

[58] https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/innovation-fund-projects_en

[59] Commission Delegated Regulation (EU) amending Regulation (EU) No 2022/869 of the European Parliament and of the Council as regards the Union list of projects of common interest and projects of mutual interest, 28.11.2023, C(2023) 7930 final.



Source: IOGP[60]

Currently, the European Commission is preparing an Industrial Carbon Management Strategy,[61] which will determine not only the potential of these technologies in reducing emissions, but also future measures for the development of pan-European infrastructure. The basis for the development of the strategy is the JRC 2019 report on the supply and demand balance in this market,[62] as well as recent research on the regulatory framework for this infrastructure.[63] During the public consultations on the content of the strategy project, conducted by the European Commission in June-August 2023, 92% of respondents agreed that the implementation of EU plans requires the creation of international coalitions with other countries, with 34% of them emphasizing the need for cooperation with countries in northern and eastern Europe, including Ukraine.[64]

iv. Administrative structure of implementing national energy and climate policies

The following authorities have the relevant powers to implement energy and climate policies:

- President of Ukraine (in terms of exercising constitutional powers to ensure national security, implementing the strategic course of the state towards full membership of Ukraine in the EU and NATO);

- Verkhovna Rada of Ukraine (in terms of adopting laws, state budget, approving national programs for economic, scientific and technological development, environmental protection);

[60] https://iogpeurope.org/wp-content/uploads/2023/10/Map-CO2-Storage-Projects-in-Europe.pdf

[61] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13848-Industrial-carbon-management-carbon-capture-utilisation-and-storage-deployment_en

[62] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC118310/jrc118310_1.pdf

[63] https://op.europa.eu/en/publication-detail/-/publication/bb3264da-f2ce-11ed-a05c-01aa75ed71a1/language-en?WT_mc_id=Searchresult&WT_ria_c=37085&WT_ria_f=3608&WT_ria_ev=search&WT_URL=https%3A//energy.ec.europa.eu/

[64] https://op.europa.eu/en/publication-detail/-/publication/3ada8466-7d32-11ee-99ba-01aa75ed71a1/language-en/format-PDF/source-search

- Cabinet of Ministers of Ukraine (as the highest body in the system of executive authorities, which directs and coordinates the work of ministries and other executive authorities);
- Ministry of Economy of Ukraine (Ministry of Economy);
- Ministry of Energy of Ukraine (Ministry of Energy)
- Ministry of Environmental Protection and Natural Resources of Ukraine (Ministry of Environment)
- Ministry of Community Development, Territories and Infrastructure of Ukraine (Ministry of Infrastructure)
- National Energy and Utilities Regulatory Commission (NEURC, Regulator)
- State Agency for Energy Efficiency and Energy Saving of Ukraine, State Service of Geology and Mineral Resources of Ukraine, State Inspection for Energy Supervision of Ukraine, other central executive authorities;
- Operators of infrastructure facilities and individual energy market participants;
- Local self-government authorities.

The Ministry of Economy is a central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine, and which ensures the formation and implementation of state policies in the economic, social development and trade, state policy in the field of technical regulation, state investment policy, state innovation policy in the real sector of the economy, state foreign economic policy, state policy in the field of entrepreneurship development, public-private partnership, state policy in the field of labor and employment, formation of state policy in the field of consumer rights protection, state price control policy, state regulatory policy and state policy on licensing, permitting system, supervision (control) in the field of economic activity[65].

Among other things, the Ministry of Economy plays a key role in ensuring standardization and technical regulation according to EU standards, implementing regulations on energy labeling and ECO design . The Ministry of Economy also conducts an analysis of the competitiveness and resource efficiency of industrial sectors, develops and coordinates measures to improve their level.

The Ministry of Energy is the central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine, and which ensures the formation and implementation of state policy in the electricity, nuclear-industrial, coal-industrial, peat extraction, oil and gas, and oil and gas processing complexes, as well as the formation and implementation of state policy in the field of renewable energy sources and alternative types of gas fuel and in the field of supervision (control) in the electricity and heat supply sectors.[66]

It is worth noting that the Cabinet of Ministers of Ukraine and the Ministry of Energy also exercise the rights of the state as the owner of individual natural gas and electricity market entities, as well as individual objects of gas and power infrastructure, including the gas transmission system (GTS) and the electricity transmission system, gas distribution systems (GDS) and electricity distribution systems, underground gas storage facilities (UGS).

[65] https://zakon.rada.gov.ua/laws/show/459-2014-%D0%BF#Text

[66] https://zakon.rada.gov.ua/laws/show/507-2020-%D0%BF

The Ministry of Environmental Protection and Natural Resources is the central executive body whose activities are guided and coordinated by the Cabinet of Ministers of Ukraine. It ensures the development and implementation of the state policy in the field of environmental protection, forestry and hunting, development of state policy in the field of geological exploration and rational use of subsoil, as well as the implementation of state supervision (control) in the field of environmental protection, rational use, reproduction and conservation of natural resources.[67]

It should be noted that Ukraine lacks a framework law that defines the role and responsibilities of government bodies on climate change issues. The main functions are assigned to the Ministry of Environment, while certain functions are assigned to other relevant bodies. Among other things, the Ministry of Environment ensures the development and implementation of state policy in the regulation of ozone-depleting substances and fluorinated greenhouse gasses, protection of the ozone layer, prevention of climate change, and compliance with the requirements of the UN Framework Convention on Climate Change, its Kyoto Protocol, and the Paris Agreement, including normative and legal regulation (develops projects, issues regulatory acts within its competence). Other bodies involved in climate policy include the Ministry of Energy, Ministry of Agrarian Policy, and the State Emergency Service.[68]

Thus, the establishment of an effective architecture of climate governance (as a system of principles, rules, and processes for the development and implementation of climate policy) requires a clear distribution of functions and powers of state bodies.

The State Service of Geology and Mineral Resources of Ukraine is the central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Environmental Protection and Natural Resources and which implements the state policy in the field of geological exploration and rational use of subsoil, and is the authorized body for the implementation of production sharing agreements.[69]

The NEURC is a permanently operating collegial central executive body with special status that carries out state regulation, monitoring and control over the activities of economic entities in the energy and communal services sectors[70]. The main tasks of the Regulator are:

1) ensuring the effective functioning and development of markets in the energy and utilities sectors;

2) promoting the efficient opening of markets in the energy and utilities sectors for all consumers and suppliers, and ensuring non-discriminatory access for users to networks/pipelines;

3) promoting the integration of Ukraine's electricity and natural gas markets with the corresponding markets of other countries, particularly within the framework of the Energy Community, cooperation with the Energy Community Regulatory Board, the Secretariat of the Energy Community, and national energy regulators of other countries;

4) ensuring the protection of consumer rights for goods and services in the energy and utilities sectors, ensuring the availability of these goods and services in sufficient quantity at reasonable prices;

5) promoting cross-border trade of electricity and natural gas, ensuring investment attractiveness for infrastructure development;

6) implementation of pricing and tariff policies in the energy and utilities sectors;

[67] https://zakon.rada.gov.ua/laws/show/614-2020-%D0%BF#Text

[68] https://rac.org.ua/uploads/content/646/files/cgainstituionalframeworkukr.pdf

[69] https://zakon.rada.gov.ua/laws/show/1174-2015-%D0%BF#Text

[70] https://zakon.rada.gov.ua/laws/show/1540-19#Text

7) promoting the implementation of energy efficiency measures, increasing the share of energy production from renewable energy sources, and protecting the environment;

8) creating favorable conditions for attracting investments in the development of energy and municipal services markets;

9) promoting competition in the energy and municipal services markets;

10) other tasks provided by law.[71]

At the same time, national regulatory authorities in the energy sector fall under the requirements of the EU acquis, in particular regarding their status, autonomy, and functions. In 2023, The Secretariat of the Energy Community highlighted certain shortcomings and the need to strengthen the institutional independence of the NEURC in a special report,[72] and the Regulator has developed a Plan of Measures to ensure its independence in accordance with Ukraine's international obligations, which, together with the accompanying letter of justification, was sent to the Cabinet of Ministers of Ukraine.[73]

The Ministry for Communities, Territories and Infrastructure Development (Ministry of Infrastructure) is the central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine. It ensures the formation and implementation of state policy in the field of automotive, railway, maritime and inland water transport, aviation transport and use of Ukrainian airspace, multimodal transport, protection of critical infrastructure in the relevant sectors, in the field of regional state policy, development of local self-government, territorial organization of power and administrative-territorial structure, housing policy, housing and communal services, management of household waste, construction, urban planning, territorial planning and architecture, in the field of recovery of regions, territories and infrastructure affected by armed aggression, as well as in the field of efficient use of fuel and energy resources, alternative types of liquid and solid fuel, energy conservation, ensuring energy efficiency. The Ministry of Infrastructure, along with the National Commission for State Regulation of Energy and Public Utilities, are key bodies that should operationalize the principle of "energy efficiency first" and ensure its comprehensive implementation.[74]

The State Agency on Energy Efficiency and Energy Saving of Ukraine is the central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Vice Prime Minister for the Restoration of Ukraine - Minister of Development of Communities, Territories and Infrastructure, and which implements the state policy in the field of energy efficiency. The main tasks of the State Agency on Energy Efficiency and Energy Saving are the implementation of the state policy in the field of efficient use of fuel and energy resources, energy conservation, renewable energy sources and alternative fuels; ensuring the increase of energy efficiency in all sectors of the national economy.

The Energy Efficiency Fund started its activities in July 2018. The goal of the Fund is to support government initiatives on energy efficiency, implement incentive and support tools for energy efficiency measures, particularly in the residential sector, in accordance with the Paris Agreement, the acquis of the European Union, and the Treaty establishing the Energy Community. Local self-government bodies play an important role, particularly in the field of improving energy efficiency.

The State Inspectorate for Energy Supervision of Ukraine is the central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of

[71] https://www.nerc.gov.ua/pro-nkrekp/osnovni-zavdannya-ta-funkciyi

[72] https://www.energy-community.org/news/Energy-Community-News/2023/10/20b.html

[73] https://www.nerc.gov.ua/news/sekretariat-energetichnogo-spivtovaristva-nagoloshuye-na-neobhidnosti-posiliti-institucijnu-nezalezhnist-regulyatora

[74] https://zakon.rada.gov.ua/laws/show/460-2015-%D0%BF#Text

Energy and which implements the state policy in the field of supervision (control) in the areas of electricity and heat supply. The inspection carries out state energy supervision of electrical installations and networks of market participants, controls compliance by market participants (excluding consumers) with the requirements of rules and other regulatory acts and documents on technical operation and condition of power plants, installations, and networks. The main tasks of the State Energy Supervision Inspectorate are: 1) implementation of the state policy in the field of supervision (control) in the areas of electricity and heat supply; 2) submission of proposals to the Minister of Energy regarding ensuring the formation of the state policy in the field of supervision (control) in the areas of electricity and heat supply; 3) organization and implementation of the state policy in the field of supervision (control) in the areas of electricity and heat supply.[75]

Through changes to the Law of Ukraine "On the Natural Gas Market" from July 2023,[76] the competence of Inspectorate is expanded to the natural gas market. The subject of supervision (control) over market participants of natural gas and other entities is their activity in terms of compliance with the requirements of regulatory acts on technical operation and technical condition of gas distribution systems, internal gas supply systems, internal gas supply networks, smoke and ventilation channels of residential and public buildings, metering devices, as well as safe use of natural gas in households.

The natural gas market is operated by the **gas TSO** (LLC "Gas Transmission System Operator of Ukraine"), which is responsible for reliable and safe operation, maintenance and development of the GTS owned by the state. The TSO is independent of other activities in the natural gas market and has been certified since 2020 according to the ISO model, as well as an observer member of ENTSOG. Natural gas storage is provided by the **gas storage operator** (PJSC "Ukrtransgaz"). The gas storage operator was certified in 2023 in accordance with the requirements of Regulation (EU) No. 715/2009 (as amended in 2022).

In the electricity market, the system-forming element is the **transmission system operator (TSO)** - PJSC NEC "Ukrenergo", which is responsible for the development of the transmission system, including international power transmission lines. Ukrenergo is a member of the European energy association ENTSO-E and is certified as a TSO according to the ISO model. The TSO also performs the functions of operational-technological management (dispatching) in the Unified Energy System of Ukraine, is the operator of the balancing market, ancillary services market, administrator of commercial metering and settlement administrator, operator of auctions for the distribution of interconnection capacity.

The operator of the day-ahead electricity spot market (DAM) and the intraday market (IDM) is the **Market Operator**, which is responsible for organizing the purchase and sale of electricity and settlements in these segments. To fulfill the functions of **guaranteed buyer**, the Guaranteed Buyer State Enterprise was created, which operates in three main directions: 1) purchasing electricity at a "green" tariff, 2) implementing PSO mechanisms to ensure public interests in the electricity market (in terms of RES development, providing the population with affordable electricity, and ensuring the security of power supply during martial law), and 3) organizing auctions for renewable generation entities.

The distribution of natural gas and electricity is carried out by **DSOs**, which are natural monopolies and are regulated by the Regulator, in particular in terms of licensing activities and compliance with licensing conditions, approval of system development plans and corresponding investment programs, approval of tariffs for distribution services, quality control of service provision, etc.

Significant changes have taken place in the management of gas DSOs since the start of the full-scale invasion. In the spring of 2022, at the request of the State Bureau of Investigations,[77] the court decided to arrest and transfer the corporate rights of 26 gas DSOs to the Asset Recovery and Management Agency

[75] https://zakon.rada.gov.ua/laws/show/77-2018-%D0%BF#Text

[76] https://zakon.rada.gov.ua/laws/show/3293-20#n67

[77] https://dbr.gov.ua/news/dbr-peredalo-v-upravlinnya-armi-26-regionalnih-operatoriv-gazorozpodilchih-sistem

(ARMA). By order No. 49-r dated May 28, 2022, "Certain issues of asset management subject to arrest in criminal proceedings in exceptional cases," in order to prevent the risk of an emergency situation in the energy sector, the Cabinet of Ministers of Ukraine approved the transfer of the arrested shares to JSC "Chornomornaftogaz" "for the period until the risk of failure and/or interruption of the functioning of assets that may lead to emergencies is eliminated, and until the completion of procedural measures". At the same time, by the resolution of the Cabinet of Ministers dated November 25, 2022, "On the settlement of the issue of the use of gas distribution systems or their components," the proposal of the Ministry of Energy regarding the conclusion with LLC "Gas Distribution Networks of Ukraine" of operating agreements for gas distribution systems or their components and the termination of existing operating agreement for gas distribution systems or their components concluded with gas distribution network operators in accordance with the provisions of the said resolution has been approved. In connection with this, LLC "Gas Distribution Networks of Ukraine", which is part of the Naftogaz Group, has obtained a license for natural gas distribution activities from 26.12.2022 No. 1839,[78] the territory of which gradually increases with the transfer of assets from previous DSOs.[79] At the same time, licenses of previous operators are suspended. Meanwhile, legal proceedings are ongoing to challenge the complex of these decisions.[80]

The major player in the natural gas market, which operates in the retail and wholesale markets and performs a number of special duties to ensure public interests, is **Naftogaz Group**, which includes extraction companies (PJSC "Ukrgazvydobuvannya" and PJSC "Ukrnafta"), supply companies (LLC "Naftogaz of Ukraine Gas Supply Company", LLC "Naftogaz Trading", LLC "Naftogaz Heat"), as well as NJSC "Naftogaz of Ukraine" as a wholesale seller.

The Naftogaz Group also includes Ukrtransnafta, which is the **operator of main oil and oil product pipelines** based on a license for the transportation of oil by a main pipeline, as well as the transportation of oil products by a main pipeline on a part of the main oil product pipeline "Samara - Western direction" (as a manager).[81]

1.3. Consultations and involvement of national and Union entities and their outcome

i. Involvement of the national parliament

Involvement of Members of Parliament representing various factions and groups of the Verkhovna Rada of Ukraine and working within relevant committees of the Verkhovna Rada of Ukraine is planned as part of public discussion after the publication of the NECP draft.

ii. Involvement of local and regional authorities

Representatives of local self-government bodies were involved in public online consultations on the dimensions of the NECP and on specific cross-sectoral issues (see below). Additional involvement is planned within the framework of public discussion after the publication of the NECP draft.

[78] https://www.nerc.gov.ua/acts/pro-vidachu-licenziyi-z-rozpodilu-prirodnogo-gazu-tov-gazorozpodilni-merezhi-ukrayini

[79] https://www.nerc.gov.ua/acts/pro-vnesennya-zmin-do-dodatka-do-postanovi-nkrekp-vid-26-grudnya-2022-roku-1839-ta-vregulyuvannya-pitan-shchodo-provadzhennya-tov-gazorozpodilni-merezhi-ukrayini-diyalnosti-z-rozpodilu-prir-4

[80] For example, https://www.nerc.gov.ua/acts/pro-zupinennya-diyi-licenziyi-z-rozpodilu-prirodnogo-gazu-vidanoyi-mikolayivgaz

[81] https://www.nerc.gov.ua/news/ukrtransnafta-otrimalo-licenziyu-z-transportuvannya-naftoproduktiv-magistralnim-truboprovodom

iii. Consultations of stakeholders, including the social partners, and engagement of civil society and the general public

The main assumptions for modeling scenarios in the preparation of the NECP and the description of the main parameters of the modeling scenarios were agreed upon within the interagency cooperation between the Ministry of Economy of Ukraine and the Ministry of Energy of Ukraine, the Ministry for Communities, Territories and Infrastructure Development of Ukraine, and the Ministry of Environmental Protection and Natural Resources of Ukraine. This was preceded by consultations at the level of deputy ministers regarding the approach to modeling within the NECP.

During the development of the NECP, the expert group conducted:

- working consultations with representatives of the Ministry of Environment on goals and policies in the dimension decarbonisation (28.09.2023), CBAM and carbon pricing instruments (1.11.2023), the state of preparation of key documents for the dimension decarbonisation (24.01.2024), policies on decarbonization in the waste sector (23.01.2024);

- working consultations with representatives of the Ministry of Infrastructure on goals, adopted and planned policies in the field of energy efficiency (28.09.2023);

- working consultations with representatives of the Ministry of Energy on goals, policies, and measures for renewable energy (including the development of biofuels) and the development of the nuclear-industrial complex (12.10.2023), future goals, policies, and measures for hydrogen (15.12.2023), coordination with the updated draft of the National Renewable Energy Action Plan (10.01.2024);

- working consultations with representatives of the Ministry of Agrarian Policy on forecasting GHG emissions and decarbonization policies in the agricultural sector (18.01.2024);

- technical consultations with infrastructure operators and major players in relevant markets, including JSC "Ukrgasvydobuvannya" (21.11.2023), JSC "Ukrtransnafta" (22.11.2023), JSC "Ukrtransgaz" (29.11.2023), PJSC "NEC "Ukrenergo" (30.11.2023), LLC "Gas TSO of Ukraine" (11.12.2023).

In addition, the following public online consultations were conducted on the dimensions of NECP and on specific cross-sectoral issues:

- "Energy efficiency in municipalities" (November 29, 2023, with approximately 150 registered participants);
- "Energy security" (November 30, 2023, with approximately 110 registered participants);
- "Decarbonisation: development of RES" (December 13, 2023, with approximately 100 registered participants);
- “Decarbonisation: integration of RES into energy systems and markets” (14.12.2023, about 70 registered participants);
- “Decarbonisation: policies and measures for GHG emissions reduction” (18.12.2023, about 80 registered participants);
- “Research, innovation and competitiveness” (08.01.2024, about 100 registered participants);
- "Development of energy markets for 2025-2030" (January 16, 2024, about 150 registered participants);
- "Improving energy efficiency of enterprises and energy companies" (January 18, 2024, 115 registered participants);

- "Motor fuels market and its decarbonization (oil refining, import, development of RES in transport)" (January 25, 2024, about 75 registered participants).

Additional working and public consultations are planned after the publication of the NECP draft.

iv. Consultations of other member states

Consultations are planned as part of the public discussion after the publication of the NECP draft. In addition, a High-Level Advisory Group (HLAG) has been established with the participation of representatives from the European Union, the Energy Community Secretariat, and G7 countries as part of the NECP preparation. During regular meetings, HLAG participants were presented with key objectives, policies, and measures of the NECP, as well as the main assumptions and preliminary modeling results, and discussions took place on the main challenges for policy harmonization in the energy and climate sectors.

v. Iterative process with the Commission

Representatives of the European Union, the Secretariat of the Energy Community were involved in the meetings of the High-Level Advisory Group (HLAG). A meeting was also held to discuss the preliminary draft of the NECP with the participation of experts from the Energy Community Secretariat and representatives of the European Commission, including the Directorate-General for Energy (DG ENER), the Directorate-General for Neighborhood and Enlargement Negotiations (DG NEAR), the Directorate-General for Climate Action (DG CLIMA), and other stakeholders from the European Commission.
Furthermore, in accordance with the requirements of Regulation (EU) 2018/1999, the draft NECP will be submitted to the Energy Community Secretariat for recommendations and further processing to prepare the final NECP draft. Representatives and departments of the European Commission will also be involved in the process on a regular basis for information and discussions.

1.4. Regional cooperation in preparing the plan

i. Elements subject to joint or coordinated planning with other Member States
By Decision 2022/02/MC-EnC[82] of December 15, 2022, the Energy Community Ministerial Council adopted the joint energy and climate goals of the Contracting Parties until 2030. Among other things, the following goals are set for Ukraine:

- Reduce greenhouse gas emissions by 65% compared to the 1990 level to 309 million tons of CO2 equivalent;
- The share of renewable energy sources in the structure of gross final energy consumption is not less than 27%;
- Primary energy consumption not exceeding 91.47 million tons of oil equivalent, final energy consumption - 50.45 million tons of oil equivalent.

The Contracting Parties of the Energy Community should jointly approach the implementation of policies to reduce dependence on fossil fuels in the short term and achieve climate neutrality of their economies by 2050. At the same time, regarding Ukraine, the goals should be reviewed at the meeting of the Energy Community Council, following the cessation of martial law in Ukraine.

ii. Explanation of how regional cooperation is considered in the plan
In relevant cases, the NECP describes specific measures of regional cooperation. Among other things, this includes cooperation in the development of the electricity transmission system and gas transmission

[82] https://www.energy-community.org/dam/jcr:421f0dca-1b16-4bb5-af86-067bc35fe073/Decision_02-2022-MC_CEP_2030targets_15122022.pdf

system, regional market integration and trade development, risk assessment and crisis response planning in energy supply, and emission reduction through bilateral cooperation agreements under Article 6 of the Paris Agreement.

2. NATIONAL OBJECTIVES AND TARGETS

2.1. Dimension Decarbonisation

2.1.1. GHG emissions and removals
i. The elements set out in point (a)(1) of Article 4

The updated nationally determined contribution of Ukraine to the Paris Agreement, approved by the government on July 30, 2021[83], significantly enhances[84] Ukraine's contribution to addressing global climate change. The document envisages a reduction of Ukraine's total GHG emissions by 65% by 2030 compared to the 1990 emissions level[85]. This same objective is reflected in the Decision of the Energy Community Ministerial Council No 2022/02/MC-EnC[86].

The national target for reducing GHG emissions in Ukraine covers all GHG emissions[87] and all sectors (energy, industrial processes and product use, agriculture, LULUCF, waste). Ukraine's commitments under the updated NDC include temporarily occupied territories, although information on economic activity and GHG emissions levels in these territories is not available (expert estimates have been conducted). It is expected that the NDC will be revised after the restoration of Ukraine's territorial integrity.

According to the National Inventory of GHG Emissions for 1990-2018, Ukraine's GHG emissions (including LULUCF) in 1990 amounted to 882.9 million tonnes of CO2-equivalent. Therefore, the target of reducing GHG emissions by 65% from the 1990 level will result in emissions reaching 309 million tonnes of CO2-equivalent by 2030.[88]

According to the Inventory of GHG Emissions for 1990-2021[89],GHG emissions amounted to 341.5 million tonnes of CO2-equivalent. (including the LULUCF sector) in 2021. This is 62.5% lower than the 1990 levels, but 7.5% higher compared to 2020.

The next review of the NDC is scheduled for 2025. The Ministry of Environmental Protection and Natural Resources of Ukraine (hereinafter referred to as the Ministry of Environment) plans to start work in this direction from the beginning of 2024.

ii. Where applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies. Where applicable for the contribution to the overall Union commitment of reducing the GHG emissions, other objectives and targets, including sector targets and adaptation goals, if available

Long-term goals for achieving climate neutrality are fixed in two strategic documents of Ukraine. The Energy Strategy of Ukraine until 2050 (hereinafter - ESU), approved by the order of the Cabinet of Ministers of Ukraine dated April 21, 2023. No. 373-r, provides for achieving climate neutrality of

[83] https://www.kmu.gov.ua/news/uryad-shvaliv-cili-klimatichnoyi-politiki-ukrayini-do-2030-roku

[84]The first NDC actually envisaged a 40% reduction in GHG emissions by 2030 from the 1990 level. The updated NDC increased the target for reducing GHG emissions to 65% below the 1990 level.

[85] https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

[86] https://www.energy-community.org/legal/decisions.html

[87] Carbon dioxide - CO2, methane - CH4, nitrous oxide (I) - N2O, hydrofluorocarbons - HFC, perfluorocarbons - PFC, sulfur hexafluoride - SF6, nitrogen trifluoride - NF3.

[88] This reference value can be recalculated in case of methodology review by the Intergovernmental Panel on Climate Change (IPCC).

[89] https://unfccc.int/ghg-inventories-annex-i-parties/2023

Ukraine's energy sector by 2050. The National Economic Strategy for the period until 2030 highlights the need to achieve climate neutrality (for the economy as a whole) by 2060.[90][91]

In addition, Ukraine has taken on additional commitments to reduce methane emissions by joining the Global Methane Pledge, which was announced during the UNFCCC COP26 conference in Glasgow in November 2021. To implement Ukraine's climate policy as part of its participation in the Global Methane Pledge, the government approved an action plan on July 7, 2023 (see description of planned actions in section 3.1).[92]

The target for reducing methane emissions is formulated as the expected result of implementing a series of tasks provided for in the Action Plan - a 30% reduction in methane emissions by 2030 from the 2020 level., as envisaged by the Global Methane Pledge initiative.

[93]According to the GHG Emissions Inventory for 1990-2021, in 2020, methane emissions amounted to 72 million tonnes of CO2-eq, in 2021, - 71.5 million tonnes of CO2-eq, which accounts for about 21% of Ukraine's total GHG emissions. Therefore, a 30% reduction in emissions in this sector (21.6 million tonnes of CO2-eq.) from the 2020 level ensures a 2.4% reduction in total GHG emissions by 2030 from the 1990 baseline.

Ukraine also has an important sectoral target that will contribute to reducing GHG emissions. In 2021 Ukraine joined the Powering Past Coal Alliance during the international conference in Glasgow and announced the goal of phasing out coal in electricity generation by 2035. The previously announced plans have been confirmed in the ESU, including the reduction of coal generation until its complete phase-out by 2035. However, the feasibility of achieving this goal by 2035 will be assessed after the end of the full-scale aggression by the russian federation, taking into account the condition and available capacities that will remain operational after the war.[94][95]

[96]Several important goals are also set in the strategic documents in the transport sector. The National Transport Strategy of Ukraine for the period up to 2030 envisages a 30% reduction in specific fuel consumption per tonne-kilometer by 2030. According to the ESU, electricity consumption in the sector is expected to increase by 11% by 2032 due to the electrification of transport. In particular, the share of electric transport is expected to reach 15% by 2032. At the same time, a new transport strategy is currently being developed, which may set new goals.

In recent years, Ukraine has also started to develop a national policy in the field of climate change adaptation. On October 20, 2021, the government approved the Strategy for Environmental Security and Climate Change Adaptation for the period up to 2030[97] with the aim of increasing environmental security, reducing the impacts and consequences of climate change in Ukraine.

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[90] https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text

[91] https://www.kmu.gov.ua/npas/pro-zatverdzhennya-nacionalnoyi-eko-a179

[92] https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text

[93] https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

[94] Coalition of national and subnational governments, enterprises and organizations working on promoting the transition from coal-based electricity generation to renewable energy sources.

[95] From the beginning of the full-scale aggression to the end of the autumn-winter period of 2022/2023, approximately 50% of the available generating capacities and transformer substations of the transmission system of NPC "Ukrenergo" were temporarily lost (damaged and occupied).

[96] https://zakon.rada.gov.ua/laws/show/430-2018-%D1%80#Text

[97] https://zakon.rada.gov.ua/laws/show/1363-2021-%D1%80#Text

Energy is identified as one of the socio-economic sectors that are vulnerable to climate change, as the expected consequences pose threats to reliable energy supply for all types of consumers. In particular, the deepening of seasonal and daily energy demand fluctuations due to climate change will complicate the balancing of Ukraine's Unified Energy System. Additionally, extreme weather events can increase the vulnerability of electrical grids.

One of the goals of the Strategy is to strengthen the adaptive capacity and resilience of social, economic, and environmental systems to climate change, for which a number of tasks and measures have been formulated (see description in section 1.2.ii).

2.1.2. Renewable energy

i. The elements set out in point (a)(2) of Article 4

The national indicative targets in the field of renewable energy are presented in the draft National Action Plan for the Development of Renewable Energy until 2030 (hereinafter referred to as the NREAP). [98]

The draft NREAP determines that the share of energy produced from renewable energy sources in the structure of gross final energy consumption should be at least 27% by 2030. This target indicator is also fixed in the Decision of the Council of Ministers of the Energy Community No 2022/02/MC-EnC.[99]

The NREAP project does not take into account temporarily occupied territories. It is expected that after the cessation or cancellation of the martial law in Ukraine and the restoration of territorial integrity, the NREAP will be reviewed.

The draft NREAP was developed before the full-scale invasion of the Russian Federation. During 2022, the document underwent a consultation process with ministries and central executive bodies and a strategic environmental assessment. However, on April 21, 2023, the government approved a new Energy Strategy of Ukraine (ESU) for the period up to 2050, in order to take into account the devastating impact of the full-scale invasion of the russian federation on Ukraine's energy sector. Accordingly, the Ministry of Energy plans to revise the draft NREAP to align it with the goals and provisions of the ESU. After the publication of the new version of the draft NREAP, this section will be reviewed.

ii. Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sector

The national indicative target for RES in gross final energy consumption by 2030 in the heating and cooling systems, electricity generation, and transportation sector is presented in Appendix 2 of the draft NREAP (see Table 2.1), particularly in the sectors:

- electricity sector - doubling the share of energy from RES from 14% to 25%;
- heating and cooling - increasing the share of energy from RES fourfold from 9% to 35%;
- increasing the share of energy from renewable sources in the transport sector fivefold from 3% to 14%.

[98] https://saee.gov.ua/sites/default/files/DraftNPDVE_2030_SAEE_21_09_2022.pdf

[99] https://www.energy-community.org/legal/decisions.html

Table 2.1. National indicative RES targets in gross final energy consumption by 2030 in heating and cooling, electricity production, and the transport sector (%)

Sector of energy use from RES	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Heating and cooling[1]	9.3	11.1	13.8	16.6	19.3	22.0	24.7	27.3	29.9	32.5	35
Electricity [2]	10.7	13.7	14.3	16.3	17.5	19.0	20.7	22.0	23.7	24.7	25.4
Transport [3]	2.5	2.9	3.8	5.4	6.5	7.7	9.0	10.3	11.6	12.8	14.0
Gross final energy consumption [4]	**8.4**	**10.3**	**12.1**	**14.3**	**16.2**	**18.2**	**20.1**	**21.9**	**23.8**	**25.5**	**27**

1 Share of renewable energy in heating and cooling systems: gross final energy consumption from renewable sources for heating and cooling (as defined in Articles 5(1)b and 5(4) of Directive 2009/28/EC), divided by gross final energy consumption for heating and cooling.

2 Share of renewable energy in electricity: gross final energy consumption from renewable sources for electricity (as defined in Articles 5(1)(a) and 5(3) of Directive 2009/28/EC, excluding normalization of electricity generated by wind and hydro power plants (including normalization, the share of energy from renewable sources in electricity consumption is - 13.9%)), divided by total gross final energy consumption for electricity.

3 Share of renewable energy in the transport sector: final volume of energy from renewable sources consumed in the transport sector (as defined in Articles 5(1)(c) and 5(5) of Directive 2009/28/EC), divided into the volume of gasoline, diesel fuel, biofuel used by road and rail transport, and electricity consumed by land transport.

4 Share of renewable energy in gross final energy consumption (determined without taking into account the normalization of electricity generated by wind and hydro power plants (taking into account the normalization, the share of energy from renewable sources in gross final energy consumption is 9.2%).

iii. Estimated trajectories by renewable energy technology that the Member State projects to use to achieve the overall and sectoral trajectories for renewable energy from 2021 to 2030, including expected total gross final energy consumption per technology and sector in Mtoe and total planned installed capacity (divided by new capacity and repowering) per technology and sector in MW

The estimated table of the contribution of RES to the energy consumption of each sector is presented in Appendix 3 of the draft NREAP (see Table 2.2). According to the estimates, the largest contribution of RES to energy consumption is expected for the heating and cooling sector - 11,478 thousand toe in 2030, while for the electricity and transport sectors, this indicator is 3,804 thousand toe and 961 thousand toe, respectively.

Table 2.2. Estimated table of the contribution of RES to the energy consumption of each sector to the final energy consumption (thousand tons of oil equivalent)

Sector of energy use from RES	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Heating and cooling	2 869	3 446	4 333	5 226	6 119	7 012	7 905	8 799	9 692	10 585	11 478
Electricity (1)	1 376	1 846	1 953	2 239	2 472	2 691	2 899	3 099	3 366	3 556	3 804
without electricity consumed by electric transport	1 332	1 782	1 867	2 135	2 339	2 522	2 700	2 870	3 106	3 266	3 484
Transport	148	177	232	340	413	493	588	681	775	867	961
without taking into account multipliers (coefficients)	95	149	191	259	310	370	428	483	540	595	651
Gross final energy consumption (2)	**4 296**	**5 377**	**6 391**	**7 620**	**8 768**	**9 904**	**11 033**	**12 151**	**13 339**	**14 445**	**15 613**

(1) Electricity from renewable sources is determined without taking into account the normalization of electricity generated by wind and hydro power plants.
(2) Electricity, hydrogen and gas from renewable energy sources are taken into account only once (as defined in Article 5(1) of Directive 2009/28/EC).

Estimate of the overall expected contribution from each type of RES to achieve indicative targets by 2030 in the heating and cooling sector is presented in Appendix 4 of the draft NREAP (see Table 2.3). It is expected that solid biomass and biogas will provide the largest share of energy consumption in the sector in 2030 - 81% and 9% respectively, while the contribution of heat pumps will be around 6% and solar energy around 3%.

Estimate of the overall contribution expected from each type of RES to achieve indicative targets by 2030 in the electricity generation sector is presented in Appendix 5 of the draft NREAP (see Table 2.4). It is expected that by 2030 the installed capacity of RES facilities will reach 23.6 GW, and the generation will be 44.2 TWh in the structure of electricity production from RES in 2030. The contribution of wind and solar energy will be the largest - 36% and 33%, respectively. The most rapid development is expected in the bioenergy sector. Thus, electricity production from installations using solid biomass, biogas, and from 2025 biomethane will increase almost 9 times - from 755 GWh in 2020 to 6,530 GWh in 2030. There is also expected to be a nearly five-fold increase in the wind energy sector - from 3.3 TWh in 2020 to 15.8 TWh in 2030. In addition, it is envisaged that the installed capacity of energy storage facilities will reach 640 MW in 2030.

Estimate of the overall contribution expected from each type of RES to achieve indicative targets by 2030 in the transport sector is presented in Annex 6 of the draft NREAP (see Table 2.5). It is expected that the use of electricity from RES in the transport sector will reach 320 thousand tons of oil equivalent (toe) in 2030; 57% will be allocated to railway transport and 16% to electric vehicles. It is envisaged that the overall consumption of liquid biofuels will amount to 325 thousand tons of oil equivalent (toe). In 2030, the lion's share (73%) will be accounted for by bioethanol from food and feed crops (190 thousand tons of oil equivalent (toe)) and bioethanol from waste and residues (48 thousand tons of oil equivalent (toe)).

Table 2.3. Estimate of the total contribution (final energy consumption) expected from each RES to achieve mandatory indicative targets for 2030 and indicative intermediate trajectory for achieving the share of energy from RES in heating and cooling systems for 2021-2030 (thousand tonnes of oil equivalent)

Production thermal energy by type of RES	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Geothermal (except low-temperature geothermal heat for use in heat pumps)				**6**	**13**	**19**	**25**	**31**	**38**	**44**	**50**
Sun	**1**	**20**	**62**	**104**	**147**	**189**	**231**	**273**	**316**	**358**	**400**
Biomass, including:	**2 816**	**3 340**	**4 116**	**4 893**	**5 669**	**6 446**	**7 222**	**7 999**	**8 775**	**9 552**	**10 328**
solid	2 797	3 300	3 970	4 640	5 309	5 979	6 649	7 319	7 988	8 658	9 328
biogas	19	40	147	253	360	467	573	680	787	893	1 000
Energy from heat pumps, including:	**52**	**86**	**154**	**222**	**291**	**359**	**427**	**495**	**564**	**632**	**700**
aerothermal	36	46	92	138	184	230	276	322	368	414	460
geothermal	10	24	39	54	69	84	100	115	130	145	160
hydrothermal	6	16	23	30	37	44	52	59	66	73	80
In total	**2 869**	**3 446**	**4 333**	**5 226**	**6 119**	**7 012**	**7 905**	**8 799**	**9 692**	**10 585**	**11 478**

Table 2.4. Estimate of total consumption (installed capacity, gross electricity production), expected from each renewable energy source in Ukraine, to achieve mandatory indicative targets for 2030 and indicative intermediate trajectory for achieving the share of energy from renewable sources in electricity generation for 2021-2030

Electricity generation by source	2020		2021		2022		2023		2024		2025		2026		2027		2028		2029		2030	
	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h	MW	GW · h
Hydropower plants:	**4 824**	**6 002**	**4 850**	**9 135**	**4 852**	**6 910**	**4 864**	**6 935**	**4 876**	**6 964**	**4 887**	**6 987**	**4 898**	**7 010**	**4 910**	**7 035**	**4 922**	**7 060**	**4 928**	**7 085**	**4 935**	**7 100**
capacity over 10MW	4 708	5 793	4 730	8 868	4 730	6 680	4 740	6 700	4 750	6 720	4 760	6 740	4 770	6 760	4 780	6 780	4 790	6 800	4 795	6 820	4 800	6 830
capacity up to 10 MW	116	209	120	267	122	230	124	235	126	244	127	247	128	250	130	255	132	260	133	265	135	270
Geothermal energy											**4**	**20**	**8**	**40**	**12**	**60**	**16**	**80**	**18**	**90**	**20**	**100**
Photoelectric plants, including	**6 872**	**5 969**	**7 586**	**7 581**	**7 813**	**8 200**	**8 360**	**9 200**	**8 971**	**10,200 –**	**9 355**	**11,100 –**	**9 550**	**11,600 –**	**9 821**	**12,000 –**	**10,725 –**	**13,200 –**	**11 122**	**13,800 –**	**11,788 –**	**14,700 –**
producers	6 093	5 236	6 381	6 430	6 443	6 830	6 545	7 330	6 681	7 750	6 833	8 200	6984	8520	7 179	8 830	7 435	9 220	7 688	9 610	7 976	10,050 –
consumers, including energy cooperatives and private households	779	733	1 205	1 151	1 370	1 370	1 816	1 870	2 290	2 450	2 522	2 900	2567	3 080	2 642	3 170	3 289	3 980	3434	4 190	3 811	4 650
Wind power plants, including	**1 314**	**3 271**	**1 535**	**3 804**	**2 520**	**6 400**	**2 920**	**7 800**	**3 320**	**8 900**	**3 667**	**9 900**	**4 120**	**11,200 –**	**4 470**	**12,400 –**	**4 820**	**13,500 –**	**5 120**	**14,500 –**	**5 420**	**15,800 –**
onshore	1 314	3 271	1 535	3 804	2 520	6 400	2 920	7 800	3 320	8 900	3667	9 900	4120	11,200 –	4470	12,400 –	4720	13 150	4 920	13,799 –	5 120	14,749 –
marine (offshore)																	100	350	200	701	300	1 051
Biomass, including	**210**	**755**	**274**	**941**	**349**	**1200**	**499**	**2100**	**651**	**2680**	**794**	**3280**	**934**	**3860**	**1074**	**4540**	**1209**	**5200**	**1344**	**5870**	**1448**	**6530**
solid	107	284	150	388	192	500	209	800	345	1310	479	1820	609	2310	717	2740	831	3200	951	3680	1030	4120
biogas	103	471	124	553	157	700	290	1300	306	1370	315	1410	324	1450	357	1600	378	1700	393	1790	418	1910
biomethane on installations that use natural gas												50		100		200		300		400		500
Highly flexible installations with possibility of fast launch							**300**		**500**		**700**		**850**		**950**		**1050**		**1150**		**1250**	
Energy storage installations			**1**		**100**		**200**		**300**		**380**		**440**		**490**		**540**		**590**		**640**	
Total (from RES)	**13,220**	**15,997**	**14,245**	**21,461**	**15,535**	**22,710**	**16,643**	**26,035**	**17,817**	**28,744**	**18,706**	**31,287**	**19,510**	**33,710**	**20,287**	**36,035**	**21,692**	**39,040**	**22,533**	**41,345**	**23,611**	**44,230**

Table 2.5. Estimated share of renewable energy in the transport sector (thousand tons of oil equivalent)

Sector of energy use from RES	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity from RES used in transport, including:	**44**	**64**	**86**	**104**	**133**	**169**	**199**	**229**	**260**	**290**	**320**
electric cars	0	1	3	5	6	7	16	25	33	42	51
railway transport	35	50	63	73	95	119	131	144	156	169	181
others types of electric transport	8	13	20	26	32	43	52	61	70	79	88
Consumption of liquid biofuel (bioethanol, biodiesel), including:	**51**	**85**	**105**	**155**	**177**	**200**	**227**	**251**	**277**	**299**	**325**
Bioethanol:	**51**	**85**	**100**	**145**	**158**	**174**	**187**	**200**	**213**	**224**	**238**
bioethanol from food and fodder cultures	51	85	100	115	124	137	148	158	169	179	190
bioethanol from waste, residues, (II generation)				30	34	37	39	42	44	45	48
Biodiesel :		**0**	**5**	**10**	**19**	**26**	**40**	**51**	**64**	**75**	**87**
biodiesel from food and fodder crops			5	10	16	21	32	41	52	61	70
biodiesel from waste, residues (II generation)					3	5	8	10	12	14	17
Consumption of biomethane, including						**1**	**2**	**3**	**4**	**5**	**6**
biomethane from food and fodder cultures						1	2	3	4	5	5
biomethane from waste, residues (II generation)											1
Total consumption of energy from RES in the transport sector	**95**	**149**	**191**	**259**	**310**	**370**	**428**	**483**	**541**	**594**	**651**
Total contribution of renewable energy in achievement indicative goal of RES in the transport sector ***(1)***	**148**	**177**	**232**	**340**	**413**	**593**	**588**	**681**	**775**	**867**	**961**

1- taking into account multiplication factors (for 2020 according to Directive 2009/28/EC, for 2021-2030 according to Directive 2018/2001).

iv. Estimated trajectories on bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink

Appendices 4, 5, 6 to the draft NREAP present the contribution of biomass to energy consumption in the heating and cooling sectors, electricity generation, and transportation (see tables 2.3, 2.4, 2.5) broken down by type of bioenergy (solid biomass, biogas, biomethane, first and second generation bioethanol, first and second generation biodiesel).

v. Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, renewable energy communities and renewables self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)

In addition to the goals for the development of the RES sector presented in the draft NREAP, some other strategic documents of Ukraine also include goals for the RES sector, which were taken into account in the development of the draft NREAP.

[100]The National Economic Strategy for the period up to 2030, approved by the Cabinet of Ministers of Ukraine on March 3, 2021, No. 179, indicates the target share of renewable energy generation in the total electricity generation at the level of 25% in 2030.

[101]The Concept of Implementation of the State Policy in the Field of Heat Supply, approved by the Order of the Cabinet of Ministers of Ukraine dated August 18, 2017 No. 569-r, sets goals for achieving the share of alternative energy sources (renewable energy sources and secondary energy resources) in the production of thermal energy by objects in the field of heat supply in 2025 - 30%, in 2035 - 40%.

[102]The National Transport Strategy of Ukraine for the period up to 2030, approved by the Cabinet of Ministers of Ukraine on May 30, 2018, No. 430-r, provides for an increase in the use of alternative fuels (biofuels or their mixture with conventional fuels) and electricity (generated from both traditional and renewable sources) in the transport sector up to 50% by 2030.

2.2. Dimension Energy Efficiency

i. The elements set out in point (b) of Article 4

1) Indicative national contribution to energy efficiency targets, as specified in Article 1(1) and Article 3(5) of Directive 2012/27/EU, based on primary or final energy consumption, primary or final energy savings, or energy intensity.

The current national indicative targets for energy efficiency are defined by the Decision of the Council of Ministers of the Energy Community No 2022/02/MC-EnC and the National Action Plan on Energy Efficiency for the period up to 2030. According to these documents, primary energy consumption in Ukraine should not exceed 91,468 thousand tons of oil equivalent in 2030. and final energy consumption - 50,446 thousand tons of oil equivalent.
Considering the ramifications of Russia's full-scale war against Ukraine and its effects on the economy overall, especially within the energy sector, as well as shifts in demographic patterns, adjustments were made to the projected levels of primary and final energy consumption during the development of the

[100] https://www.kmu.gov.ua/npas/pro-zatverdzhennya-nacionalnoyi-eko-a179
[101] https://zakon.rada.gov.ua/laws/show/569-2017-%D1%80#Text
[102] https://zakon.rada.gov.ua/laws/show/430-2018-%D1%80#Text

NECP. These targets were established through modeling with the TIMES model, enabling the incorporation of technical and economic factors into energy system planning.
Based on modeling, primary energy consumption in Ukraine in 2030 should not exceed 72,224 thousand tons of oil equivalent, and final energy consumption - 42,168 thousand of oil equivalent.

Table 2.6. Indicative indicators of primary energy consumption and final energy consumption, thousand tons of oil equivalent.

Energy consumption assessment	2020	2025	2030	2040	2050
Total primary energy consumption	79 172	58 683	72 224	75942	75985
Total final energy consumption	45 239	34 786	42 168	46234	48671

The National Energy Strategy also encompasses a goal to reduce the overall energy intensity of the economy, aiming to decrease it from around 89 t.e per million US dollars (at 2020 prices) to reach 76 t.e per million US dollars between 2023 and 2032. It is expected that this target will be achieved through the implementation of measures aimed at improving the efficiency of energy use in all sectors of the economy. The National Economic Strategy for the period leading up to 2030 also establishes a sector-specific target of reducing the energy intensity of the extractive industry by 30% by the year 2030.

2) The total amount of energy savings to be achieved in the period from 2021 to 2030, in accordance with point (b) of Article 7(1) regarding energy savings obligations under Directive 2012/27/EU.

Article 9 of the Law of Ukraine "On Energy Efficiency", which transposes Article 7 of Directive 2012/27/EU, establishes that the target indicator for annual energy consumption reduction should be at least 0.8% of the total annual energy supply to consumers, averaged over the period from January 1, 2017 to December 31, 2019. Energy supply volumes in the transport sector are not taken into account when calculating and setting the target indicator for annual energy consumption reduction.

Table 2.7. Calculation of the total volume of energy savings in final consumption for 2021-2030, thousand tons of oil equivalent

2021	303.8										303.8
2022	303.8	303.8									607.6
2023	303.8	303.8	303.8								911.4
2024	303.8	303.8	303.8	303.8							1215.2
2025	303.8	303.8	303.8	303.8	303.8						1519
2026	303.8	303.8	303.8	303.8	303.8	303.8					1822.8
2027	303.8	303.8	303.8	303.8	303.8	303.8	303.8				2126.6
2028	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8			2430.4
2029	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8		2734.2
2030	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8	3038
Total volume of energy savings in final consumption											**16 405.2**

Source: calculation by the authors based on data from the State Statistics Service

[NB: The calculation may be reviewed in accordance with the Methodology for determining the target indicator of annual energy consumption reduction, which has not been approved by the Ministry of Infrastructure as of the beginning of February 2024].

3) Indicative intermediate indicators of the long-term strategy for the reconstruction of the national fund of residential and non-residential buildings, which are in public and private ownership, a roadmap with internally defined measurable progress indicators, empirically substantiated assessment of the expected volume of energy savings and other benefits, as well as contributions to achieving the target indicators of energy efficiency improvement of the Union in accordance with Directive 2012/27/EU and Article 2(a) of Directive 2010/31/EU.

The Ministry of Community Development, Territories and Infrastructure of Ukraine (Mininfrastructure) has developed a Long-Term Strategy for thermal modernization of buildings until 2050. The main goal of the Strategy is to decarbonize the national building stock by 2050. The Strategy sets intermediate targets for 2030, which include:

- Achieving the target energy savings indicator in government buildings, with an annual energy consumption reduction of 1% per area of the respective buildings.
- implementation and functioning of energy management systems in no less than 90% of communities;
- final energy consumption in the building sector reduced by 15%;
- share of residential and public buildings that meet the minimum energy efficiency requirements is at least 36%;
- share of public buildings meeting near-zero energy buildings' requirements is at least 10%;
- The amount of investments attracted to improve energy efficiency of buildings is not less than 87 million euros;
- The number of qualified personnel in the field of energy efficiency is not less than 100,000 people per year.

Table 2.8. Some expected results of the first stage of the Building Thermomodernization Strategy for the period up to 2050

Name	Units of measurement	Residential buildings		Non-residential buildings	
		individual	CPC	public	other non-residential
Thermomodernized buildings (comprehensive or partial)	pc.	3 088 352	97 916	15 784	74 192
Updated building areas	million m^2	220,6	260,0	59,4	66,8
Annual natural gas savings (natural gas equivalent)*	billion m^3	2,5 (8,37)	0,71 (2,36)	0,17 (0,58)	0,12 (0,40)
Annual heat energy savings	GWh	31 606	22 595	7 389	5 136
Annual electricity savings	GWh	247	453	1 062	1 105
Annual savings	million euros	1 022,2	939,2	580,3	397,9

* Annual natural gas savings based on its share in heat energy generation (30%) and the calculated energy savings in natural gas equivalent

In the Long-Term Thermal Modernization Strategy, the projected scale of building thermal modernization is outlined based on an ambitious scenario. However, due to the adverse impacts of a full-scale war, such as challenges in attracting private investments and debt capital, the baseline scenario for thermal modernization outlined in the Strategy was adopted for the NECP. According to this baseline scenario, the plan is to thermally modernize 10% of buildings. The benchmarks from the ambitious scenario of the Strategy for building thermal modernization are factored into the WAM+ scenario.
The Concept for Implementation of State Policy in the Field of Energy Efficiency of Buildings, focusing on increasing the number of buildings with near-zero energy consumption (referred to as the NZEB Concept), also establishes target metrics for enhancing energy efficiency within the building sector. Specifically, the NZEB Concept aims to achieve a 24% reduction in final energy consumption in the residential sector by 2025 and a 16% reduction in final energy consumption in public buildings.

4) The total useful area subject to reconstruction, or equivalent annual energy savings volumes to be achieved from 2021 to 2030 in accordance with Article 5 of Directive 2012/27/EU on the exemplary role of public buildings.

Ukraine has chosen an alternative approach to the implementation of Article 5 of Directive 2012/27/EU. The target energy savings indicator in government buildings is expressed as a numerical value of the annual energy consumption reduction achieved by bringing buildings that meet all the criteria for energy efficiency to minimum requirements, with an area of at least 1% of the total building area.

Ukraine has opted for an alternative approach to the implementation of Article 5 of Directive 2012/27/EU. The target energy savings indicator in government buildings is quantified as a numerical value representing the annual reduction in energy consumption achieved by upgrading 1% area of buildings of the central government to meet minimum energy performance requirements. This applies to buildings meeting the following criteria:

1) are in state or municipal ownership;

2) occupied by a central executive authority;

3) the heated area exceeds 250 square meters.

According to preliminary estimates by the Ministry of Infrastructure, there are approximately 100 buildings that meet the specified criteria. The average heating area of public buildings in Ukraine is 9,447.5 cubic meters, with an average specific energy consumption of 51.69 kWh per cubic meter. The minimum requirements for public buildings average at 25 kWh per cubic meter. Therefore, aligning these buildings with the minimum requirements could result in a 51% reduction in energy consumption. The anticipated energy savings in buildings meeting the criteria mentioned above amount to 24.9 GWh per year.

At the same time, it should be noted that in order to determine and monitor the achievement of the target energy savings indicator in buildings of state authorities in accordance with the Law of Ukraine "On Energy Efficiency of Buildings", it is necessary to create a database of buildings of state authorities, which is a component of the national Building Database. As of December 2023, the Building Database has not been established. With support from the GIZ Project "Energy Efficiency Reform in Ukraine", a pilot phase for implementing such a database has been initiated. During this pilot phase, 12 regional state administrations across Ukraine participated, collecting energy and operational data for 6,164 budget buildings.

ii. The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contributions to the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2a of Directive 2010/31/EU

See above, in section 2.2.i. (indicators of the Strategy for Thermal Modernization of Buildings until 2050).

iii. Where applicable, other national objectives, including long-term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

Heat supply

District heating (DH) systems in Ukraine annually provide 5.3 million households with approximately 24 million Gcal of thermal energy. According to the Ministry of Regional Development's estimates as of 2022, DH systems had the following key indicators:

- Specific fuel consumption for thermal energy production by boiler plants - 165 kg of conventional fuel per Gcal.
- The share of losses in heat networks is 20%;
- The share of natural gas in the fuel consumption structure of heat energy systems is 90%.

As of October 20, 2023, 84.9% of residential buildings and 83.5% of commercial buildings are equipped with heat energy commercial metering points.

The concept of implementing state policy in the field of heat supply envisages achieving the following indicators:

- ensuring 100% commercial accounting of consumed thermal energy;
- specific fuel consumption during the production of thermal energy by boiler houses - 155 kg of fuel equivalent per gigacalorie in the first stage of implementation;
- share of losses in heat networks - 12% in the first and 10% in the third stage of implementation.

2.3. Indicator Energy Security

i. The elements set out in point (c) of Article 4

The key documents that define the goals in terms of deepening the diversification of energy sources and supply routes from third countries with the potential aim of reducing dependence on energy imports are the National Economic Strategy for the period up to 2030[103] and the Energy Strategy of Ukraine for the period up to 2050[104].

Increasing the flexibility of the national energy system is not explicitly declared as a clear goal in policy documents.

[103] https://zakon.rada.gov.ua/laws/show/179-2021-%D0%BF

[104] https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text

The National Economic Strategy for the period up to 2030 includes among its goals ensuring the formation of a sufficient amount of flexible capacity to ensure the economically efficient operation of all generations.

The Energy Security Strategy includes two relevant strategic goals:

- Goal 2. Stability of the functioning of the energy sector;
- Goal 4. Energy efficiency in the use of energy resources and energy efficiency of the national economy.

One of the tasks in Energy Strategy of Ukraine for the period up to 2050 includes the implementation of high maneuverability capacities, in order to ensure the balance reliability of Ukraine's power system and support further integration of RES:

- flexible capacities of HPPs and PSPs;
- balancing and reserve capacities of CHPs using combined fuel (natural gas and/or biomethane), other technologies; gas turbine and gas piston units are also mentioned;
- power installations, including Power-to-X long-term (seasonal) storage accumulators.

The target indicators for 2032 in terms of total available capacity are indicated as 9.4 GW for semi-peak and peak generation (without technology breakdown), as well as 4.9 GW for HPPs and 4.1 GW for PSPs. The increase in available HPP capacity will be 30%, and for PSPs - approximately 2.4 times. In addition, the ESU refers to the Program for the Development of Hydropower in Ukraine for the period up to 2026[105], which includes the goal of increasing the share of flexible HPP and PSP capacities in the overall balance by 2026 to 15.5%.

Regarding RES, their active use is projected after 2032. By 2050, the capacity of RES compared to the projected 2024 will triple and amount to 1.56 GW. As part of the demand response program, which is intended to become a separate direction of energy efficiency, ESU only foresees the implementation of pilot projects until 2032.

Detailed target indicators are presented by the TSO in the Generation Capacity Adequacy Assessment Report to cover the projected demand for electricity and ensure the necessary reserve in 2022. See also section 2.4.3. Market integration (Dimension Internal energy market).

In terms of addressing constrained or interrupted supply of an energy source, for the purpose of improving the resilience of regional and national energy systems, the main goals are indicated in the Energy Strategy of Ukraine until 2050, the Law "On Critical Infrastructure"[106], the Cybersecurity Strategy of Ukraine[107], the Law "On the Basic Principles of Cybersecurity in Ukraine"[108], the Law "On the Electricity Market"[109], the Law "On the Natural Gas Market"[110], and relevant subordinate acts.

Ensuring a constant and uninterrupted energy supply is particularly important for Ukraine. That is why significant attention is paid to the protection of energy facilities.

The ESU emphasizes the comprehensive protection of energy sector infrastructure. The target indicator is to ensure physical, engineering, technical, and cyber protection of 100% of the facilities. It is specifically stated that in conditions of full-scale war, the priority is the protection of critical infrastructure facilities (CIF), and the management system for such protection is defined at the level of a separate law. The

[105] https://ips.ligazakon.net/document/view/kr160552?an=1&ed=2016_07_13
[106] https://zakon.rada.gov.ua/laws/show/1882-20
[107] https://zakon.rada.gov.ua/laws/show/447/2021#Text
[108] https://zakon.rada.gov.ua/laws/show/2163-19
[109] https://zakon.rada.gov.ua/laws/show/2019-19#Text
[110] https://zakon.rada.gov.ua/laws/show/329-19#Text

Concept of ensuring national resilience, approved by the Decree of the President of Ukraine No. 479/2021 dated September 27, 2021, also states that such a system should include the security and protection of critical infrastructure facilities, including stable energy supply and heat supply.[111]

Another group of goals is the formation and preservation of energy resource reserves - natural gas, coal, fuel oil - within the government's activities to prepare for the autumn-winter periods[112]. As a rule, target indicators are determined at the government level in the form of orders or departmental decisions (plans-schedules) that are coordinated with market participants[113]. Some of the goals are regulated at the legislative level. At the end of 2022, amendments to the Law "On the natural gas market" established the obligation of the Ministry of Energy to calculate the target level of gas storage filling and to form a filling schedule. In 2023, the Law "On minimum reserves of crude oil and petroleum products" was adopted, which provides for the creation of reserves equivalent to 90 days of net imports or 61 days of domestic consumption.[114]

Finally, the framework laws on gas and electricity markets define the government's responsibility for minimum supply security standards and their monitoring. The Ministry of Energy is responsible for approving rules on the security of natural gas and electricity supply, as well as the National Action Plan (which regulates the preparation and response to a gas crisis), which are mandatory for all participants in the respective markets to comply with, and also for monitoring supply security (for electricity - jointly with the Regulator, the transmission system operator, and other relevant institutions).

All specified elements have found their place in the comprehensive Energy Security Strategy[115], which is a strategic planning document, contains threat analysis, identifies priorities, describes strategic choices, goals and tasks aimed at preventing threats to Ukraine's energy security. The objectives of the Strategy are built around eight strategic goals:

1) Availability of energy sources and resources of all types for consumers;
2) Resilience of the energy sector;
3) Economic efficiency of the energy sector, energy supply systems, and mineral raw materials substitution;
4) Energy efficiency of resource use and energy efficiency of the national economy;
5) Environmentally acceptable impact of energy on the natural environment;
6) Integration of the energy sector into the political, technological, technical, economic, and legal space of the EU;
7) Independence of the state in shaping and implementing domestic and foreign policies in the energy sector, ensuring the realization of national interests;
8) Development of Ukraine's scientific, technological, innovative, and educational potential for the needs of the energy sector.

In the context of EU membership for Ukraine, integration into supply security processes is important, which is manifested in participation in regional and pan-European risk assessment events, planning preventive measures, and responding to supply crises for natural gas (according to Regulation (EU) 2017/1938) and electricity (according to Regulation (EU) 2019/941).

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[111] https://www.president.gov.ua/documents/4792021-40181

[112] https://zakon.rada.gov.ua/laws/show/515-2023-%D0%BF#Text

[113] For example, https://zakon.rada.gov.ua/laws/show/586-2021-%D1%80#Text

[114] https://zakon.rada.gov.ua/laws/show/3484-IX#Text

[115] https://zakon.rada.gov.ua/laws/show/907-2021-%D1%80#Text

ii. National objectives with regard to increasing: the diversification of energy sources and supply from third countries for the purpose of increasing the resilience of regional and national energy systems

The National Security Strategy declares the need to diversify sources and routes of energy resource supply[116]. The National Economic Strategy for the period up to 2030 defines the overall goal of ensuring diversification of energy resource supplies at a level not exceeding 30% from one supplier. At the same time, the target indicator is formally defined for nuclear fuel (see below), as the import of gas, oil products, coal, as well as electricity, is sufficiently diversified in terms of supplier structure and countries of origin - and this trend has intensified after the ban on the import of any goods from the Russian Federation and the actual cessation of trade with the Republic of Belarus.[117]

iii. Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

The Energy Security Strategy includes among its priority tasks:

- to achieve Strategic Goal 3 "Economic efficiency of the functioning of the energy sector, energy supply systems, and import substitution of mineral resources"
    - stimulating import substitution, in particular through the development of bioenergy, wind energy, and rational increase in energy resource extraction
- to achieve Strategic Goal 7 “Independence of the state in shaping and implementing domestic and foreign energy policy, ensuring the realization of national interests”:
    - prevention of increased dependence of Ukraine on external suppliers, ensuring a proper level of diversification of energy resources and technologies, in particular through economically justified increase in the share of renewable energy sources and local energy sources in Ukraine's energy balance; economically justified increase in the volumes of natural gas and oil extraction, as well as other types of energy resources;
    - bringing the volume of coal extraction in line with the energy needs of Ukraine based on market principles of management and competition, with a determination of the coal usage period for energy needs.

The National Economic Strategy for the period up to 2030 sets the strategic goal of "Ensuring a high level of energy security and Ukraine's integration into the European energy market" with the following indicators:

- formation and ensuring the preservation of crude oil and petroleum products reserves for at least 90 days of average daily consumption in Ukraine;
- reducing the level of import dependence (gross import of energy resources in total primary energy supply) to 33%;
- reducing the share of a single supplier in the nuclear fuel market to 60%.

In particular, the document notes high import dependence on nuclear fuel (due to the depletion of active uranium deposits and high cost of extraction, domestic production only covers one-third of the demand) and gas, high depletion level of hydrocarbon extraction wells, over 70% import dependence on petroleum products, and low level of diversification, which collectively pose a high risk of possible disruptions in energy resource supply for the economy's needs.

[116] https://zakon.rada.gov.ua/laws/show/392/2020#Text

[117] https://zakon.rada.gov.ua/laws/show/426-2022-%D0%BF#Text

Separately, in terms of the development of the extractive industry, the NES envisages the strategic goal 3 of "Meeting the needs of the national economy by creating a reliable basis for the production of high value-added products" with an indicator of ensuring 100% of the households' natural gas needs through domestic production. At the same time, the prospect of gradually lifting regulation in the gas market after the end of the martial law regime does not allow allocating resources from Ukrainian production for the needs of a specific category of consumers, such as households. The goal of reducing import dependence requires taking into account the entire demand in the economy (i.e. all categories of consumers).

Among the goals of ESU are comprehensive integration with the EU energy markets and ensuring the efficient functioning of domestic energy markets. One of the indicators of its achievement is the construction of an export-oriented energy sector, which includes:

- Production and export of electricity;
- Increase in oil and gas reserves and production;
- Export of Ukrainian gas to the EU;
- Integration of gas storage facilities into the EU network;
- Production and export of hydrogen and alternative gases;
- Production and export of equipment and components for the energy sector;
- Production of small modular reactors and various components for nuclear generation;
- Implementation of the nuclear cycle from nuclear fuel production to radioactive waste management.

iv. National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

See above and section 2.4.3. Market integration (Dimension Internal energy market).

2.4. Dimension Internal energy market

2.4.1. Electricity interconnectivity

i. The level of electricity interconnectivity that the Member State aims for in 2030 in consideration of the electricity interconnection target for 2030 of at least 15 %, with a strategy with the level from 2021 onwards defined in close cooperation with affected Member States, taking into account the 2020 interconnection target of 10 % and the following indicators of the urgency of action:

(1) Price differential in the wholesale market exceeding an indicative threshold of EUR 2/MWh between Member States, regions or bidding zones;
(2) Nominal transmission capacity of interconnectors below 30 % of peak load;
(3) Nominal transmission capacity of interconnectors below 30 % of installed renewable generation.

Each new interconnector shall be subject to a socioeconomic and environmental cost-benefit analysis and implemented only if the potential benefits outweigh the costs2.4.1. Integration of energy systems

The 2050 Energy Strategy of Ukraine (ESU2050) envisages expanding the total capacity of interconnectors between the IPS of Ukraine and the energy systems of ENTSO-E countries to 6 GW by 2032. At the same time, the total installed generating capacity in 2032 is estimated at 62.9 GW. Accordingly, the target level of integration of the IPS of Ukraine is about 9.5%

The analysis of price dynamics on the day-ahead markets (DAM) of Ukraine and EU countries (Poland, Romania, Slovakia, and Hungary) shows that during 2020-2023,[118] the difference between daily price indices Base DAM in the majority of periods (days) is higher than 2 euros/MWh (compared to Poland - in 98% of periods, Romania - 95.6%, Slovakia - 94.9%, Hungary - 95.8%). The average difference between daily indices Base DAM of Ukraine compared to the markets of Poland was 98.0 euros/MWh, Romania - 269.8 euros/MWh, Slovakia - 268.7 euros/MWh, Hungary - 285.4 euros/MWh.[119]

The high price divergence between the electricity markets of Ukraine and EU countries is not only due to insufficient interconnector capacity. To a large extent, it is also caused by the lack of integration of spot electricity markets and price regulation of the wholesale electricity market of Ukraine by the Regulator (application of price caps).[120]

After the start of full-scale military aggression by the Russian Federation against Ukraine on February 24, 2022, electricity consumption in the IPS of Ukraine significantly decreased - by approximately 30-35%. Correspondingly, the peak load values in the power system have also changed. Approximately, in 2023, the ratio of the nominal capacity of Ukraine's interconnectors to the peak load in the power system (17,445 MW) is about 11-13%. [NB: Actual data on the nominal capacity of interconnectors and peak load in the IPS of Ukraine are expected from Ukrenergo for a more accurate assessment.]

As a result of the Russian military aggression, intense hostilities, especially in areas with the highest concentration of RES in the southern and eastern regions, and systematic shelling of Ukraine's energy infrastructure, the installed generating capacity of RES facilities operating in Ukraine's power system has changed due to their damage, destruction, and/or occupation. Approximately 25-28% is the estimated ratio of Ukraine's nominal transmission capacity of interconnectors to the installed capacity of RES generation (excluding large hydro generation) in 2023. [NB: Actual data on the NOMINAL transmission capacity of interconnectors and the installed generating capacity of RES in Ukraine's power system are expected from Ukrenergo for a more accurate assessment.]

All three indicators mentioned above are inconsistent with their threshold levels and indicate the need to increase the capacity of Ukraine's interconnectors to ensure better integration of electricity markets.

2.4.2. Energy transmission infrastructure

i. Key electricity and gas transmission infrastructure projects, and, where relevant, modernisation projects, that are necessary for the achievement of objectives and targets under the five dimensions of the Energy Union Strategy

Electricity infrastructure

Ukraine is currently not participating in EU Projects of Common Interest (PCI) related to the development of electricity transmission infrastructure. The list and description of key projects in Ukraine for the development of the transmission system, particularly the construction of cross-border power lines, are included in the Transmission System Development Plan for 2023-2032, developed by the TSO and approved by the Regulator (NEURC).[121]

In order to strengthen cross-border electricity connections, Ukraine will implement the following key projects of mutual interest (PMIs):

[118] The period from January to September 2023, which was considered in the analysis of electricity prices at the NDC, includes January-September 2023.

[119] https://map.ua-energy.org/uk/resources/5bee4464-ba9f-4117-a4ca-f71584bd5f54/

[120] https://map.ua-energy.org/uk/resources/cc738a86-c28e-4a3a-86b6-bd965fd27663/

[121] https://zakon.rada.gov.ua/rada/show/v0266874-23#Text

- Restoration of the 400 kV overhead transmission line Mukachevo (Ukraine) - Velke Kapusany (Slovakia), aimed at increasing cross-border capacity to 1,000 MW. Expected capital investment - 10.5 million euros. Planned project implementation period - 2028.[122]

- Restoration and modernization of the 750 kV South Ukrainian NPP (Ukraine) - Issaccea (Romania) overhead transmission line, aimed at increasing cross-border capacity to 1,000 - 1,200 MW. Expected capital investments - 383.3 million euros. Planned project implementation period - 2026.[123]

Infrastructure for transportation and storage of natural gas

Considering that the transit of natural gas from russia and belarus through Ukraine to the EU is most likely to cease from 2025, the demand for natural gas within the country will remain, and there may also be potential for natural gas exports to the EU in 2025-2030. The following goals are envisaged regarding the infrastructure for transportation and storage of natural gas:

- ensuring sufficient connectivity for the transportation of natural gas between Ukraine and the EU/Energy Community;
- modernization (reconstruction) of gas infrastructure facilities to maintain proper technical condition, increase energy efficiency, reduce emissions of harmful substances, and optimize the operation of such facilities;
- Prospective repurposing of existing gas infrastructure facilities for new activities within the framework of decarbonization.

1) Sufficient connectivity for gas transportation between the EU/Energy Community/Ukraine.

As of December 2023, the following capacity volumes are available on international interconnections with the EU and the Energy Community:

Table 2.9: Capacity of entry/exit points on interconnections with the EU

No	Point name (VIP - virtual IP; IP - interconnection point)	Country	Entry into Ukraine, million m3/day	Exit from Ukraine, million m3/day	Notes
1	VIP Ukraine-Poland	Poland	4	12,9	The entry capacity into Ukraine is currently available as guaranteed on a daily basis and as interruptible conditionally guaranteed - on a quarterly and monthly basis
2	IP Uzhhorod/Velke Kapushany	Slovakia	0	281	
3	IP Budince	Slovakia	42	19	The entry capacity of 42

[122] https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL07.html

[123] https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL09.html

					million m3/day is available until 31.03.2024.
4	VIP Bereg	Hungary	8	48,8	The entry capacity is currently available until 31.03.2024.
5	IP Issacea 1/Orlivka 1	Romania	0	19,1	The exit capacity is available upon reservation of capacity at the entry point Kaushany. The entry capacity is currently interruptible, up to 11.5 million m3/day.
6	IP Ananyiv	Moldova	0	0	
7	IP Hrebenyky	Moldova	0	36	The entry capacity is currently interruptible, ranging up to 7 mln m3/day depending on the season.
8	IP Kaushany	Moldova	36	12	The capacity is available if the capacity is reserved at the entry and/or exit point Issacea 1/Orlivka 1 and/or the virtual exit point to the border consumers of the Republic of Moldova.
9	IP Oleksiivka	Moldova	0	7,9	
10	Virtual exit point to border consumers of the Republic of Moldova	Moldova	-	0,85	The available capacity is available in case of capacity reservation at the entry point Kaushany and/or entry point Isakcha1/Orlivka 1

Source: LLC "Gas TSO of Ukraine"

The goals for the development of existing interconnections are provided both by Ukraine's international obligations and by separate strategic documents. Thus, according to Article 5 of Annex III to Regulation (EU) 2017/1938, adapted in the Energy Community, all cross-border gas pipelines must ensure a continuous (guaranteed) bidirectional gas flow between the Contracting Parties of the Energy Community (i.e. Ukraine and Moldova). In this regard, regarding existing gas pipelines, by February 1, 2024, GTS operators must submit an application to the relevant state authorities for ensuring bidirectional flow or for

exemption from this obligation. LLC "Gas TSO of Ukraine" currently does not have the possibility to obtain the corresponding exemption or to submit an application, considering that the provisions of Regulation (EU) 2017/1938 have not yet been implemented into Ukrainian legislation, and therefore the Ministry of Energy and the National Commission for State Regulation of Energy and Public Utilities are not yet empowered to make such decisions. At the same time, according to preliminary assessments by the GTS Operator, there was a demand for capacity in the direction from Moldova to Ukraine for the IP Oleksiivka and IP Hrebenyky during the assessment of market demand for new (increased) capacity (see further). As for the IP Ananiev and the virtual exit point to border consumers of the Republic of Moldova, there is no need to create guaranteed capacity in both directions.

In addition, certain strategic documents define specific goals in this direction: for example, the National Recovery Plan for 2022 provides for an increase in gas interconnectors with European LNG terminals, ESU2050 - an increase in guaranteed capacities to ensure the transportation of natural gas with strategic partners of the EU, and NES - the creation of a hub based on Ukrainian gas storage facilities with increased throughput capacities. At the same time, these goals should be interpreted taking into account market demand, namely the latest results of capacity increase procedures conducted by LLC "Operator of the GTS of Ukraine" together with operators of neighboring GTS.

According to paragraphs 1-2 of Chapter 1 of Section XX of the GTS Code, the GTS Operator assesses the market demand for increasing capacity for points of interstate connection. The assessment of potential demand for new (increased) capacity was conducted from July 3 to August 28, 2023, inclusive (8 weeks). During the specified period, transportation service customers had the right to submit non-binding applications. As a result of the received non-binding applications from natural gas market participants, demand for capacity at the entry points to Ukraine was identified in two directions: Poland and the Trans-Balkan direction. According to the aggregated non-binding applications, the maximum demand for guaranteed capacity from Poland to Ukraine was 9 million m3/day,[124] from Romania to Ukraine - 18 million m3/day,[125] from Moldova to Ukraine - 20 million m3/day.[126]

In accordance with the EU's Capacity Allocation Network Code (CAM NC), as well as in compliance with point 3 of Chapter 2 of Section XX of the GTS Code, LLC "Operator of the GTS of Ukraine" in cooperation with GAZ-SYSTEM conducted public consultations on increasing capacity at the state border between Poland and Ukraine (consultations lasted until November 30, 2023). The draft project proposal for the new (increased) capacity between the gas transmission system of Poland and the gas transmission system of Ukraine[127] was prepared by the GTS operators based on non-binding demand requests received from market participants during the market demand assessment procedure, which was conducted from July 3 to August 28, 2023. According to the GTS Code, the next stage of the new (increased) capacity procedure on interstate connections is the coordination and publication of information on the new (increased) capacity procedure (Chapter 3 of Section XX).

In addition, in order to implement the Memorandum of Cooperation in the creation of the "Vertical Corridor", signed on January 19, 2024, LLC "Operator of the GTS of Ukraine" together with GTS operators from Romania and Moldova started public consultations on February 1, 2024 regarding the project proposal for the new (increased) capacity project along the Isaccea/Orlovka I - Kaushany - Grebeniki route.[128]

[124] https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_PL-UA_GAZ-SYSTEM_GTSOU_UKR.pdf

[125] https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_UA-RO_UKR.pdf

[126] https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_UA-MD_UKR.pdf

[127] https://tsoua.com/wp-content/uploads/2023/10/20231030_Consultation_document_INC-PL_UA_UKR.pdf

[128] https://tsoua.com/news/ogtsu-rozpochynaye-publichni-konsultacziyi-po-rozshyrennyu-reversnoyi-potuzhnosti-transbalkanskogo-truboprovodu-v-ramkah-proczedury-novoyi-zbilshenoyi-potuzhnosti-spilno-z-operatoramy-gts-rumuniyi-t/

This route requires minor additional investments, but it can provide not only the infrastructure integration of the EU and the Energy Community (Ukraine and Moldova), but also provide more opportunities through access to potent Ukrainian GTS.

2) *Modernization (reconstruction) of gas infrastructure facilities to maintain proper technical condition, increase energy efficiency and reduce emissions of harmful substances, as well as optimize the operation of such facilities.*

ESU2050 defines the strategic goal of updating and modernizing the energy infrastructure according to the best global standards, which includes optimizing the underutilized gas infrastructure and ensuring efficient operation of its remaining facilities. In this regard, it is envisaged, in particular:

- increasing the level of automation for monitoring parameters and controlling gas distribution stations;
- reducing the amount of technological gas losses;
- optimizing the number of gas distribution stations, taking into account the reduction in consumption;
- replacing gas distribution stations with new automatic block-modular ones;
- reconstruction of gas distribution stations and priority compressor stations.

In the National Recovery Plan for 2022, the overall goal is to modernize the gas transportation and distribution systems, while NES provides for the optimization of capacities and technological parameters of the GTS according to expected load scenarios, as well as developing and implementing economically viable projects to optimize and modernize the GDS according to the needs of the economy, carrying out necessary reconstruction of outdated networks, and preparing the GDSs for hydrogen transportation.

The national action plan on energy efficiency sets tasks for the IV quarter of 2021 for the Ministry of Energy and the National Commission for Energy and Utilities Regulation (NEURC) to implement energy efficiency measures to reduce losses in transmission and distribution networks for electricity and gas distribution networks through the implementation of investment programs. In addition, the Action Plan for the Implementation of Ukraine's Climate Policy within the framework of participation in the global initiative to reduce methane emissions, the Global Methane Pledge, includes a comprehensive task of reducing leaks and emissions of methane during the extraction, processing, and transportation of natural gas and oil using credit funds or funds from international partners.

3) *Prospective repurposing of existing gas infrastructure facilities for new activities within the framework of decarbonization.*

ESU2050 envisages the implementation and realization of projects aimed at carbon capture and storage (CCUS), which will allow to neutralize the residual emissions volume by 2050. In addition, ESU2050 considers the possibilities of alternative use of existing infrastructure for the transportation of biomethane, synthetic methane, and hydrogen.

In terms of hydrogen transportation preparation, from an infrastructure perspective in Ukraine until 2030 the creation of a dedicated corridor for its transportation through repurposed or new networks is envisaged. At the moment, there are no plans for blending methane gas with hydrogen in existing gas networks.

At the beginning of 2022, draft technical specifications were prepared and preliminarily agreed with the representation of the European Commission in Ukraine for conducting a comprehensive study of the possibility of using Ukraine's GTS for hydrogen transportation with an approximate budget of 3 million euros. In addition, a fundamental research project on the mechanisms of hydrogen interaction with pipeline steels, their flooding, corrosion, and destruction at micro and macro levels, taking into account the condition of existing gas pipelines and operational factors (loads, environments) is being implemented by the specialized scientific institution, the G.V. Karpenko Institute of Physics and Mechanics of the National Academy of Sciences of Ukraine (Lviv). The project was started in May 2023, and the planned completion date is June 2024. LLC "Operator of Ukraine's GTS" has joined the project by providing pipe fragments for research - those that have been in operation for 34 years and analogues from emergency stockpiles.

In addition, in November 2021, a memorandum of understanding was signed between LLC "Operator of the GTS of Ukraine", JSC "Ukrtransgaz", NJSC "Naftogaz of Ukraine", LLC "Eco-Optima" RAG Austria AG, Open Grid Europa GmbH, Gas Connect Austria GmbH, Bayerngas GmbH, Eustream a.s., Nafta a.s., Bayernets GmbH regarding the initiation of the H2EU+Store project, which involves the deployment of hydrogen production and underground storage in Ukraine, the formation of a pipeline corridor from Ukraine through Slovakia and Austria to Germany.

Infrastructure for the transportation and storage of oil

ESU2050 includes several infrastructure projects for oil. Their implementation is entrusted to JSC "Ukrtransnafta". The company's plans include both the modernization and development of the oil transportation system, including diversification of oil and petroleum product delivery routes through pipelines, in order to ensure energy security.

In the context of modernization, Ukrtransnafta JSC envisages:

- repair and reconstruction of tank farms, oil pumping stations and linear sections of oil pipelines: automation of technological processes, expansion of IT infrastructure, replacement of equipment, including taking into account energy efficiency requirements;
- monitoring and implementation of measures to reduce greenhouse gas emissions at oil pipeline facilities;
- programs for decarbonization and increasing energy efficiency of the oil pipeline system.

Two promising projects aim to diversify sources and routes of oil supply to attract additional transportation volumes, as well as in case of reduction / cessation of transit of Russian oil:

1) Project 'Brody - Adamova Zastava':

The project allows connecting the oil transportation systems of Ukraine and Poland, while the latter is connected to the oil transportation system of Germany. The project provides the possibility of oil transportation in both directions - from the Polish port of Gdansk to Ukraine, as well as from the Black Sea ports of Ukraine to Poland and Germany. According to the decision of the Ministerial Council of the

Energy Community No.D/2020/04/MC-EnC, the project is included in the list of projects of interest to the Energy Community (PECI).

A joint venture MPR "Sarmatia" sp. z o.o. has been created for the implementation of the project.[129] The participants of the joint venture are JSC "Ukrtransnafta" (28.78%), Polish operator PERN (28.78%), Azerbaijani company SOCAR (25.32%), Georgian company GOGC (16.10%), Lithuanian company AB Klaipedos Nafta (1%). Preparatory work, including marketing research and techno-economic justification, has practically been completed (necessary permits have been obtained in both countries or need to be updated, which should not create obstacles for the implementation of the project). The project is at the stage of searching for a strategic investor, with an estimated cost of 14 million euros (design) and approximately 400 million euros (construction). With the availability of funding and state support in Ukraine and Poland, the project can be implemented within 2 years.

On the Polish side, the necessary regulatory measure is the extension of the Polish Law on the Preparation and Implementation of Strategic Investments in the Oil Sector to the project.

Plans for the development of oil transportation infrastructure

Source: JSC "Ukrtransnafta"

2) *Implementation of the possibility of transporting different types of oil (except Urals) through the southern branch of the "Druzhba" oil pipeline*

Currently, only one type of oil is being transported through this route in transit from the territory of belarus. At the same time, certain measures would allow for the transportation of other types of oil from Ukrainian ports to Slovakia, Hungary, and the Czech Republic.

No additional investments are needed for the project implementation. JSC Ukrtransnafta already has experience in transporting various types of oil from the port of Odessa to the Kremenchuk oil refinery. At the same time, the project requires support from recipient countries at both the government and corporate

[129] https://sarmatia.com.pl/about-us/?lang=en

levels. It is also worth noting that the project depends on the possibility of using Ukrainian Black Sea ports for oil supply from other countries.

Infrastructure for transportation and storage of hydrogen

NES provides for the regulation of market, regulatory, and technical opportunities for the production and export of hydrogen from renewable energy sources and nuclear power plants at a guaranteed price in euros and long-term contracts. The National Recovery Plan 2022 provides for the production of 1.5 million tons of hydrogen by 2032. ESU2050 defines the task of building an export-oriented energy sector, which includes the production and export of hydrogen and alternative gases. ESU2050 also predicts the start of hydrogen production in 2032; however, according to the more recent plans of the Ministry of Energy,[130] hydrogen exports in 2035 are expected to be in the range of 0.3-0.4 million tons (i.e., theoretically, exports can start earlier, but in smaller volumes), and by 2050, exports could reach 1.5-2 million tons. According to the Memorandum between Ukraine and the EU in the field of biomethane, hydrogen, and other synthetic gases, a hydrogen corridor Ukraine-EU should be created by 2030.

Thus, there is a discrepancy between the planned date for the commissioning of hydrogen infrastructure and the plans for the start of production and export of products that need to be transported. If Ukraine plans to export hydrogen to the EU from 2030, the corresponding production plans need to be adjusted; at the same time, it is understandable that significant obstacles to investment in this sector are the conditions of armed aggression against Ukraine.

The announced plans for the construction of export-oriented hydrogen production facilities, presented by Hydrogen Ukraine LLC, relate to two locations:

- Zakarpattia, near the Ukraine-Slovakia interstate connection;
- Odesa region (included in the Global Hydrogen Valley Platform[131]), near the Trans-Balkan gas pipeline, which passes through Romania and Bulgaria.

At the same time, the optimal method of hydrogen transportation is the subject of current political and scientific discussions. Three transportation methods can be distinguished, which are related to the oil and gas infrastructure and may be relevant for Ukraine:

- transportation through dedicated (or reconstructed) pipelines;
- transportation through oil infrastructure (in the form of LOHC);
- transportation through an ammonia pipeline.

1) Transportation of hydrogen through dedicated (or reconstructed) pipelines.

The Central European Hydrogen Corridor (CEHC)[132] project is a joint initiative of the operators of the gas transmission systems of Ukraine (Operator of the Gas Transmission System of Ukraine LLC), Slovakia (Eustream a.s.), Czech Republic (NET4GAS s.r.o.), and Germany (Open Grid Europe GmbH). The project, initiated in September 2021, aims to create a pipeline corridor for the transportation of 100% hydrogen from Ukraine to Germany with a planned capacity of 144 GWh/day, mainly utilizing existing gas pipelines. The estimated length of the corridor will be approximately 1,446 km. In relation to Ukraine, this project is included in the TYNDP 2022 as project HYD-N-1137 "Central European Hydrogen Corridor (Ukr part)", implemented by the Operator of the Gas Transmission System of Ukraine LLC. By decision of the European Commission,[133] this project is included in the list of PCIs/PMIs as a generic corridor under number 10.4. Within the project, a Pre-Feasibility Study is currently being prepared, with an expected completion date of June 2024.

[130] Within the framework of Ukraine's Hydrogen Strategy for the period up to 2050.

[131] https://h2v.eu/hydrogen-valleys?populate=&field_ch_1_q_10_value=UA

[132] https://www.cehc.eu

[133] Commission Delegated Regulation (EU) amending Regulation (EU) No 2022/869 of the European Parliament and of the Council as regards the Union list of projects of common interest and projects of mutual interest, 28.11.2023, C(2023) 7930 final.

This corridor has the potential to serve exports from hydrogen production projects in Zakarpattia. There are no plans from the Ukrainian side for the development of a hydrogen corridor along the Trans-Balkan gas pipeline route (the capacity demand of this gas pipeline towards Ukraine determines its further use for natural gas transportation).[134]

2) *Transportation through oil infrastructure (in the form of LOHC).*

The use of oil transport for hydrogen transportation over certain distances is currently one of the promising directions of scientific research involving European companies. At the EU level, relevant research is often funded by public funds. For example, the following projects can be highlighted: [135]

- UNLOHCKED project "Unlocking the potential of LOHCs through the development of Key sustainable and efficient systems for Dehydrogenation" (Spain);[136]
- SHERLOHCK project "SUSTAINABLE AND COST-EFFICIENT CATALYST FOR HYDROGEN AND ENERGY STORAGE APPLICATIONS BASED ON LIQUID ORGANIC HYDROGEN CARRIERS: ECONOMIC VIABILITY FOR MARKET UPTAKE" (France);[137]
- HYSTOC project "Hydrogen supply and transportation using liquid organic hydrogen carriers" (Germany).[138]

In particular, the implementation of the latter was carried out by HYDROGENIOUS LOHC TECHNOLOGIES GMBH, which specializes in solutions for using existing oil infrastructure for hydrogen transportation.[139] PJSC "Ukrtransnafta" does not have its own experience in conducting research or measures aimed at determining the possibility of using the existing oil pipeline system for hydrogen transportation in the form of a liquid organic hydrogen compound (LOHC). At the same time, it is advisable to consider the possibility of involving PJSC "Ukrtransnafta" in the prospective direction of using existing infrastructure for hydrogen transportation.

3) *Transportation by ammonia pipeline.*

The ESU2050 also mentions the feasibility of using the ammonia pipeline "Tolyatti-Odesa", which passes through the territory of 6 regions of Ukraine (Kharkiv, Dnipropetrovsk, Zaporizhia, Kherson, Mykolaiv, and Odesa regions) and is branched to the city of Horlivka (Donetsk region), for the transportation of ammonia produced from hydrogen, connected to the city of Odesa (Odesa Port Plant). The operator of the ammonia pipeline is the State Enterprise "Ukrkhimtransamiak". Currently, the start of the ammonia pipeline is located in the active combat zone.

ii. Where applicable, main infrastructure projects envisaged other than Projects of Common Interest (PCIs)

Electricity infrastructure

The list and description of key projects in Ukraine for the development of the electricity transmission system, particularly the construction of internal trunk networks, are included in the Transmission System

[134] ACER notes the potential issues of availability of capacities for gas transportation during the reprofiling of a specific part of them for hydrogen transportation. SeeOpinion No.06/2023 of 14 July 2023 on the ENTSOG draft Ten-Year Network Development Plan 2022, para 57.

[135] João Godinho, Ric Hoefnagels , Catarina G. Braz, Ana M. Sousa, José F.O. Granjo, An economic and greenhouse gas footprint assessment of international maritime transportation of hydrogen using liquid organic hydrogen carriers, Energy, Volume 278, Part A, 2023, 127673, ISSN 0360-5442, https://doi.org/10.1016/j.energy.2023.127673.

[136] https://www.clean-hydrogen.europa.eu/projects-repository/unlohcked_en

[137] https://cordis.europa.eu/project/id/101007223

[138] https://cordis.europa.eu/project/id/779694/factsheet

[139] https://hydrogenious.net/

Development Plan for 2023-2032, developed by the TSO and approved by the Regulator (NEURC). Projects for technical modernization and development of the transmission system are primarily aimed at increasing the reliability and security of electricity supply by releasing closed capacities, removing internal system constraints, and reducing the level of technological losses during transmission.[140]

In accordance with the Transmission System Development Plan for 2023-2032, the construction of the 750/400/330 kV Lvivska substation is planned to strengthen the electrical connections with ENTSO-E. As part of the project, the construction of the 400 kV Lvivska-Zheshuv overhead line is planned in 2027 and the 400 kV Lvivska-Khelm overhead line is planned in 2029. The possibility of constructing the 400 kV Lvivska-Krosno overhead line is being considered in the future. All mentioned lines are in the pre-project stages, and their totla estimated capacity is 250 MW.

In accordance with the Transmission System Development Plan for 2022-2031, the TSO, Ukrenergo, has developed a comprehensive program for the reconstruction, modernization, and automation of substations, which provides for phased reconstruction of all transmission system substations, with the implementation of automated process control systems on them. For the first stage of the Program, substations that provide electricity supply to administrative centers and large industrial enterprises have been selected. The service life of such substations and the equipment installed on them exceeds 35 years, which is beyond the project's operating period. When selecting objects for reconstruction, the prospects for the development of distribution systems in the respective regions, their infrastructure, environmental and social risks for the population were taken into account. The schedule for the reconstruction of substations for the first stage has been developed taking into account the possibility of ensuring uninterrupted operation of the Ukrainian power system and without critically reducing the reliability of the operation of key substations of the power systems. The schedule for the automation of substations for the second phase has been developed taking into account the possibilities of equipment withdrawal and the availability of already reconstructed substations in operation. Funding is provided through credit funds from international financial institutions (EBRD, EIB, Government of Germany, and KfW).

Table 2.10. Projects within the Reconstruction, Modernization, and Automation of Substations Program of Ukrenergo (pre-war assessment)

Project Name	IFI	Substations	Completion Years
Substation Reliability Enhancement Program	EBRD	11 SS 330 kV 1 SS 750 kV	2024-2025
Modernization of the Transmission Network of "Ukrenergo"	EBRD	9 SS 330 kV 1 SS 400 kV 2 SS 750 kV	2024-2025
Improving energy efficiency in electricity transmission (reconstruction of transformer substations) - II	KfW	7 SS 330 kV 1 SS 750 kV	2025
Second electricity transmission project	IBRD	2 SS 220 kV 18 SS 330 kV 1 SS 750 kV	2022-2025
Improving the efficiency of electricity transmission	KfW	2 SS 330 kV	2022
Reconstruction of substations in the eastern part of Ukraine	KfW	2 SS 330 kV 2 SS 750 kV	2023

[140] https://zakon.rada.gov.ua/rada/show/v0266874-23#Text

Construction of 750 kV Power Line Rivne NPP - Kyiv	EBRD	1 SS 330 kV	2023

The key effects of implementing the Program for the Reconstruction, Modernization, and Automation of Substations of the TSO are as follows:

- increased reliability of the transmission system substations through the use of modern, cost-effective, highly reliable, and environmentally safe equipment, which will ensure the stable operation of substations while maintaining network stability criteria and power quality indicators.
- Replacing outdated switching equipment that uses oil and air as insulating materials with modern gas-insulated equipment will reduce electricity consumption at substations by 3-5 times.
- Replacing electromechanical relay protection devices and emergency automation with microprocessor-based ones will reduce electricity consumption for each panel (cabinet) by up to 10 times.

Overall, a reduction in electricity consumption for own needs of substations is expected at a level of about 30-35%. Also, all air switches with a voltage of 110-330 kV are planned to be replaced with gas-insulated ones. The total estimated cost of implementing the Program to improve the reliability of equipment at substations, overhead lines, and relay protection devices operated by Ukrenergo is 636.4 million UAH (at 2020 prices).

In order to modernize the telecommunications network and ensure the transmission of information at high speeds between energy facilities of the Ukrainian Power System Ukrenergo in new construction, reconstruction and technical re-equipment projects, the development of fiber-optic communication lines (FOCL) is envisaged. In order to ensure the reliable operation of the IPS of Ukraine and the criteria for operational safety of the transmission system, taking into account the challenges of information security, the TSO implements a program for the development of information technologies (through "roadmaps" with a term of implementation from 2019 to 2025) in the following directions: "IT solutions for reliable dispatching of the Ukrainian Power System", "Information security", "IT infrastructure and transmission of technological information", "Automation of business processes", "Service-oriented organization of IT processes".

Within the framework of improving the reliability of equipment operation of substations, overhead lines and relay protection devices operated by Ukrenergo, the following programs have been approved and implemented:

- Program for phased replacement of potentially dangerous current transformers of types TFRM-330, TRN-330 for the period 2021-2025 (the estimated cost of the program is 102.7 million UAH at 2020 prices);
- Program for phased replacement of defective reinforced concrete supports and lightning protection cables of NPC "Ukrenergo" for the period 2021-2025 (the estimated budget of the program is 441.8 million UAH at 2020 prices);
- Program for phased replacement of HV transmission equipment control commands and protection posts for the period 2021-2025 (the estimated budget of the program is 91.9 million UAH at 2020 prices).

Oil and gas transmission infrastructure

See above in section 2.4.2.i.

2.4.3. Market integration

The current direction of the EU energy policy, as fixed in the REPowerEU plan, includes several components that significantly affect the value of gas as an energy resource for the transition to a carbon-neutral economy by 2050. Many EU member states, particularly those with their own natural gas production and/or significant gas dependence, explicitly highlight the key role of gas in meeting energy needs in the medium-term perspective in their NECPs. This recognition is accompanied by a range of policies and measures related to natural gas and oil, namely:

- increase in domestic production, including the development of resources on the continental shelf (Romania, Italy);
- new construction, modernization, and optimization of infrastructure to increase cross-border flows, including strengthening the capacity of systems within the country (Romania, Italy, Bulgaria).

As a result, by 2030, they predict a significant share of natural gas in meeting primary energy needs (for example, in Italy - 33-38% out of 41% in 2021).

At the same time, other countries are setting a date for the end of hydrocarbon exploration and development, for example, the Netherlands - in 2040. In both cases, the direction towards decarbonization of the oil and gas sector and the understanding of the inevitability of reducing consumption are obvious, which is why the following measures are taken:

- setting specific goals, obligations, and promoting the development of biomethane and other types of gas from renewable or alternative sources in heat production and transportation (France, Italy);
- optimization of gas infrastructure for both transportation and storage (Netherlands, France);
- repurposing of gas infrastructure for transportation/storage of hydrogen or carbon dioxide (Netherlands) or implementation of research projects in this direction (Italy).

It is advisable for Ukraine to consider these approaches when shaping short- and medium-term energy policy. The presence of significant natural gas production, the largest in the EU, a wide-ranging system of transportation, storage, and distribution of natural gas provides both opportunities and creates additional obstacles on the path to decarbonization under incredibly complex conditions.

On the one hand, in the period until 2030 Ukraine has the ability to meet a significant portion of its energy needs through domestically produced gas. In addition, there may be resources for natural gas exports to the EU. On the other hand, Ukraine needs to prepare for future abandonment of natural gas in favor of gas and other forms of energy from renewable or alternative sources. Therefore, policies and measures for the development of the domestic market should apply not only to electricity, but also specifically to gas. These policies and measures should overall ensure:

- access of gas consumers to reliable and affordable energy;
- reducing the consumption of all types of energy, including gas;
- increasing the share of gas from renewable or alternative energy sources in the total volume of gas consumption;
- increasing competition in the relevant markets and providing consumers with the benefits of liberalized markets;
- creating necessary conditions and providing correct incentives and signals to natural gas market participants to prepare for operation in a decarbonized economy.

i. National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation,

mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met

Full-scale and comprehensive integration with European energy markets

ESU2050 includes a strategic goal of fully and comprehensively integrating Ukraine's energy markets with European markets through ensuring legal, technical, and economic synchronization, accompanied by expanding trading opportunities between neighboring countries, enhancing competition, and ensuring the efficient functioning of the domestic market. At the same time, the development of an export-oriented energy sector is envisaged.

The Law of Ukraine "On the Electricity Market" (Article 15) defines that regional cooperation should contribute to the harmonization of the regulatory framework and the development of electricity exchanges between countries, coordinated allocation of cross-border capacity based on non-discriminatory market decisions, regional integration of the day-ahead market (DAM), balancing mechanisms and capacity reservation.

It should be noted that such integration is based on the principles of the Treaty establishing the Energy Community and the Association Agreement with the EU, the main ones of which are:

- harmonization of Ukrainian legislation with EU energy law;
- unhindered and duty-free movement of energy resources across the borders between Ukraine and the EU;
- the presence of an independent and competent national energy regulator.

As mentioned above, full and comprehensive integration will require appropriate measures, including from the EU and its member states (particularly in the context of creating conditions for gas imports from Ukraine).

Achieving competitive prices

NES sets a target within strategic goal 3 "Ensuring the functioning of free, efficient and competitive markets" to establish free energy pricing for all categories of consumers with efficient mechanisms to support vulnerable consumers, as well as ensuring the absence of debt burden on energy market participants.

In accordance with the Law of Ukraine "On the natural gas market" (part 2, article 12), the supply of natural gas is carried out at prices freely determined between the supplier and the consumer, except in cases provided by this Law. The Law of Ukraine "On the electricity market" defines the right of traders to buy and sell electricity on the market and engage in exports-imports at free prices (article 55). Also, the electricity supply to consumers is carried out at free prices (article 56), except in cases established by this Law (article 72). Among the principles of the electricity market functioning (article 3), the Law defines non-discriminatory price and tariff formation, reflecting economically justified costs.[141]

Similarly, ESU2050 is based on the principle of market orientation, which implies that the development of the energy sector should be accompanied by competition in the markets and fair pricing.

Smart grids, aggregation, demand-side management, energy storage, distributed generation, dispatching mechanisms, redispatching and constraints, real-time price signals

According to the Concept of Implementation of Smart Grids in Ukraine until 2035, the implementation of smart metering of electricity is planned to be implemented from 2022 to 2035. As part of the eConsumer

[141] https://zakon.rada.gov.ua/laws/show/2019-19#Text

initiative and the construction of smart grids, it is planned to ensure 100% commercial metering in energy resource markets, automatic collection and transmission of consumption data (readings) for processing. As a result, consumers should be provided with the opportunity to manage electricity consumption, reduce energy costs without compromising their lifestyle and excessive restrictions on electricity consumption for household needs. Also, the possibility of aggregation activities is provided by the legislation (see section 3.4.3.iii).

In accordance with the ESU2050, as a result of the modernization of the electrical networks, it is planned to reduce power outages according to the SAIDI indicator (System Average Interruption Duration Index) to 150 minutes in urban areas and 300 minutes in rural areas.

The expected reduction in electricity losses in the networks by 2030 is at least 30%. It is also planned to reduce the electricity not supplied index by at least 3 times by 2030.[142]

One of the key principles of the NECP is the decentralization of the energy sector - all measures should be implemented with a strategic focus on the development of distributed generation and consumption control. Among the strategic initiatives and tasks until 2025, the NECP identifies the restoration of damaged energy infrastructure objects with a focus on minimizing GHG emissions through:

- development of RES, which includes a complex of measures for the construction of energy storage facilities, wind generation, and support for the development of distributed solar generation for self-consumption;
- active implementation of energy storage technologies with further expansion of their use.

Among the key tasks of transforming Ukraine's energy sector by 2032, increasing the share of electricity and heat production from RES is defined. In particular, the share of RES in the electricity mix from 2032 should exceed 25%.

According to the conclusions of the Generation Capacity Adequacy Assessment Report, in order to cover the projected demand for electricity and ensure the necessary reserve in 2022, to increase the flexibility of the energy system, maintain and restore frequency, it is necessary to build up to 0.8 GW of energy storage facilities (with a total energy capacity of 2 GWh) with technical characteristics that meet the requirements of the Transmission System Code, provided that RES are involved in balancing the energy system and providing reserves. Without involving RES in balancing or limiting the capacities of nuclear power plants during surplus periods, the need for energy storage facilities in the energy system may exceed 2 GW.[143]

ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets, including a timeframe for when the objectives are to be met

Electricity market

The Law of Ukraine "On the Electricity Market" provides for non-discriminatory participation of all market participants in the electricity market, including licensing, access to networks and congestion management, allocation of cross-border transmission capacity, contest procedures for attracting new investments in generating capacities, dispatching of the power system, procurement of balancing services, pricing and tariff formation, electricity supply, etc. At the same time, Ukraine has not set specific goals

[142] https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text

[143] https://zakon.rada.gov.ua/rada/show/v0664874-23#Text

for non-discrimination in the integration of RES, demand-side management, energy storage, and aggregation.

Natural gas market

At the state level, the goal of increasing and promoting the production of biomethane is recognized. For example, ESU2050 sets tasks for the implementation of biomethane production projects and overcoming barriers to the efficient development of such production.

In addition, according to paragraphs 4-5 of part 2 of Article 4 of the Law of Ukraine "On the natural gas market", the main tasks of the NEURC as the energy regulator include, in particular:

- application on a non-discriminatory basis of legislation on the natural gas market to biogas or other types of gas from alternative sources; promotion of safe, reliable and efficient functioning of gas infrastructure (gas transmission and distribution systems, gas storage facilities and LNG facilities), which will enable gas producers from alternative sources to enter the natural gas market regardless of production volumes;
- providing simple and non-burdensome conditions for connection to gas transmission and distribution systems for new customer facilities, ensuring simple and non-burdensome access to gas transmission and distribution systems, gas storage facilities, and LNG installations for new customers, including removing barriers that may hinder such access for new wholesale sellers or suppliers, as well as for wholesale sellers or gas suppliers from alternative sources.

The Law of Ukraine "On Alternative Fuels" provides for the basic principles of state policy in the field of alternative fuels, including promoting the development and rational use of unconventional sources and types of energy raw materials for the production (extraction) of alternative fuels in order to save fuel and energy resources and reduce Ukraine's dependence on their import.

ESU2050 also mentions the need to take measures to promote the use of biomethane as motor fuel, adoption of European standards for the use of biomethane in the transport sector, introduction of mechanisms to stimulate biomethane production, and introduction of incentives for profit reinvested in production.

iii. Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters

Electricity market

Ukraine has not set specific goals regarding the participation of consumers in the operation of the energy system, the benefits they receive from self-generation for their own needs and new technologies, including smart meters. At the same time, the ESU2050 provides all consumers with the opportunity for interactive interaction with all electricity service providers through the implementation of smart metering systems, automatic meter reading, and transmission of consumption data for processing. In addition, the legislation provides for the participation of active consumers[144] in the electricity market through self-generation mechanism (net billing) and other methods.[145]

Natural gas market

[144] Active consumer - consumer , including private household , energy cooperative and consumer , who is a customer of energy services , consuming and producing electricity , and/or engaging in energy storage and/or selling excess generated and/or stored electricity , or participating in energy efficiency and demand management activities , provided that these types of activities are not professional and/or commercial activities.

[145] https://zakon.rada.gov.ua/laws/show/2019-19#Text

Ensuring 100% gas metering

NES envisages a goal of ensuring the installation of gas meters and the establishment of a remote metering and gas balancing automation system. According to its data, more than 1 million gas consumers do not have individual metering devices, which prevents monitoring of gas consumption and does not create incentives for its efficient use. Thus, a significant number of residential consumers are not even equipped with ordinary meters (according to data from 2021, which are likely to remain relevant).

According to Article 2 of the Law of Ukraine "On Ensuring Commercial Accounting of Natural Gas" until 01.01.2023 all natural gas consumers must be equipped with meters. Taking into account the circumstances, this goal is subject to review, and the reasons for the constant non-fulfillment of obligations by operators must also be established and regulated.

Accuracy and completeness of commercial gas accounting

ESU2050 sets the task of improving the quality of gas commercial accounting.

The gas commercial metering system in general serves to determine data on the quality and quantity of gas that should be used in calculations between gas market participants. The relevant data should be generated based on metering data, but often the latter is not available: this refers to situations when the gas meter (metering point) is absent, when it is faulty, when its readings cannot be promptly transmitted to provide market participants with mutual settlements.

In general, a large number (but not all) of commercial accounting problems could be solved by providing 100% metering with the ability to remotely transmit data. However, firstly, making a decision to equip all consumers with such advanced tools and systems requires a comprehensive assessment of benefits and costs, as well as allocation of funds. Secondly, even with such a decision in place, its implementation will take a considerable amount of time. Finally, there may still be situations where metering data is not accessible.

The commercial metering system must perform several functions:[146]

- unambiguously determine whose volumes of gas were transmitted/supplied/used;
- ensure the determination of the reliable volume of transmitted/supplied/used gas;
- if at a certain time the data from the devices are not available, use replacement data formed in a transparent and justified manner, as well as take into account the data obtained from the metering devices at a specified time;
- to ensure a constant flow of data, their reliability and secure storage, including responding to significant discrepancies between actual volumes and volumes used in calculations;
- to resolve disputes regarding metering data that may arise between market participants, taking into account their conflicting interests;
- to create incentives for the development of competition in the retail gas market (in accordance with Directive 2009/73/EC, consumers must have the right to control their consumption data by transferring them to the supplier or other persons of their choice).

[146]There are problems in Ukraine in all these areas. Since 2015, a large number of legal disputes have been related to the distribution of supplied/used gas among market participants (TSO, DSOs, PSO supplier, DHCs, supplier of last resort). For the purposes of commercial balancing, data provided by consumers or determined by calculation are used, which raises many questions about the method of calculating this data; most of the data used for calculations are substitution data, not actual data. As a result of the DSO control checks, which need to be carried out at least once every 6 months, the corresponding data of the commercial metering are not adjusted; not all DSOs fulfill their obligation to regularly conduct control checks. Data on consumption is accumulated at the level of DSOs while there is a high risk of losing this data, as no government body defines requirements for preserving this data and implementing consumer rights regarding them.

iv. National objectives with regard to ensuring electricity system adequacy, as well as for the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives are to be met

Electricity market

Ensuring compliance (adequacy) of the energy system

The ESU 2050 envisages that the increase in electricity demand will be met primarily through carbon-neutral sources (RES and nuclear generation). Since WPPs and SPPs are intermittent capacity, their balancing in the system will be done through:

- flexible capacities of HPPs and PSPs;
- balancing and reserve capacities - CHP plants using combined fuel (natural gas and/or biomethane) and in the future other technologies with similar technical parameters;
- expansion of RES capacities, including long-term (seasonal) storage units using Power-to-X technology (hydrogen, ammonia, and others).

According to the forecasts of the ESU2050, the total available capacity of power plants in the IPS of Ukraine will increase to 62.9 GW by 2032 (NPP - 17.4 GW, TPP - 2.5 GW, WPP - 10.1 GW, SPP - 12.6 GW, HPP - 4.9 GW, PSPP - 4.1 GW, CHP - 1.1 GW, bioCHP - 0.3 GW, semi-peak and peak generation - 9.4 GW, energy storage - 0.5 GW). In particular, it is projected that the share of nuclear generation will be maintained at around 56% in the overall electricity mix in the IPS of Ukraine by 2050. To replace coal generation, CHPs and TPPs using combined fuel (natural gas/biomethane) or other technologies with similar characteristics will be used.

Increasing the flexibility of the system

The IPS of Ukraine does not have sufficient flexibility and will require its gradual increase to ensure proper integration of variable renewable energy power plants, such as solar and wind power plants, into the system by 2030 and beyond.

According to the conclusions of the Generation Capacity Adequacy Assessment Report, the power system does not meet the adequacy requirements for generating capacity to cover the projected electricity demand and provide the necessary reserve in 2022, and the problems with ensuring operational security will worsen with further increase in variable renewable energy power plants.

The commissioning of highly flexible power units with the ability for quick ramp-up (from zero to nominal power within 10-15 minutes) and fast-acting reserves based on energy storage systems (ESS) will provide the power system with the necessary regulation reserves to meet adequacy requirements in the future.

According to Ukrenergo's estimates, in order to increase the flexibility of the system in the near future, it is necessary to build:

- at least 1.7 GW of highly flexible capacity with fast ramp-up (full activation from a shutdown state - no more than 15 minutes, the ability to ramp up and down at least four times a day with a regulation range of at least 80% of the installed capacity). To maximize electricity production from RES and minimize its curtailments, it is crucial to build at least 2 GW of highly flexible capacity.

- 0.8 GW ESS (with a total energy capacity of 2 GWh) with technical characteristics that meet the requirements of the Transmission System Code - provided that RES are involved in system balancing and reserve provision. Without involving RES in system balancing or curtailing NPPs during surplus periods, the need for ESS in the power system may exceed 2 GW.[147]

Natural gas market

Achievement of adequate volumes of domestic production

NES envisages "ensuring 100 percent of Ukraine's population's natural gas needs through domestic production" as a target indicator for 2030. ESU2050 has two objectives - self-sufficiency on one hand, and the development of an export-oriented energy sector, with Ukrainian gas exports to the EU being a key element. In this regard, ESU2050 sets the goal of natural gas exports by 2050, stating that the forecast for domestic production by 2032 is 21.5 billion cubic meters under the base scenario and 26.8 billion cubic meters under the optimistic scenario. National Recovery Plan 2022 includes natural gas exports of 3.4 billion cubic meters by 2032 (it can be concluded that this refers to the optimistic scenario as well).

In addition, the Law of Ukraine "On Approval of the State Program for the Development of the Mineral Resource Base of Ukraine for the Period up to 2030" aims to increase oil and condensate reserves to 72.5 million tons and natural gas reserves to 287.0 billion cubic meters by 2030.

At the same time, the Energy Security Strategy includes among its priority tasks the rational increase in the extraction of energy resources within the framework of Strategic Goal 3 "Economic Efficiency of the Functioning of the Energy Sector, Energy Supply Systems, and Mineral Resource Substitution" (which can be an early reflection of the principle of "energy efficiency first").

These goals require coordination, considering significant investments needed for exploration and development of gas fields, the possibility of alternative use of funds (including uncollected revenues from tax benefits and discounts), and the principle of energy efficiency priority, as well as prospects for natural gas consumption in Ukraine and the EU.

In this regard, Ukraine needs to clearly outline the strategic priority of Ukraine's energy policy:

- Option A: increase production to maximize exports while natural gas sales are possible, or
- Option B: normalize production at the consumption level[148] with the possibility of selling small volumes for export.

Both options involve ensuring production at the level of domestic consumption; however, option A involves additional production and corresponding investments. Both options represent investments in fossil fuels, which should be compared to possible investments in more sustainable energy production and energy efficiency projects.

v. Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

NES includes the goal of establishing a marked-based price for energy carriers for all categories of consumers, with effective mechanisms to support vulnerable population groups.

[147] https://zakon.rada.gov.ua/rada/show/v0664874-23#Text

[148] In this variant, it is also necessary to determine the consumption of which specific categories should be covered by domestic production. For example, the volume of natural gas consumption directly by the population (household consumers) has long been less than the total volume of domestic production. However, in practice, comparing these indicators is not appropriate, as there are legal restrictions according to the laws of Ukraine and the EU regarding the allocation of the entire production volume for the needs of only domestic consumers.

One of the principles of the natural gas market operation according to the Law of Ukraine "On the Natural Gas Market" is to ensure a high level of protection of rights and interests of natural gas consumers, including ensuring the priority interest of gas supply security through diversification of gas sources. Articles 12-14 of the same Law define the basic rights of consumers, including minimum contractual conditions, information to be placed on payment documents, the right to change the supplier, etc. The main tasks of the Regulator include promoting the achievement of a high level of compliance with special obligations to ensure public interests in the natural gas market, protecting vulnerable consumers, and establishing a data exchange process necessary for consumers to exercise their right to change the supplier.

According to the Law of Ukraine "On the Electricity Market" (Art. 60, 61), in order to protect consumer rights, electricity market participants cannot use unfair competition methods against consumers. The provisions and conditions of contracts with consumers should be transparent and clear. The electricity supply should be non-discriminatory, and disconnection of consumers should be carried out exclusively in accordance with this Law and the rules of the retail market. Disconnection of protected consumers is carried out in compliance with the requirements for the electricity supply to protected consumers.

Vulnerable consumers have the right to legally provided support for reimbursement of expenses for consumed electricity payment by the procedure established by the Cabinet of Ministers. Currently, the Procedure for the protection of vulnerable consumers is being developed, which determines their categories; accounting procedures; monitoring and state control measures; special protection measures against disconnection; the scope of targeted assistance.[149]

Switching the electricity supplier by the consumer's initiative must be completed within a period of no more than three weeks. A shortened form of supplier switching within a period of no more than three calendar days is also provided.[150]

At the same time, according to the NEURC data, there is a significant concentration in the wholesale and retail natural gas markets. Considering the administrative price control for residential consumers, the dynamics of changing the supplier are low. The state of war and energy security challenges have a significant impact on market development.

According to the recommendations of the European Commission, the activity of energy markets should be monitored using the following parameters:[151]

- concentration index (Herfindahl-Hirschman index, HHI);
- comparison of the price dynamics in the domestic market and in developed hubs in Europe;
- change in supplier dynamics;
- tariff deficit (share of uncovered costs for regulated components of the final price).

Other specific indicators may also be used, the choice of which can be adapted to the characteristics of the domestic market. Although both the NEURC independently and within the framework of the Energy Community Regulatory Board often use relevant indicators, they are not fixed at the state level as targets.[152]

Such goals should be used instead of more vague tasks contained in legislation and strategic documents.

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[149] https://zakon.rada.gov.ua/laws/show/2019-19#Text

[150] https://zakon.rada.gov.ua/laws/show/v0312874-18#Text

[151] COM(2019) 285 final, 18.06.2019, p.22; SWD(2015) 243 final, 18.11.2015, pp.32-43.

[152] European Gas Target Model (for wholesale market); 2017 Handbook for National Energy Regulators: How to assess retail market functioning, Ref: C16-SC-52-03, 24.01.2017 (for retail market).

2.4.4. Energy poverty

Where applicable, national objectives with regard to energy poverty, including a timeframe for when the objectives are to be met

Reducing energy poverty, protecting vulnerable consumers, gender and social inclusion are strategic goals of the ESU2050. It is expected that the transformation of the energy sector will significantly reduce the level of energy poverty in Ukraine and achieve and maintain the average European indicator of 7.9%.

ESU2050 defines energy poverty as a situation where the cost of energy consumed by a household consumer constitutes a large portion of their income, leading to the inability to pay for the cost of consumed energy and/or reduce its consumption, which in turn negatively affects the quality of life. At the legislative level, there is currently no similar definition, as well as quantitative and qualitative indicators that provide grounds for classifying them as energy poor.

2.5. Dimension Research, Innovation and Competitiveness

i. National objectives and funding targets for public and, where available, private research and innovation relating to the Energy Union, including, where appropriate, a timeframe for when the objectives are to be met

According to experts from the International Energy Agency, "accelerating the innovation process is crucial for achieving zero emissions by 2050, and policies in this direction will play a decisive role. Almost half of the emissions reductions needed to achieve zero emissions by 2050 will be achieved through technologies that are still in the demonstration phase today. This is particularly relevant for sectors that stubbornly remain dependent on fossil fuels, such as intercity transport and heavy industry. The goal of achieving zero emissions by 2050 will be unattainable without significant innovative efforts to improve and commercialize known technologies in this decade, as well as the rapid market entry of less mature ideas to minimize the costs of the energy transition.[153]

The key relevant national documents that define priorities in the direction of research, innovation and competitiveness are:

- National Economic Strategy for the period up to 2030[154]
- Strategy for Innovative Activity Development until 2030[155]
- Energy Strategy of Ukraine until 2050
- Concept of "smart grids" implementation in Ukraine until 2035[156]

It should be noted that there is another government document that defines innovations in the field of energy and climate change - the Low Emission Development Strategy. However, since this document has not completed all stages of approval since its development in 2021, the priorities mentioned in it will be included in the next National Energy and Climate Plan of Ukraine.

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[153] Tracking Clean Energy Innovation in the Business Sector: an Overview https://www.iea.org/reports/tracking-clean-energy-innovation-in-the-business-sector-an-overview/executive-summary

[154] "On amendments to the National Economic Strategy for the period until 2030" https:// zakon . rada .gov. ua /go/202-2021-%D0%BF

[155] Strategy for the development of innovative activities for the period until 2030 https://zakon.rada.gov.ua/laws/show/526-2019-%D1%80#Text

[156] Concept of implementing smart grids in Ukraine until 2035. (2023, October 30). Verkhovna Rada of Ukraine.. Retrieved December 25, 2023, from https://zakon.rada.gov.ua/laws/show/908-2022

The National Economic Strategy, which was approved in 2021, includes a number of goals (in terms of the Strategy - "expected result of implementation") to be achieved:

- It is necessary to use innovative technologies or approaches
- State support for innovation development is needed
- Requires state support in one form or another

Among the expected results of implementation, the following have a direct relation to innovation and competitiveness:

determining and social support for the state's strategic course in the economic sphere, consistent implementation of which will enable:

- **to create competitive conditions for business and investment and restore confidence in the state;**
- **to become competitive in the international market;**
- to stimulate the development of innovation and modernization of economic sectors to ensure their competitiveness in the international market;
- **ensure the development of human potential and win the competition for talent;**
- **ensure equal rights and opportunities for women and men in all spheres of society.**

The National Economic Strategy defines the following guidelines, principles, and values in economic policy:

- decarbonization of the economy (increasing energy efficiency, development of renewable energy sources, development of circular economy, and synchronization with the European Green Deal initiative);
- […]
- development of entrepreneurship, innovation, and talents;

The strategy also defines a number of unacceptable steps ("red lines"), including:

[…]

- monopolization of competitive markets;
- unfair use of economic incentives;
- deviation from the reform of underdeveloped markets;

[…]

- deterioration of the environment.

In line with the strategic goal of "Ensuring mutually beneficial trade with countries around the world and achieving expanded access to foreign markets," the National Economic Strategy defines tasks, including:

- formation of an individual approach to the application of the Carbon Border Adjustment Measure (CBAM) to Ukraine as a country that has undertaken commitments regarding political association and economic integration with the EU within the Association Agreement between Ukraine and the EU
- coordination with all stakeholders of the parameters for reviewing Annexes XXX and XXXI to the Association Agreement between Ukraine and the EU (environment and climate protection)

Also, Ukraine's National Economic Strategy (NES) for the period up to 2030[157] envisages a wide range of indicative measures for various sectors of the economy that will require the implementation of research and innovation projects to support the competitiveness of the Ukrainian economy. In particular, the vision for the ICT direction in the NES states "Ukraine - [...] a European center for scientific research and design work".

The strategic goal of NES is to create new production capacities through stimulating innovative activities of enterprises in all regions of the country, utilizing their competitive advantages. Among the list of challenges, it mentions the following points:

- high cost and duration of connecting production capacities to the power grid (the cost of connection to the electricity grid in Ukraine is several times higher than in EU countries);
- low level of funding for research (investment in low-tech production and low costs for research);
- lack of close cooperation between scientific institutions and industrial enterprises (disconnect between Ukrainian science and real needs of industry and lack of effective collaboration between science and industry);

The National Economic Strategy also focuses on the high energy intensity of Ukraine's GDP, but does not propose specific indicators and targets for reducing the energy intensity of the economy:

> High energy intensity and low productivity lead to a decrease in the competitiveness of the Ukrainian processing industry. In 2017, Ukraine's GDP per unit of primary energy supply amounted to $5,054, which is close in value to countries in Eastern Europe, the Caucasus, and Central Asia. Although Ukraine experiences annual growth in GDP per unit of primary energy supply (on average by $100-200). Poland generates $10,620 (twice as much) per 1,000 tons of oil equivalent, while the average indicator in EU countries is 2.53 times higher ($12,802) than in Ukraine. tonnes of oil equivalent, while the average indicator in EU countries is 2.53 times higher ($12,802) than in Ukraine.,

The National Economic Strategy assigns a significant role to the energy sector, in particular, it identifies significant ways in terms of research, innovation, and competitiveness to achieve the strategic goal of ensuring the functioning of a smart, modernized, and reliable energy system that fully satisfies the requirements and needs of end consumers:

Ways to achieve the strategic goal	Tasks
1. Modernization and optimization of capacity operation	[…] ● Regulation of the operation of distributed generation aggregators and balancing service providers ● […] ● Ensuring the increase of energy storage capacity - battery energy storage system ● Exploring the possibility of hydrogen production using excess electricity in the system for further hydrogen export to the EU ● Regulation of the operation of localized generation from renewable energy sources, which is directly connected to consumer networks without

[157] "On amendments to the National Economic Strategy for the period until 2030" https:// zakon . rada .gov. ua /go/202-2021-%D0%BF

Ways to achieve the strategic goal	Tasks
	payment for distribution and transmission of electricity […]
2. Promotion of infrastructure development	• Support for reconstruction and construction of distribution networks in accordance with the development of distributed electricity generation • Formation and implementation of economically viable projects for the optimization and modernization of gas distribution networks in accordance with the needs of the economy, reconstruction of necessary outdated networks, and preparation of gas distribution networks for hydrogen transportation • […] • Release of closed capacities as a result of the implementation of the power grid development program and the implementation of projects aimed at removing internal constraints • Providing a clear definition of the purpose and boundaries of the use of a small distribution system • […] • Consideration of the issue of infrastructure development to ensure Ukraine's integration into the hydrogen economy • […] • Support for the reconstruction and development of distribution networks in accordance with the development of distributed power generation

Within the framework of the ways to achieve the strategic goal of "Increasing energy efficiency of the economy and ensuring the environmental friendliness of the energy sector," the following tasks are envisaged:

Ensuring sustainable development	• Stimulating scientific organizations to research energy efficiency and hydrogen technologies • Regulating market, regulatory, and technical capabilities of hydrogen production and export from renewable energy sources and nuclear power plants with guaranteed prices in euros and long-term contracts

The National Economic Strategy sets the strategic goal of "Enhancing the competitiveness of industrial products produced in Ukraine, implementing resource and energy-efficient technologies". One of the ways to achieve this strategic goal is to increase resource efficiency, with the following tasks:

Increasing resource efficiency	• increasing awareness of the implementation of resource-efficient technologies • implementation of effective regulation in the field of resource conservation and renewable energy use • attracting grants and loans for resource-saving and energy-saving technologies • ensuring access to high-quality energy audits • ensuring the implementation of energy management systems • development of sustainable public procurement by increasing market participants' awareness and providing methodological support for the

	application of sustainability criteria • implementation of a tax incentive system for energy modernization • implementation of a greenhouse gas emissions trading system and other instruments for setting the price of greenhouse gas emissions • Introduction of the best available technologies and management methods

The above-mentioned strategic goal also includes stimulating the development of a circular economy with corresponding tasks:

Stimulating the development of a circular economy	• Creating transparent and competitive markets for secondary raw materials by improving and harmonizing Ukrainian legislation with relevant EU laws and regulations • stimulating the reduction of waste generation volumes • simplifying the procedure for metal scrap operations • formation of a circular economy policy • implementation of an extended producer responsibility system • implementation of a set of measures for the commercial development of industrial waste

Another relevant strategic goal for the NECP within the National Economic Strategy is goal 4 "Creating new production capacities through stimulating innovative activities of enterprises in all regions of the country, utilizing the competitive advantages of each of them", which relates to the ways of implementing innovative technologies with the following tasks:

Implementation of innovative technologies	• Creation of a platform for exchanging experience in the implementation of innovative technologies • Improvement of the mechanism for commercializing scientific and technical developments, research works • Reducing the risk of implementing innovative projects through insurance tools for such projects • Creating favorable conditions for the development of clusters • formation of relationships and strengthening cooperation between higher education institutions, research centers, and industry • integration of industrial clusters of Ukraine with the European platform for cluster cooperation • creation of scientific and technical clusters involving core enterprises • implementation of the best available techniques according to EU Best Available Techniques reference documents

Also, within the framework of goal 4, significant attention is given to Industry 4.0 and related research and innovation projects:

Implementation of Industry 4.0	• popularization of the concept of "Industry 4.0" and its individual elements as a mandatory factor in increasing the competitiveness of industrial enterprises in international markets • institutionalization of Industry 4.0 - synchronization of strategy • involvement of industrial companies in the implementation of the concept of "Industry 4.0" through the funds of the EU, in particular, under the

	Horizon Europe framework program of the European Union for research and innovation (2021-2027) ("Horizon Europe") • support for educational events on transferring advanced experience from the IT sector to industrial sectors • ensuring the integration of innovations in the field of Industry 4.0 in the strategy of the defense complex and national security • formation of new competencies of personnel in the industry for the implementation of digital technologies • full-scale digitalization of key industrial sectors • ensuring clustering in the field of Industry 4.0 at the national and regional levels

The strategic course of policy in the development of the agro-industrial sector, defined in the NES, provides several ways to achieve the strategic goal of "Ensuring a stimulating and advisory agricultural policy", which are relevant to the issues of the NECP:

State policy in the agro-industrial sector regarding environmental protection and natural resource management in agriculture	• approximation of national legislation, standards and practices to the general European principles of sustainable agriculture policy and proper agricultural practices, gradual alignment of state agricultural policy with the EU Green Deal in agriculture • development and monitoring of indicators of the impact of agricultural activities on the state of ecosystems • development, promotion of implementation and introduction of monitoring of compliance with minimum environmental standards • implementation of a national report on greenhouse gas emissions during the production and circulation of agricultural crops • implementation of economic incentives for measures related to land use and conservation, soil fertility improvement, reduction of water pollution and other environmental components from agricultural sources, improvement of land and land use structure, restoration of anthropogenically altered ecosystems, implementation of sustainable land use and achievement of a neutral level of land degradation

Increasing the technological capabilities for monitoring the quality of land resources	• conducting systematic monitoring of soil fertility indicators and their quality, implementing satellite monitoring • reforming the system of state scientific research institutions, improving the quality and efficiency of scientific support for the agro-industrial complex, expanding the conduct of relevant scientific research for agricultural producers, strengthening the innovation potential, deepening the integration of domestic scientific institutions into the international scientific research community • ensuring the adjustment of crop cultivation technologies taking into account the results of navigation with the global positioning system and agricultural machinery

The strategic goal of the NES "Balancing the production of high- and low-margin products to increase profitability [of the agricultural] sector" includes:

Ensuring the	• encouraging sustainable agricultural production, protecting the

development of sustainable production	environment and animals, promoting the use of organic production methods and biotechnology, "climate-smart" agriculture and forestry with a reduction in greenhouse gas emissions and adaptation to climate change, sustainable management of natural resources and conservation and enhancement of biodiversity

The Strategy for Innovative Activity Development until 2030 does not highlight low-carbon sectors and technologies as one of the priority directions, but refers to the Low Emission Development Strategy until 2050 as one of the approximately 40 strategic sectoral documents related to innovation development in various fields[158]. At the same time, attention should be paid to the status of this document, which is supported and approved by the protocol decision of the Cabinet of Ministers of Ukraine on July 18, 2018[159], and published on the UNFCCC website[160], but it is not available in the databases of official documents of Ukrainian government bodies. There is also a resolution of the Verkhovna Rada (Parliament) dated November 5, 2021, No. 1870-IX[161], which, inter alia, instructs the Cabinet of Ministers of Ukraine to develop and submit to the Verkhovna Rada of Ukraine a draft Law of Ukraine on the Low Emission Development Strategy of Ukraine until 2050.

Among the program measures aimed at solving the problems of the innovation sphere in Ukraine, the Strategy for the Development of the Innovation Sphere calls for a review of the priority directions of science and technology development in order to bring them closer to the directions defined in developed countries based on current global technological trends.

Considering the extremely high priority of research in the climate and low-carbon technology sphere in most highly developed countries, this affirms the trend towards the development of low-carbon technologies in the Ukrainian scientific and innovation sphere.

The Strategy for Innovative Activity Development also includes the creation of exchange schools for sharing experience and national resources in entrepreneurship and innovation, with the involvement of world experts, trainers, mentors, and the European Enterprise Network (EEN), as well as qualification enhancement networks for both teachers and managers of higher education institutions and research institutions.

One of the most transformative factors for the entire Ukrainian economy and for the low-carbon technology sector in particular, the Strategy for Innovative Activity Development calls for the implementation of European technical standards in Ukraine as provided for in the Association Agreement between Ukraine and the EU.

Among the indicators of the implementation of the Strategy for Innovative Activity Development are the following (base year - 2017):

- **The share of expenses for the implementation of scientific and scientific-technical works in gross domestic product is 3% (in 2017 - 0.45%);**
- The share of innovative enterprises in the total number of enterprises is not less than 30% (in 2017 - 16.2%);

[158] Approval of the Strategy for the development of innovative activities for the period until 2030 https://zakon.rada.gov.ua/go/526-2019-%D1%80.

[159] https://mepr.gov.ua/diyalnist/napryamky/zmina-klimatu/pom-yakshennya-zminy-klimatu/strategiya-nyzkovugletsevogo-rozvytku-ukrayiny-do-2050-roku/

[160] https://unfccc.int/sites/default/files/resource/Ukraine_LEDS_en.pdf

[161] https://zakon.rada.gov.ua/laws/show/1870-IX#Text

- **The share of exports of goods produced by high-tech and medium-tech industrial enterprises in the total volume of goods exports is 30% (in 2017 - 15.4%);**
- The share of employees working in enterprises belonging to the high- and medium-tech sectors of industry, out of the total number of employees in the industry, is 29% (in 2017 - 21.3%);
- The share of realized innovative products in the total volume of industrial products sold is 10% (in 2017 - 0.7%).

Action plan for 2021-2023 for the implementation of the Strategy for the development of innovative activities until 2030, approved by the Cabinet of Ministers on December 9, 2021. No. 1687-r, includes several important steps for low-carbon technologies sector:

Promoting the development of the Industry 4.0 centers network (Ministry of Economy, Ministry of Education and Science, Ministry of Regional Development, Ministry of Digital Transformation, Ministry of Strategic Industries, industry and business associations (with consent)

Expected result:

- Expanded competencies and capabilities of Industry 4.0 centers, cooperation of such centers with the network of Digital Innovation Hubs (DIHs)

Development of a network of technology and innovation support centers with the assistance of the World Intellectual Property Organization (Ministry of Economy, Ministry of Education and Science, Ukrpatent (with consent))

Expected result:

- technology and innovation support centers have been established in all regions
- innovation actors have access to a patent database and receive basic consulting services

providing financial support to higher education institutions and research institutions for innovation activities (Ministry of Education and Science)

Expected result:

- higher education institutions and research institutions receive financial support for innovation activities based on the results of competitive selection of scientific, scientific and technical works and projects funded by the European Union's external assistance instrument for the implementation of Ukraine's obligations under the European Union Framework Programme for Research and Innovation "Horizon 2020"

Ensuring the conduct of information campaigns on the possibility of participating in domestic competitions and international innovative programs, on success stories of innovative activities (Ministry of Education and Science, Ministry of Digital Transformation, Ministry of Economy, Ministry of Regional Development)

Expected result:

- Increased awareness level of innovators regarding opportunities to participate in domestic competitions and international programs, on success stories of innovative activities
- Information days were held for innovators to inform them about the opportunity to participate in the Horizon Europe program to support innovation.

- Information days were held for innovators to inform them about the opportunity to participate in the EUREKA program.

The energy strategy of Ukraine for the period up to 2050 includes the strategic goal of achieving a target indicator of "Reducing energy intensity of GDP by 50 percent through the implementation of an effective energy resource utilization policy".

In assumptions regarding the energy intensity of individual sectors of the NES, the indicators listed below are taken into account:

- Extractive industry: a 21% reduction in energy intensity by 2032 compared to 2023.
- Processing industry: the main changes will affect the metallurgy sector (a 51% reduction in energy intensity by 2050) and the engineering sector (a 50% reduction), with gas consumption decreasing due to hydrogen substitution.
- Service sector: transitioning to the use of RES, natural gas, and electricity will reduce energy intensity by 22% by 2032 and by half by 2050 (compared to 2023).

The Concept of "smart grids" implementation in Ukraine until 2035, which was approved by the Cabinet of Ministers' order on October 14, 2022, No. 908-r, is a document that establishes the state's obligations in the field of implementing "smart grids". Despite the fact that the word "innovation" is used only once in this document, the entire Concept is dedicated to the implementation of a set of technologies that are innovative in nature. An important feature of this document is that it pays significant attention to:

- work on changing legislation to facilitate the implementation of smart grid technologies;
- coordination between various government bodies (Ministry of Energy, Ministry of Digital Transformation, Ministry of Economy, Ministry of Education, Ministry of Justice, National Commission for State Regulation of Energy and Public Utilities, State Special Communications Service) to improve the regulatory framework that will promote the implementation of smart grids;
- involvement of private and public stakeholders in organizational activities aimed at promoting smart grids in Ukraine

The purpose of the Concept is to "determine the directions and tasks, as well as ensure coordination of actions for the implementation of "smart grids" taking into account existing and planned state and regional development and modernization programs of the energy sector measures".

The Concept notes that the implementation of "smart grids" requires significant funding, however, the Concept states that the funding of measures provided for in the document should be carried out through:

- inclusion of measures for the implementation of "smart grids" in the investment programs of regulated companies (distribution system operators, transmission system operators, electricity producers; other sources not prohibited by law);
- attracting funds from donors and international financial institutions

An appendix to the Concept is the "Action Plan for the Implementation of the Concept of Smart Grids in Ukraine until 2035", which provides for the sequential implementation of 33 specific interconnected measures during 2022-2035. The measures include both regulatory, organizational, and technical measures, the time of their implementation is indicated, and the responsible government bodies are determined, the expected results of the implementation of the measures are specified.

ii. Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives, including long-term targets (2050) for deployment of low-carbon

technologies, including for decarbonising energy and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

See above in section 2.5.i., particularly in terms of specific indicators of Ukraine's Energy Strategy for the period up to 2050.

iii. Where applicable, national objectives with regard to competitiveness

See above in section 2.5.i.

3. POLICIES AND MEASURES

3.1. Dimension Decarbonisation

3.1.1. GHG emissions and removals

i. Policies and measures to achieve the target set under Regulation (EU) 2018/842 as referred in point 2.1.1 and policies and measures to comply with Regulation (EU) 2018/841, covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a low emission economy and achieving a balance between emissions and removals in accordance with the Paris Agreement

PM_D_WEM_01 Carbon tax

Goal: Stimulating the reduction of carbon dioxide emissions and generating revenue for the budget.

Legal basis: Tax Code, Budget Code

Responsible authorities: Ministry of Environmental Protection and Natural Resources, Ministry of Finance, State Tax Service, State Agency for Energy Efficiency and Energy Saving

[162]Description: The carbon dioxide tax in Ukraine was introduced in 2010 with the approval of the new Tax Code of Ukraine. Initially, the tax rate was only 0.2 hryvnias per ton of emissions and gradually increased until 2018. In 2019, the tax rate was increased by more than 24 times - from 0.41 UAH/t to 10 UAH/t, and in 2022 - another 3 times. As of 2023, the tax rate is 30 UAH/t. It is expected that the tax rate will continue to increase, but detailed plans for the reform of the environmental tax (including the carbon dioxide tax) are still being developed.

The carbon dioxide emissions tax is an environmental tax levied on emissions of carbon dioxide into the atmosphere by stationary sources of pollution. Entities that emit less than 500 tons of CO2 per year are not subject to the tax. In case of exceeding this limit, entities are required to register as taxpayers in the tax (reporting) period, prepare and submit tax reports, calculate and pay taxes for the tax (reporting) period. For entities whose annual emissions exceed 500 tons, the tax base is reduced by the amount of such emissions up to 500 tons per year based on the results of the tax (reporting) year.

The Tax Code provides that at least 70% of the tax revenues from CO2 emissions should be directed towards measures that lead to a reduction in carbon dioxide emissions (decarbonization) in sectors classified under Section C "Processing Industry" and Section D "Supply of Electricity, Gas, Steam, and Conditioned Air" of the National Classifier of Ukraine "Classification of Types of Economic Activity", in accordance with the procedure established by the Budget Code of Ukraine. At the same time, the Budget Code provides for the establishment of the State Fund for Decarbonization and Energy Efficiency Transformation from January 1, 2024, and the revenues from the CO2 emissions tax will be one of its sources of funding (see section 3.2, PM_EE_WEM_2 for more details).

Results: With the increase in the tax rate, tax revenues to the state budget gradually increased. For example, in 2021, the tax brought in 1.2 billion UAH to the state budget[163]. Although the tax rate was tripled from 2022, tax revenues only increased by 25% to 1.5 billion UAH, which is due to a significant decline in industrial production due to the full-scale invasion of the Russian Federation.

[162] https://zakon.rada.gov.ua/laws/show/2755-17/ed20230903#Text

[163] https://openbudget.gov.ua/national-budget/incomes

PM_D_WAM_01 Carbon dioxide emissions tax reform

Goal: Increase budget revenue from the carbon tax.

Legal basis: Tax Code, National Revenue Strategy until 2030

Responsible authorities: Ministry of Environmental Protection and Natural Resources, Ministry of Finance, Ministry of Energy, State Tax Service

[164]Description: The Ministry of Environmental Protection and Natural Resources, together with the Ministry of Finance, is developing a reform of the carbon dioxide emissions tax. In particular, the National Revenue Strategy until 2030, approved by the government at the end of December 2023, provides for the development of a model for transitioning from taxing actual carbon dioxide emissions to taxing the extraction (import) of fossil fuels (oil, gas, coal, etc.) based on their carbon dioxide content. It also sets a schedule for implementing changes to environmental and tax legislation. Other characteristics of this instrument (described above) remain unchanged.

Results: It is expected that the implementation of the reform will increase budget revenues.

PM_D_WAM_02 National plan for reducing emissions from large combustion plants

Objective: Gradual reduction of emissions of sulfur dioxide, nitrogen oxides, and substances in the form of suspended particulate matter, undifferentiated by composition, from existing large combustion plants with a nominal thermal capacity of 50 MW and above, and the first permit for emissions or permit for the design of the installation was issued before July 01, 1992; ensuring compliance with Directive 2010/75/EU on industrial emissions.

Legal basis: Cabinet of Ministers Order No. 796-r "On the National Plan for Emission Reduction from Large Combustion Plants" dated November 8, 2017.

Responsible authorities: Ministry of Energy

[165]Description: The government approved the National Plan for Emission Reduction from Large Combustion Plants (hereinafter referred to as NERP) on November 8, 2017, in order to fulfill Ukraine's obligations under the Energy Community Treaty regarding the limitation of pollutant emissions. The Ministry of Energy has been designated as the coordinator for the implementation of the mentioned National Plan.

Although the NERP is directly aimed at reducing air pollution rather than reducing GHG emissions, the implementation of the NERP will indirectly contribute to the reduction of GHG emissions through the reduction of operation of thermal generation facilities. Appendix 4 of the NERP provides a list of installations that are required to be closed after reaching a specified limit of operating hours. Additionally, all other installations listed in Appendix 2 of the National Plan that have not been environmentally

[164] https://www.mof.gov.ua/storage/files/National%20Revenue%20Strategy_2030_.pdf

[165] https://zakon.rada.gov.ua/laws/show/796-2017-%D1%80#Text

upgraded in accordance with the requirements of Directive 2010/75/EU on industrial emissions must be decommissioned.

The draft action plan for the implementation of the NDC provides for the development of a regulatory act on the determination of the procedure and sources of financing for environmetnal measures provided by the NERP, as well as the approval of schedules for the reconstruction and closure of power units (with the possibility of revision depending on the consequences of the war).

Results: It is expected that the implementation of the NERP will significantly reduce emissions from large combustion installations.

PM_D_WAM_03 National Emissions Trading System

Objective: Stimulating greenhouse gas emissions reduction.

Legal basis: Law of Ukraine "On the Principles of Monitoring, Reporting and Verification of Greenhouse Gas Emissions", project of the Action Plan for the Implementation of Ukraine's Updated Nationally Determined Contribution to the Paris Agreement for the period up to 2030.

Responsible authorities: Ministry of Environmental Protection and Natural Resources

Description: Ukraine has committed to implementing Directive No. 2003/87/EC on the establishment of a greenhouse gas emissions trading scheme when it signed and ratified the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their Member States, on the other hand, in 2014. The first step towards creating a national greenhouse gas emissions trading system (hereinafter referred to as ETS) was the adoption of the Law "On the Principles of Monitoring, Reporting and Verification of Greenhouse Gas Emissions" (hereinafter referred to as MRV) in 2019 and the subordinate acts that allowed the full launch of the MRV system in 2021. Prior to the full-scale invasion by Russia, there were over a thousand installations that were supposed to be covered by the MRV. According to preliminary estimates by the Ministry of Environmental Protection, the number of such installations has decreased by 40% due to the destruction of industrial facilities in Donbas and other regions of Ukraine by Russian aggressors. However, the registration of installations in the MRV system continues even during the full-scale war.[166]

The draft action plan for the implementation of the NDC provides for the development of the draft Law of Ukraine "On the Emissions Trading System" and the necessary regulatory acts for the implementation of the domestic emissions trading scheme in Ukraine to be carried out during 2023-2024. The Ministry of Environment expects that the ETS will be launched in 2025, albeit in a test mode.

Results: It is expected that the implementation of the ETS will reduce greenhouse gas emissions from covered installations.

PM_D_WAM_04 Action Plan for the Implementation of Ukraine's Climate Policy within the Global Methane Pledge

[166] https://zakon.rada.gov.ua/laws/show/377-20#Text

Objective: Stimulating the reduction of methane emissions.

Legal basis: Cabinet of Ministers Order No. 607-r "On approval of the action plan for the implementation of Ukraine's climate policy within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge"

Responsible authorities: Ministry of Environmental Protection and Natural Resources, Ministry of Energy

[167]Description: In order to fulfill Ukraine's commitments within the framework of the global initiative to reduce methane emissions, the government has developed and approved the Action Plan on July 7, 2023. The plan includes the implementation of 23 measures by 2030 in the sectors of natural gas and oil extraction, processing and transportation, coal mining, waste management, and agriculture. As an example, several of the most significant measures in the oil and gas sector are presented in Table 3.1 below.

Table 3.1. Selected measures to reduce methane emissions in the oil and gas sector

Name of measure	Responsible for implementation	Implementation period, years	Sources of funding
Conducting comprehensive monitoring of methane emissions during the extraction, processing, and transportation of natural gas and oil	Ministry of Energy Ministry of Environment NJSC "Naftogaz of Ukraine" (with consent) LLC "Operator of the GTS of Ukraine" (with consent)	2023-2024	loans from international financial organizations; other sources of financing not prohibited by law
Introduction of effective accounting of methane emissions at energy sector enterprises in accordance with the OGMP 2.0 initiative	Ministry of Energy Ministry of Environment NJSC "Naftogaz of Ukraine" (with consent) LLC "Operator of the GTS of Ukraine" (with consent)	2023-2030	loans from international financial organizations; other sources of financing not prohibited by law
Development and approval of a sectoral action plan to reduce methane emissions and inclusion of such measures in investment programs of state-owned enterprises in the oil and gas sector	Ministry of Energy Ministry of Environment NJSC "Naftogaz of Ukraine" (with consent) LLC "Operator of the GTS of Ukraine" (with consent)	2023-2030	loans from international financial organizations, including within the framework of financing post-war recovery and development of Ukraine; other sources of financing not prohibited by law

[167] https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text

Development and approval of requirements for the gas transmission system operator and gas distribution system operators regarding regular practices for detecting and eliminating leaks from gas networks (LDAR)	Ministry of Energy, NEURC (with consent) LLC "Operator of the GTS of Ukraine" (with consent) NJSC "Naftogaz of Ukraine" (with consent)	2023	loans from international financial organizations; other sources of financing not prohibited by law

Results: It is expected that the implementation of the plan will reduce methane emissions by 30% by 2030 compared to the emission level in 2020.

Policies and measures to reduce GHG emissions in the transport sector

To stimulate the reduction of GHG emissions in the transport sector, a number of measures are planned for the development of renewable energy use in the transport sector (PM_D_WEM_05, PM_D_WEM_06), electrification (PM_D_WEM_07, PM_D_WEM_08), and the transition of municipal transport to low-carbon alternatives (PM_D_WEM_09).

The list of policies and measures may be updated after the publication of the draft new transport strategy and action plan for it.

Policies and measures for reducing GHG emissions in agriculture

To stimulate the reduction of GHG emissions in the agricultural sector, a number of policies and measures are planned to be implemented, including:

PM_D_WAM_05 Promoting Minimal Tillage Technologies

PM_D_WAM_06 Promoting Organic Farming Development

PM_D_WAM_07 Use of nitrogen fertilizers with slow or controlled release of nutrients

PM_D_WAM_08 Use of information and communication technologies in crop production

PM_D_WAM_09 Use of food additives that contribute to the reduction of GHG emissions from enteric fermentation of livestock

[A detailed description of the proposed policies is planned for the next stages of work on the NECP]

Policies and measures to reduce GHG emissions in the LULUCF sector

In the forestry sector, the draft action plan on NDC implementation includes planning measures for the restoration of forests damaged and destroyed as a result of the armed aggression of the Russian

Federation, conducting afforestation work to increase forest area by 1 million hectares by 2030, and the use of nature-based forestry methods, among others.

[A detailed description of the proposed policies is planned for the next stages of work on the NECP]

Policies and measures to reduce GHG emissions in the waste sector

To incentivize the reduction of GHG emissions in the waste sector, the implementation of a range of policies and measures provided for by current legislation (the Law on Waste Management, the draft National Waste Management Plan until 2033, and the draft Action Plan of the National Waste Management Plan until 2033) is planned to be approved in 2024. In particular, the following policies and measures are being considered.[168][169]

PM_D_WAM_10 Promotion of the practice of reusing components of MSW

PM_D_WAM_11 Scaling up the practice of recycling MSW

PM_D_WAM_12 Scaling up the practice of composting organic components of MSW

PM_D_WAM_13 Scaling up the practice of thermal treatment of MSW (with energy recovery)

PM_D_WAM_14 Increasing the volume of utilization (recovery and flaring) of landfill gas at MSW landfills

PM_D_WAM_15 Implementation of methane utilization (recovery and flaring) practices in wastewater management facilities

[A detailed description of the proposed policies is planned for the next stages of work on the NECP]

ii. Where relevant, regional cooperation in this area

The project of the action plan for the implementation of NDC provides for the development of procedures for consideration, approval and implementation of projects aimed at reducing anthropogenic emissions or increasing greenhouse gas absorption during 2023-2024, in order to enable the conclusion of agreements on bilateral cooperation through the initiation of voluntary cooperation under Article 6 of the Paris Agreement.

iii. Without prejudice to the applicability of State aid rules, financing measures, including Union support and the use of Union funds, in this area at national level, where applicable

Within the budget program 2701530 "State support for measures aimed at reducing emissions (increasing absorption) of greenhouse gases, including insulation of premises of social security institutions, development of international cooperation on climate change", funding for measures is provided for thermal modernization of buildings in the social sphere.

[168] https://mepr.gov.ua/wp-content/uploads/2023/12/proyekt-Natsionalnyj-plan-upravlinnya-vidhodamy-23.11-002.docx

[169] https://mepr.gov.ua/wp-content/uploads/2023/12/Dodatok-1.-Plan-zahodiv-NPUV_23.11-1.docx

Starting from January 2024, a part of the revenue from the CO2 emissions tax will be allocated to the financing of the State Decarbonization and Energy Efficiency Transformation Fund (see section 3.2, PM_EE_WEM_2) .

3.1.2. Renewable energy

i. Policies and measures to achieve the national contribution to the binding 2030 Union target for renewable energy and trajectories as referred to in point (a)(2) Article 4, and, where applicable or available, the elements referred to in point 2.1.2 of this Annex, including sector- and technology-specific measures

PM_D_WEM_02 "Green" tariff for electricity producers from RES

Objective: stimulating the development of the RES sector

Legal basis: Law of Ukraine "On Amendments to Certain Laws of Ukraine on the Establishment of a "Green" Tariff" No. 601-VI52 of September 25, 2008, Law of Ukraine "On Amendments to Certain Laws of Ukraine on Improving the Conditions for Supporting the Production of Electricity from Alternative Energy Sources" No. 810-IX of July 21, 2020, Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of the Energy System of Ukraine" of June 30, 2023

Responsible authorities: Ministry of Energy, State Agency for Energy Efficiency and Energy Saving, NEURC

[170]Description: The main tool for stimulating the development of the RES sector was the so-called "green" tariff, which was introduced by the Law of Ukraine "On Amendments to Certain Laws of Ukraine on the Establishment of a "Green" Tariff No. 601-VI52 of September 25, 2008. The incentive tariff was applied to electricity producers from RES based on the retail tariff for consumers of the second voltage class as of January 2009, multiplied by the "green" coefficient approved for each type of renewable energy with an additional bonus for the use of Ukrainian-made equipment. Initially, the "green" tariffs were set at a very high level, but then reduced through the introduction of legislative changes in several stages.

However, the lack of sustainable financing mechanisms (especially within the new electricity market model) for the rapid growth of the RES sector has led to the accumulation of huge debts to investors in renewable energy by 2020. In order to reduce the cost of supporting renewable energy, the government initiated negotiations with investors in renewable energy for voluntary restructuring of 'green' tariffs through the Secretariat of the Energy Community. On June 10, 2020, a Memorandum of Understanding on the resolution of problematic issues in the field of renewable energy in Ukraine was signed by the key parties. The provisions of the Memorandum were reflected in Law 810-IX, which provides for a 7.5% and 15% reduction in preferential rates for wind and solar power plants, respectively, the introduction of liability for imbalances, debt repayment, etc.[171]

[170] https://zakon.rada.gov.ua/laws/show/601-17#Text

[171] https://zakon.rada.gov.ua/laws/show/810-20#Text

[172]On June 30, 2023, the Verkhovna Rada adopted Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of Ukraine's Energy System", which, starting from January 1, 2024, narrows the scope of the "green" tariff only for private households, provided that they have buildings and other capital structures within their territory and consume electricity for private household purposes. State support for RES electricity producers in the form of the "green" tariff will be in effect until December 31, 2029.

[173][174]Results: Overall, the "green" tariff contributed to a rapid increase in electricity generation from RES, from 51.8 million kWh in 2009 to 11.4 billion kWh in 2021. As of the beginning of 2022, the installed capacity of RES facilities that received the "green" tariff, excluding objects located in temporarily occupied territories, amounted to 9,656 MW, of which:

- solar power plants of economic entities (producers) - 6,381 MW;
- solar power plants of private households (consumers) - 1,205 MW;
- wind power plants - 1,673 MW;
- biomass power plants - 152 MW;
- biogas power plants - 124 MW;
- small hydropower plants - 121 MW.

PM_D_WEM_03 Incentive tariff for heat energy from RES

Objective: to stimulate the generation of thermal energy from alternative sources

Legal basis: Law of Ukraine "On Amendments to the Law of Ukraine "On Heat Supply" regarding stimulation of thermal energy production from alternative energy sources" No. 1959-VIII dated March 21, 2017

Responsible authorities: Ministry of Energy, State Agency for Energy Efficiency and Energy Saving, NEURC

Description: In order to stimulate the production of thermal energy from RES, the Verkhovna Rada of Ukraine adopted the Law of Ukraine No. 1959-VIII dated 21.03.2017[175]. The law establishes a stimulating tariff for thermal energy from alternative sources at 90% of the current tariff for thermal energy from gas (or at the level of the weighted average tariff for thermal energy from gas by regions in case of its absence).

Results: It was expected that the law would promote the stimulation of increased production of thermal energy from alternative sources at the local level, as well as saving costs for budgetary institutions. However, the actual effectiveness of the introduced tariff incentives for the generation of thermal energy from alternative sources was not assesssed.

[172] https://zakon.rada.gov.ua/laws/show/3220-20#Text

[173] Annual report of the NEURC for the year 2014, https://www.nerc.gov.ua/data/filearch/Catalog3/Richnyi_zvit_2014.pdf

[174] https://www.nerc.gov.ua/storage/app/sites/1/Docs/Byuleten_do_richnogo_zvitu/byuleten_do_richnogo_zvitu_nkrekp-2021.pdf

[175] https://zakon.rada.gov.ua/laws/show/1959-19#Text

PM_D_WEM_04 Tax benefits for imported equipment operating on RES

Goal: To stimulate the development of RES by reducing the cost of imported RES equipment.

Legal basis: Tax Code, Customs Code, Resolution of the Cabinet of Ministers of Ukraine No. 293 "Issues of importation of energy-saving materials, equipment, machinery and components for demonstration projects of Japanese technologies to the customs territory of Ukraine" dated 30.03.2016

Responsible authorities: Ministry of Finance, State Tax Service, State Customs Service

[176]***Description:*** The Tax Code of Ukraine provides a number of tax benefits for businesses operating in the RES sector. In particular, Article 197.16 provides for exemption from value-added tax for operations involving the importation into the customs territory of Ukraine:

- 97.16.1. equipment operating on renewable energy sources, energy-saving equipment and materials, means of measuring, controlling and managing fuel and energy costs, equipment and materials for the production of alternative fuels or for the production of energy from renewable energy sources;
- 197.16.2. materials, equipment, components used for production:
- 97.16.2.1. equipment operating on renewable energy sources;
- 197.16.2.2. materials, raw materials, equipment and components that will be used in the production of alternative fuels or energy production from renewable energy sources;
- 197.16.2.3. energy-saving equipment and materials, products whose operation ensures fuel and energy resource savings and rational use.

[177]In addition, Article 282 (paragraphs 14 and 16) of the Customs Code defines that the above-mentioned equipment and machinery are exempt from customs duties when imported into the customs territory of Ukraine or exported outside its borders. However, the duty exemption applies only if these goods are used by taxpayers for their own production and if identical goods with similar quality indicators are not produced in Ukraine.

The procedure for providing these benefits, as well as the list of materials, equipment, and components for which these benefits apply, is determined by the resolution of the Cabinet of Ministers of Ukraine dated 30.03.2016 No. 293 "Issues of importing energy-saving materials, equipment, and components for demonstration projects of Japanese technologies"."[178]

Results: the effectiveness of these tax benefits has not been evaluated.

PM_D_WEM_05 Exemption from customs duties for agricultural equipment operating on biofuels

[176] https://zakon.rada.gov.ua/laws/show/2755-17#Text

[177] https://zakon.rada.gov.ua/laws/show/4495-17#n2353

[178] https://zakon.rada.gov.ua/laws/show/293-2016-%D0%BF#n16

Objective: to stimulate the production and consumption of biofuels

Legal basis: Customs Code, Cabinet of Ministers of Ukraine Resolution No. 581 "On Approval of the Procedure for Importing Equipment, Machinery, Inventory, Technical and Transport Means Used for the Development of Biofuel Production and Consumption" dated May 18, 2011

Responsible authorities: *State Customs Service*

Description: The Customs Code (Article 282, paragraph 17) provides for exemption from customs duties when importing into the customs territory of Ukraine or exporting outside its borders, technical and transport equipment, including self-propelled agricultural machinery, working on biofuels and classified under codes according to the Ukrainian Classification of Goods for Foreign Economic Activity, as defined by Article 7 of the Law of Ukraine "On Alternative Fuels", if such goods are not produced in Ukraine. The procedure for importing such equipment is regulated by the Cabinet of Ministers of Ukraine Resolution No. 581 of May 18, 2011.[179]

Results: the effectiveness of these tax benefits has not been evaluated.

PM_D_WEM_06 Exemption of bioethanol from excise tax

Objective: stimulating the production and use of bioethanol

Legal basis: *Tax Code*

Responsible authorities: Ministry of Finance, State Tax Service

Description: The Tax Code of Ukraine (Article 229) states that bioethanol used in the production of automotive gasoline blends containing bioethanol, ethyl tert-butyl ether, and other bioethanol-based additives, as well as bioethanol used for biofuel production, is exempt from excise tax.

According to the Ministry of Finance's estimates, as a result of applying this privilege, 569 million UAH was not received by the state budget in 2018. In the following years, the assessment of the revenue foregine to the budget was not carried out. [180]

Results: the effectiveness of this tax benefit was not assessed.

PM_D_WAM_16 Auction system for the distribution of support quotas for RES

Objective: Creating competitive conditions to support renewable energy projects and achieving a balance of interests between society, electricity consumers, and other market participants, while simultaneously promoting further development of renewable energy and reducing the burden on electricity prices.

Legal basis: Law of Ukraine No. 2712-VIII "On Amendments to Certain Laws of Ukraine to Ensure Competitive Conditions for the Production of Electricity from Alternative Energy Sources" dated April

[179] https://zakon.rada.gov.ua/laws/show/581-2011-%D0%BF#Text

[180] https://www.eu4environment.org/app/uploads/2023/09/Review-of-Energy-Subsidies-in-the-Context-of-Energy-Sector-Reforms-Ukraine-prefinal.pdf

25, 2019, Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of the Energy System of Ukraine" dated June 30, 2023

Responsible authorities: Ministry of Energy, State Agency for Energy Efficiency and Energy Saving, NEURC

[181]***Description:*** In order to increase competition in the renewable energy market, the Law of Ukraine No. 2712-VIII introduced an auction mechanism for large-scale renewable energy installations in 2019. According to the Law, wind and solar installations with a capacity of over 5 MW and 1 MW, respectively, are required to participate in quota support distribution auctions, while small producers can participate voluntarily. Small installations at the household level with a capacity of up to 50 kW still have the right to green tariffs until 2029.

In order to launch auctions for RES, the Cabinet of Ministers also adopted Resolution No. 1175 dated 27.12.2019 On the introduction of competitive conditions for stimulating the production of electricity from alternative energy sources, which approves the procedure for conducting auctions and allocating quotas to support RES.[182]

On June 30, 2023, the Verkhovna Rada approved Law No. 3220-IX of Ukraine "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of the Energy System of Ukraine", which improved the model of conducting auctions for the allocation of support quotas for electricity producers from energy sources, in particular, the Law introduced the following changes:

- establishing a support period of up to 12 years;
- introduction of a contracts for difference model (market premium mechanism) instead of a fixed tariff;
- simplification of conditions for participation in auctions;
- conducting auctions for the construction of renewable energy facilities together with energy storage installations;
- determining specific hours of the day during which it can be provided support based on the results of the auction;
- granting the Cabinet of Ministers of Ukraine the right to determine the share of the auction price, which is fixed in euros, but not less than 50%;
- determination of load profiles of renewable energy facilities for which support has been obtained based on the results of the auction.

Results: It is expected that the auction mechanism will contribute to the development of RES on competitive basis. However, as of the end of 2022, this instrument has not yet been implemented.

PM_D_WAM_17 Market premium mechanism for RES electricity producers (feed-in premium)

Objective: ensuring the development of renewable energy on competitive basis, integration of "green" generation into the energy system and electricity market.

[181] https://zakon.rada.gov.ua/laws/show/2712-19#Text

[182] https://zakon.rada.gov.ua/laws/show/1175-2019-%D0%BF#Text

Legal basis: Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of Ukraine's Energy System" dated June 30, 2023

Responsible authorities: Ministry of Energy, NEURC

Description: On June 30, 2023, the Verkhovna Rada of Ukraine adopted Law No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of Ukraine's Energy System", which introduced a number of new market instruments to support electricity producers from RES, including the Feed-in-Premium mechanism or contracts for difference.

The mechanism of market premium is a system of stimulating the production of electricity from alternative energy sources, under which the guaranteed buyer pays to economic entities that have established a "green" tariff, and to economic entities that have acquired the right to support as a result of an auction, the difference between the size of the "green" tariff or auction price, taking into account the surcharge to it, and the calculated price determined in the order established by the Law of Ukraine "On the electricity market".

The market premium mechanism creates conditions for renewable energy producers to become full-fledged market participants and independently sell the generated electricity, reducing their imbalances and optimizing their revenues.

Results: It is expected that the implementation of the market premium mechanism will contribute to the development of renewable energy on competitive basis and create prerequisites for deeper integration of "green" generation into the energy system and electricity market.

PM_D_WAM_18 Direct contracts for the purchase and sale of electricity between producers and end energy consumers (corporate PPA)

Objective: Stimulating the development of the RES sector on market principles

Legal basis: Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of Ukraine's Energy System" dated June 30, 2023

Responsible authorities: Ministry of Energy, NEURC

Description: Law No. 3220-IX has eliminated a number of regulatory barriers for the conclusion of direct electricity purchase and sale agreements (corporate PPAs) between energy producers and end consumers, where the buyer of electricity is a private consumer rather than the state as the guaranteed buyer. In particular, the Law has removed the obligation for RES generators to sell electricity through bilateral contracts at electronic auctions, but the right to continue using this instrument on a voluntary basis remains. The Law has also expanded the list of counterparties for concluding agreements on ensuring the stability of the price for electricity generated from alternative energy sources, in addition to the consumer, to include the electricity supplier and trader. In addition, the authority of the NEURC to establish the maximum term of bilateral contracts no longer applies to contracts concluded by RES electricity producers. These changes have created opportunities for businesses that generate electricity from RES or plan to become such producers to seek partners for long-term bilateral electricity purchase and sale agreements even at the project development stage.

Results: It is expected that the legislative changes introduced by Law No. 3220-IX will stimulate the development of the segment of direct power purchase agreements between alternative energy producers and consumers (Corporate PPA's), both physical and virtual.

PM_D_WAM_19 Guarantees of origin for electricity from RES

Objective: to stimulate the development of renewable energy on competitive basis and to implement the provisions of European legislation, in particular, European Parliament and Council Directive 2018/2021 of 11.12.2018.

Legal basis: Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of Ukraine's Energy System" dated June 30, 2023

Responsible authorities: NEURC, Ministry of Energy

Description: At the end of June 2023, the Verkhovna Rada adopted Law of Ukraine No. 3220-IX, which introduces a mechanism for issuing, using, and terminating guarantees of origin for electricity generated from RES. The law defines guarantees of origin for electricity generated from RES as an electronic document generated based on information from the register of guarantees of origin for electricity generated from renewable energy sources, which confirms that a certain amount of electricity is generated from renewable energy sources, confirms its environmental value, and certifies the rights associated with the positive effect of electricity production from RES. Guarantees of origin confirm the origin of electricity generated from RES:

- a business entity that generates electricity from RES,
- a consumer who has installed a generating installation for self-consumption, or
- an active consumer.

The guarantee of origin is issued for a volume of 1 MWh of electricity from RES, released into the grid or generated and used for self-consumption. The guarantee of origin is automatically formed in a special register and is issued free of charge in accordance with the procedure for issuance, circulation, and redemption approved by the Cabinet of Ministers of Ukraine. NEURC is the authority responsible for issuing, circulating, and redeeming guarantees of origin and ensuring the functioning of the guarantee of origin register.

The guarantee of origin circulation of electricity from RES is carried out within 12 months from the date of its production. At the same time, the owner of the guarantee of origin has the right to extinguish it within 18 months from the date of production of the corresponding volume of electricity. The purchase and sale of guarantees of origin of electricity produced from renewable energy sources is carried out on market principles at free prices. Export and import of guarantees of origin of electricity produced from renewable energy sources are carried out under foreign economic contracts. However, in order to realize export opportunities, it is necessary to ensure full compliance of the guarantee of origin mechanism with European standards. For this purpose, the Law assigns the task of ensuring the integration of the register of guarantees of origin of electricity from RES with the registers of the Energy Community countries, the European Union, and the Organization for Economic Cooperation and Development to the tasks of the NEURC.

To fully launch the mechanism of guaranteeing the origin of electricity from RES, the adoption of a number of by-laws is expected in the coming months, including the procedure for issuing, circulating, and redeeming guarantees of origin, as well as the launch of the corresponding registry.

Results: It is expected that the implementation of an effective system of guarantees of origin for electricity from RES will become a significant impetus for the development of the RES sector in Ukraine and create conditions for the export of "green" electricity.

In addition, a range of tools is currently being developed to stimulate the development of distributed generation of electricity from RES, and their full implementation is expected in the near future, including support for active consumers through the self-generation mechanism (PM_IME_WEM_03) and a state target economic program to stimulate the development of distributed generation of electricity from renewable energy sources for the period up to 2030 (PM_IME_WAM_05) (see section 3.4.3.ii for more details).

ii. Where relevant, specific measures for regional cooperation, as well as, as an option, the estimated excess production of energy from renewable sources which could be transferred to other Member States in order to achieve the national contribution and trajectories referred to in point 2.1.2

[Planned for the next stages of work on the NECP]

iii. Specific measures on financial support, where applicable, including Union support and the use of Union funds, for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport

[183]The cost of price support for electricity producers from RES, which sell generated electricity at a "green" tariff, reached UAH 39,033 million in 2020. In addition, electricity producers from RES, as well as biofuels, have access to a number of tax incentives (described above PM_D_WEM_04, PM_D_WEM_05, PM_D_WEM_06). However, the cost of such support (in the form of the revenue foregone to the state budget) for the RES sector has not been evaluated in recent years.

iv. Where applicable, the assessment of the support for electricity from renewable sources that Member States are to carry out pursuant to Article 6(4) of Directive (EU) 2018/2001

[Planned for the next stages of work on the NECP]

v. Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of power purchase agreements

Summary of the policies and measures under the enabling framework Member States have to put in place pursuant to Article 21(6) and Article 22(5) of Directive (EU) 2018/2001 to promote and facilitate the development of self-consumption and renewable energy communities

It is expected that two instruments supporting the development of self-consumption of energy will soon be operational: support for active consumers under the self-consumption mechanism

183 https://www.eu4environment.org/app/uploads/2023/09/Review-of-Energy-Subsidies-in-the-Context-of-Energy-Sector-Reforms-Ukraine-prefinal.pdf

(PM_IME_WEM_03) and a state target economic program to stimulate the development of distributed generation of electricity from renewable energy sources for the period up to 2030 (PM_IME_WAM_05) (see section 3.4.3.ii for more details).

vi. Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources

[Planned for the next stages of work on the NECP]

vii. Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account:

- *biomass availability, including sustainable biomass: both domestic potential and imports from third countries*
- *other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use*

Most of the policies and measures described in section 3.1.2 above are available to biomass electricity and heat producers, as well as producers based on other renewable sources.

3.1.3. Other elements of the dimension
i. Where applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS
ii. Policies and measures to achieve other national targets, where applicable

PM_D_WAM_20 State target program for the just transformation of coal regions of Ukraine until 2030

Objective: Overcoming socio-economic development issues in coal regions due to the closure of coal mining and related enterprises.

Legal basis: Cabinet of Ministers Resolution No. 1024 "On Approval of the Concept of the State Targeted Program for the Just Transformation of Coal Regions of Ukraine for the Period up to 2030"

Responsible authorities: Ministry of Community Development, Territories and Infrastructure of Ukraine, Ministry of Energy

Description: The EU states that the use of coal generation will be reduced until it is completely phased out by 2035. In addition, the action plan for the implementation of the updated NDC envisages the liquidation of unprofitable and non-prospective state-owned coal mining enterprises by 2030 as part of a gradual phase-out of coal use.

[184]In order to overcome the problems of socio-economic development of coal regions due to the closure of coal mining and related enterprises, on September 22, 2021, the government approved the Concept of the State Targeted Program for the Just Transformation of Coal Regions of Ukraine for the period up to 2030. According to the Concept, coal regions are defined as regions where coal mining and coal processing enterprises are located, including those in the process of liquidation, conservation, or reorientation to other types of economic activity, as well as coal-fired thermal power plants regardless of ownership form.

[184] https://zakon.rada.gov.ua/laws/show/1024-2021-%D0%BF#Text

In total, these are about 20 territorial communities in Volyn, Dnipropetrovsk, Donetsk, Luhansk, and Lviv regions, with a population of about 850,000 residents.

The concept envisaged the development of the State Targeted Program for the Fair Transformation of Coal Regions of Ukraine for the period up to 2030 within a six-month period. However, due to the full-scale invasion of the Russian Federation, the development of the state program was postponed due to the impossibility of assessing the condition of flooded mines in temporarily occupied territories, as well as military actions and extensive destruction of infrastructure in Vuhledar and other coal communities of Donetsk region.

In addition, the government plans to create a Fund for Just Transition in Coal Regions as an effective and transparent mechanism for financing transformation projects in coal regions.

Results: Implementation of the State Target Program should ensure overcoming the problems of socio-economic development of coal regions due to the closure of coal mining and related enterprises.

PM_D_WAM_21 Strategy for environmental security and climate change adaptation until 2030

Objective: Increasing the level of environmental safety, reducing the impacts and consequences of climate change in Ukraine.

Legal basis: Cabinet of Ministers Order No. 1363-r "On Approval of the Strategy for Environmental Safety and Climate Change Adaptation for the period up to 2030.

Responsible authorities: **Ministry of Environmental Protection and Natural Resources**

Description: To achieve the goal of strengthening the adaptive capacity and resilience of social, economic, and environental systems to climate change, a number of tasks have been identified, including:[185]

- conducting sectoral studies on assessing risks, vulnerability, and forecasting climate change in the areas of water resources management, biodiversity conservation, forestry, energy, public health, agriculture and soils, transportation and infrastructure, tourism.
- developent of action plans for climate change adaptation in the areas of water resource management (within the river basin management plan), biodiversity conservation, forest resources, energy, public health, agriculture and soils, transportation and infrastructure, tourism;
- ensuring consideration of current and projected climate change impacts in strategic planning at the national, regional, and local levels, as well as during infrastructure construction;
- review of state construction norms taking into account current and projected climate change impacts;
- strengthening the resilience of forest ecosystems to pests and new climate conditions, implementing measures for prevention and rapid response to fires;

[185] https://zakon.rada.gov.ua/laws/show/1363-2021-%D1%80#Text

- technical upgrade and development of hydrometeorological observation and forecasting systems;
- conducting a financial assessment of climate change adaptation measures implementation.

The implementation of the Strategy will be carried out through the implementation plans, which will be approved by the Cabinet of Ministers of Ukraine for a three-year period, as well as the National Action Plan for Environmental Protection until 2025, approved by the Cabinet of Ministers of Ukraine on April 21, 2021, No. 443.[186]

The operational plan for the implementation of the Strategy in 2022-2024 provides for the implementation of 28 measures, including the preparation of research and recommendations for the integration of adaptation issues into strategic documents at the local and national levels, risk assessment and vulnerability to climate change in various socio-economic sectors, development of sectoral adaptation plans, development of regional and local climate change adaptation strategies or inclusion of adaptation issues into regional development strategies, territorial community development strategies and action plans, as well as economic and social development programs for regions, districts, cities, etc.

Results: Implementation of the Strategy should ensure the achievement of the goal and strategic objectives, in particular, regarding the strengthening of the adaptive capacity and resilience of social, economic, and environmental systems to climate change.

iii. Policies and measures to achieve low emission mobility (including electrification of transport)

PM_D_WEM_07 Tax incentives for electric transport

Objective: Stimulating the manufacturing and use of electric transport.

[187]***Legal basis:*** Tax Code, Customs Code, Law of Ukraine 674-IX "On the Customs Tariff of Ukraine" of June 4, 2020, Law of Ukraine No. 400/97-VR "On the Mandatory State Pension Insurance Contribution" of June 26, 1997[188]

Responsible authorities: Ministry of Finance, State Tax Service, State Customs Service

Description: The Tax and Customs Codes of Ukraine provide a number of tax incentives to stimulate the use of electric vehicles, which have been introduced since 2018 and their validity has been extended several times. In particular, no customs duty is levied on the importation of electric vehicles (Section XVII of the Customs Tariff of Ukraine), and operations with the importation into the customs territory are exempt from VAT taxation (paragraph 64 of subsection 2 of section XX of the Tax Code) until 2026. In addition, the excise tax rate for electric vehicles is significantly lower than for vehicles with internal combustion engines or hybrids - 1 EUR per 1 kWh capacity of the electric accumulator (Article 215.3.5).

Starting from July 1, 2022, electric cars are also exempt from mandatory state pension insurance payments upon first registration (paragraph 7, article 1 of the Law of Ukraine "On the collection of mandatory state pension insurance").

[186] https://zakon.rada.gov.ua/laws/show/443-2021-%D1%80#n12

[187] https://zakon.rada.gov.ua/laws/show/674-20#Text

[188] https://zakon.rada.gov.ua/laws/show/400/97-%D0%B2%D1%80/ed20231208#Text

To stimulate domestic production of electric vehicles, from January 1, 2022, to January 1, 2031, operations related to the importation of goods used for the production of vehicles equipped exclusively with electric motors are exempt from import duties (subparagraph 16 item 4 of Chapter XXI of the Customs Code) and VAT taxation (paragraph 78 of subsection 2 of Chapter XX of the Tax Code).

In addition, from January 1, 2022 to December 31, 2035, profits of enterprises engaged exclusively in the production of electric motors, as well as manufacturers of lithium-ion (lithium-polymer) batteries and chargers for vehicles equipped exclusively with electric motors, and manufacturers of vehicles equipped exclusively with electric motors, are exempt from taxation (paragraph 56 of Subsection 4 of Section XX of the Tax Code). At the same time, the released funds (tax amounts not paid to the budget and remaining at the disposal of the taxpayer) should be used for scientific research and design work in the field of electric transport, creation or modernization of material and technical base, increasing production volume, and implementation of advanced technologies. The procedure for monitoring the use of released funds is established by the Cabinet of Ministers of Ukraine.

[189]According to the Ministry of Finance's estimates, the expected amount of budget losses in 2022 due to provided tax benefits is:

- due to the exemption from VAT for operations with the supply of vehicles equipped exclusively with electric motors on the customs territory of Ukraine - approximately 364 million UAH;
- due to the exemption from profit taxation for enterprises engaged exclusively in the production of electric motors for vehicles equipped exclusively with electric motors and electric vehicles - 584 million UAH.

[190][191]***Results:*** The effectiveness of the provided tax benefits was not evaluated. However, the number of cars with exclusively electric engines increased from 7,439 units in 2018 (as of May 1st) to 72,435 units in 2023 (as of September), which is almost ten times higher. This indirectly indicates the effectiveness of fiscal incentives for the development of the electric transport sector.

PM_D_WEM_08 Stimulating the development of electric charging infrastructure

Objective: Reducing the consumption of fossil fuel resources by the transport sector

Legal basis: Law of Ukraine No. 2956-IX "On certain issues of the use of vehicles equipped with electric motors and amending certain laws of Ukraine regarding overcoming fuel dependence and the development of electric charging infrastructure and electric vehicles"

Time boundaries: 2024-2030

Responsible authorities: Ministry of Community Development, Territories and Infrastructure of Ukraine

Description: In March 2023, the Law of Ukraine "On certain issues of the use of electric vehicles and amendments to certain laws of Ukraine regarding overcoming fuel dependence and development of electric charging infrastructure and electric vehicles" (Law on electric transport) came into force. According to this Law, the development of electric vehicles and charging station infrastructure is prioritized in shaping the state policy in the field of automotive transport. The concept of an electric

[189] https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=8000&conv=9

[190] https://texty.org.ua/fragments/85448/Skilky_de_ta_jakyh_jelekromobiliv_v_Ukrajini-85448/

[191] https://eauto.org.ua/news/393-rekordna-kilkist-vzhivanih-elektromobiliv-z-za-kordonu-ta-import-novih-z-kitayu-shcho-kupuvali-u-veresni

vehicle includes both passenger and freight transport equipped exclusively with electric motors (one or several) and an energy storage system.

According to current building regulations, at least 5% of the total number of parking spaces should be provided for parking electric vehicles. Such spaces can be equipped with charging stations .[192]

State authorities and local self-government bodies must approve programs for the development of electric charging infrastructure by December 31, 2023, which will provide charging stations for objects owned by the state or municipalities, in existing parking lots, garages, and other parking areas (except those exclusively used by such authorities or state or municipal enterprises, institutions, organizations) in accordance with building regulations. In accordance with these programs, state and municipal commercial enterprises, subjects of economic activity in the state sector, must provide existing objects owned by such subjects or assigned to them on the basis of economic management rights, with the necessary contractual capacity and charging stations for electric vehicles in existing parking lots, garages, and other parking areas by December 31, 2024 (except those exclusively used by such subjects).

The law on electric transport provides that projects for the construction of new multi-storey residential buildings should take into account the need to provide at least 50% of parking spaces for electric vehicles with charging stations. The development of electric charging infrastructure for existing buildings is also envisaged: associations of co-owners of multi-apartment buildings have the right to install charging stations on the adjacent territory and independently determine the rules of use and payment for such stations.

PM_D_WEM_09 Stimulating the development of low-carbon municipal transport

Objective: Reducing the consumption of fossil fuel resources by the transport sector

Legal basis: Law of Ukraine No. 2956-IX "On certain issues of the use of vehicles equipped with electric motors and amending certain laws of Ukraine regarding overcoming fuel dependence and the development of electric charging infrastructure and electric vehicles"

Time boundaries: 2024-2030

Responsible authorities: Ministry of Community Development, Territories and Infrastructure of Ukraine

The law on electric transport provides for a gradual replacement of municipal transport with low-carbon alternatives. On urban bus routes in cities with a total population of over 250,000, the number of electric buses and/or buses running exclusively on methane (compressed or liquefied) or biogas, and/or buses with a hydrogen fuel cell as a percentage of the bus fleet should be no less than:

- 25% by January 1, 2030;
- 50% by January 1, 2033.

In addition, starting from January 1, 2036, only electric buses or buses running exclusively on compressed or liquefied natural gas or biogas, and/or buses with a hydrogen fuel cell are allowed for passenger transportation on urban bus routes of general use in cities of district and regional significance in the regular passenger transportation mode.

At the same time, local sauthorities have the opportunity to review these shares (but not more than 50%) and terms (not more than two years).

From January 1, 2028, gradual restrictions are imposed on the purchase of internal combustion engine buses for use in public transport.

[192] DBN V.2.3-15:2007. Parking lots and garages for passenger cars. https://e-construction.gov.ua/laws_detail/2845786368808847244?doc_type=22

iv. Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels
[Planned for the next stages of work on the NECP]

3.2. Dimension Energy Efficiency

Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2, including planned measures and instruments (also of a financial nature) to promote the energy performance of buildings, in particular with regard to the following:

i. Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU and to be prepared in accordance with Annex III to this Regulation

As of the end of 2022, the cumulative value of achieved energy savings amounted to 36.97 GWh, and the cumulative value of CO2 emissions reduction was 10,360 thousand tons. When assessing the achievement of the target indicator for annual energy consumption reduction, energy savings achieved as a result of implementing energy efficiency measures implemented since December 31, 2008, which affect energy consumption reduction after the entry into force of the Law "On Energy Efficiency" and can be measured and evaluated, may be included in the calculation.

The Law of Ukraine "On Energy Efficiency" provides an alternative approach to implementing Article 7 of Directive 2012/27/EU. Achieving the target indicator of annual energy consumption reduction is ensured through the following ways:

- implementation of activities by the Energy Efficiency Fund and other funds;
- implementation of state target programs in the field of energy efficiency;
- adoption of standards, norms and rules for improving the energy efficiency of goods and services, including buildings and vehicles, the requirements of which exceed the requirements of European standards, norms and rules that are mandatory under the legislation of the European Union, decisions of the Energy Community;
- introduction of requirements for energy labeling and eco-design of energy-consuming products for which there are no requirements under the norms of the legislation of the European Union, decisions of the Energy Community;
- implementation of other measures, the result of which is to ensure annual energy consumption reduction.

PM_EE_WEM_01 Energy Efficiency Fund Activity

a) Energodim Program

The Energy Efficiency Fund offers partial reimbursement for energy efficiency measures through its Energodim Program. Beneficiaries can select one of two energy efficiency packages for implementation in their homes: Light or Comprehensive.

The Fund provides grants exclusively to homeowners' associations (HOAs) of multi-apartment buildings. The formation of an HOA is not mandatory in Ukraine. As of January 1, 2024, State Statistics Service data shows that 39,709 HOAs were registered out of approximately 180,000 multi-apartment buildings.

According to amendments to the Law of Ukraine "On the Features of Exercising the Right of Ownership in a Multi-Apartment Building," effective from November 2023, HOA decisions are typically made by a simple majority vote. However, the HOA may require a higher percentage of votes (up to 67%) for decisions regarding matters such as the election of management bodies, changes in management structure, determination or alteration of contributions/payments, and approval of the budget. Co-owners can vote during association meetings or via written means, including the option to sign survey letters containing a list of adopted decisions using an electronic digital signature.

The "Light" Package (Package A) includes the following mandatory measures:

· installation of a residential heat meter;

· installation or modernization of an individual heat substation (ITS).

In addition, HOAs may receive partial reimbursement for the implementation of additional measures, such as replacement or modernization of the central boiler; thermal insulation and/or replacement of pipelines of the internal heating or hot water supply system; installation of automatic (balancing) valves; thermal insulation of attics and roofs; installation of heat energy distributors in apartments; replacement or repair of windows or external doors; modernization of lighting in common areas.

The "Comprehensive" package (Package B) includes the following mandatory measures:

- mandatory measures for Package A;

- thermal insulation and/or replacement of pipelines for internal heating and hot water supply systems in unheated premises;

- installation of automatic (balancing) valves;

- replacement or repair of external doors and/or arrangement of vestibules at the external entrance; replacement or repair of windows in common areas of the building.

Additional (optional) measures include thermal insulation of external walls, attics (technical floors), roofs, basements; modernization of the hot water supply system; replacement or/and thermal insulation of heating system pipes or/and devices of the water heating system in common areas of the building and in apartments; installation of heat energy distributors in apartments; installation of automatic air temperature regulators on water heating devices and others. The full list of eligible measures for partial reimbursement of their cost is determined by the Fund's Program. In the portfolio of projects of the Energy Efficiency Fund, the majority are projects of Package B (77% of approved applications to participate in the Energy House program).

The amount of partial reimbursement of the cost of energy efficiency measures (grant) varies depending on the time of application submission (increased grant amount for the first 500 applications) and the selected package of measures. The current grant sizes are:

· 70% of the cost of conducting a preliminary energy audit; development of project documentation and its expertise; technical and author's supervision services; energy efficiency certification after project implementation and inspection of engineering systems of the building where energy efficiency measures have been implemented during project implementation - for both packages of measures;

· 40% of the cost of works, equipment, materials - for Package A

· 50% of the cost of works, equipment, materials - for Package B.

For the first 500 applications, an additional grant of 20% of the cost of works, equipment, materials was provided for both packages.

According to the Operational Plan of Measures for the Implementation of the Long-Term Strategy for the Thermal Modernization of Buildings for the period up to 2050 (hereinafter - the Implementation Plan of the Strategy for the Thermal Modernization of Buildings), the Government plans to gradually reduce the share of reimbursement of costs for energy efficiency measures after the cessation/cancellation of the state of war.

Grants are provided by the Energy Efficiency Fund in separate tranches, after the implementation of the corresponding project stage and its verification by the Fund. Starting from September 23, 2023, HOAs can receive partial advance payment for construction works at a level of 30% of the project cost, but not exceeding 6.5 million UAH. At the same time, beneficiaries need to confirm that their selected contractors meet the requirements of the Fund, as outlined in the Energodim Program.

As of December 2023 138 projects of the Fund (Packages A and B) have been completed. The cumulative value of achieved energy savings is 110017.083 kWh, the cumulative value of CO2 emissions reduction is 30.693 thousand tons. [193]

The achievement of annual end-use energy savings through the activities of the Energy Efficiency Fund largely depends on sustainable state funding. However, the expenses for the functioning of the Energy Efficiency Fund were not provided for in the State Budget for 2020, 2023-2024.

Currently, the Fund primarily focuses on executing individual projects. However, in the second quarter of 2024, the pilot project for thermal modernization of a residential quarter ("Energy Efficient District of Lviv") will conclude. This project is being undertaken in Ukraine by the Energy Efficiency Fund with support from GIZ. This approach aims to operationalize the "energy efficiency first" principle and ensure comprehensive, synergistic thermal modernization of buildings, heating networks, and heat-generating equipment.

The government also plans to expand the activities of the Energy Efficiency Fund by directing funding towards:

- measures aimed at increasing the share of energy produced from renewable energy sources;
- measures aimed at increasing the number of buildings with near-zero energy consumption;
- energy efficiency measures in private (country) houses.

The implementation plan for the Long-Term Thermal Modernisation Strategy provides for making appropriate changes to the Energy Efficiency Fund Program in the fourth quarter of 2024.

The Energy Strategy, as part of the "Reducing Energy Poverty" direction, includes exploring the viability of implementing subsidies for minor energy renovations in vulnerable households, following the "first in line for repairs" principle, with priority given to vulnerable consumers. Conducting such an analysis would be advisable as part of evaluating options to enhance funding for the Energodim Program of the Energy Efficiency Fund. Until 2032, as outlined in the Energy Strategy, the promotion of energy-efficient measures will involve subsidizing vulnerable consumer groups, providing grants, and offering low-interest loans to a specific subset of households (those with low income levels).

b) Vidnovydim Program

[193] https://docs.google.com/spreadsheets/d/e/2PACX-1vRfJ05_dwOPnVXEYRvDrH7G0DM3yDkI0i-Dh4MUtbm_WowUBx2ZrorgBW1qXL6rfe3eehtYD1DSOGFD/pubhtml#

In August 2022, amendments were made to the Law of Ukraine "On the Energy Efficiency Fund," enabling the Fund to finance not only energy efficiency measures but also programs related to the restoration of buildings destroyed and/or damaged due to armed aggression. Since November 2022, the Fund has been implementing a new program called "Renewable." Exclusive participants in this program are HOAs. Funding under the Vidnovydim Program is allocated for the implementation of the following types of work (services):

- replacement or repair of damaged windows, external and internal vestibule doors;
- repair of building facades damage;
- repair of roof structures / building cover damage;
- repair of damaged equipment of roof boilers and engineering networks.

Funding is allocated for construction works, as well as for the purchase of materials and equipment required for their execution. This funding is offered in the form of a grant, covering 100% of the expenses for implementing eligible measures as per the project, with a cap not exceeding 7.2 million UAH.

PM_EE_WEM_02 State Decarbonization and Energy Efficiency Transformation Fund

In May 2023, amendments to the Budget Code of Ukraine took effect, establishing the State Decarbonization and Energy Efficiency Transformation Fund (Decarbonization Fund) as part of the special fund of the State Budget of Ukraine. The funds of the Decarbonization Fund will be allocated for:

- Financing measures and state-targeted programs in the fields of energy efficiency, increasing the utilization of renewable energy sources (RES) and alternative fuels, and reducing CO2 emissions.
- Providing compensation, reimbursement, and reduction of obligations for individuals and legal entities under credit and leasing agreements entered into for the implementation of energy efficiency measures, energy services, increasing the utilization of RES and alternative fuels, and reducing CO2 emissions.
- Meeting debt obligations under loans obtained by the state for the implementation of investment projects in the fields of energy efficiency, increasing the utilization of RES and alternative fuels, and reducing CO2 emissions.

The Decarbonization Fund will be replenished through the collection of CO2 emissions tax (a component of the environmental tax), government borrowing, and other revenues. The state budget for 2024 allocates funding for the Decarbonization Fund in the amount of 759.2 million UAH. The mechanism for disbursing funds from the Decarbonization Fund and the specifics of potential financing measures should be governed by the Procedure for the utilization of funds from the State Decarbonization and Energy Efficiency Transformation Fund. Initially, funding for the activities of the Decarbonization Fund was slated to commence from January 1, 2024. However, as of early February 2024, the corresponding Procedure for fund utilization has not been adopted.

PM_EE_WAM_01 Energy efficiency obligations scheme

In case the target indicator of end-use energy savings is not achieved through organizational, economic, and legal measures to stimulate energy efficiency, the Cabinet of Ministers of Ukraine has the authority to activate the energy efficiency obligation scheme. The Law of Ukraine "On Energy Efficiency" defines electricity and natural gas suppliers as obligated parties. These obligated parties can ensure compliance with the scheme requirements by:

- Independently implementing eligible energy efficiency measures at the level of end energy consumers;

- Engaging energy service providers and other economic entities to implement energy efficiency measures;
- Contributing to the Energy Efficiency Fund (buy-out).

Lists of eligible measures within the energy efficiency obligation scheme, the establishment of target indicators for energy consumption reduction for specific obligated parties, and the monitoring procedures for achieved energy consumption reduction will be regulated by secondary legislation.

ii. Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, including policies, measures and actions to stimulate cost-effective deep renovation and policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU

PM_EE_WAM_02 Implementation of the State Target Economic Program for the Support of Building Thermomodernization until 2030

Goal: Implementation of long-term objectives in the field of increasing energy efficiency of buildings.

Legislative basis: Law of Ukraine "On Energy Efficiency of Buildings"; Long-Term Strategy for Building Thermomodernization until 2050; Concept of the State Target Economic Program for the Support of Building Thermomodernization until 2030.

Time limits: 2023-2030

Responsible authorities: Ministry of Infrastructure; State Agency on Energy Efficiency

Results: Planned policy

In order to achieve the goals of the first stage of the Long-Term Strategy for the Thermal Modernization of Buildings until 2050, the Ministry of Infrastructure has developed a draft Concept of the State Targeted Economic Program to support the thermal modernization of buildings until 2030 (Concept of the program to support the thermal modernization of buildings).

The concept of the program to support building thermal modernization provides for the implementation of the following measures to stimulate energy efficiency improvement in the residential sector:

- compensation of a portion of citizens' loans for the implementation of priority energy-efficient measures or thermal modernization in individual residential buildings;
- providing support to citizens who own individual houses destroyed as a result of military actions for the construction of residential buildings with near-zero energy consumption levels;
- stimulating citizens to install heat pumps in individual heating systems of multi-apartment buildings that are not connected to centralized heating systems;
- stimulating citizens to install mechanical ventilation systems with heat energy recovery in multi-apartment and individual residential buildings;
- stimulating local self-government bodies to reconstruct (modernize) or overhaul heating and hot water supply systems in multi-apartment buildings connected to the centralized heating system;
- stimulating local self-government bodies to ensure the installation of heat energy metering nodes (including heat energy distributors) together with automatic air temperature regulators in multi-apartment buildings.

In the sector of state and municipal property buildings, the Concept of the program to support building thermal modernization provides for:

- implementation of priority energy-efficient measures or projects thermal modernization;
- ensuring the construction (including reconstruction of buildings damaged by military actions) of public buildings owned by the state, which house state authorities, in compliance with energy consumption requirements close to zero level;
- ensuring the implementation of energy management systems in central executive authorities and local state administrations;
- encouraging local self-government bodies to implement energy management systems;
- encouraging local self-government bodies to install mechanical ventilation systems with heat energy recovery in public buildings owned by the community, particularly aimed at combating the spread of acute respiratory disease COVID-19 caused by the SARS-CoV-2 coronavirus and other diseases.

Among other things, the Concept of the program to support building thermal modernization defines the need to create a favorable market environment for building thermal modernization and the development of energy services. To support businesses, the Concept of the program includes the following measures:

- Support for the development of micro and small businesses that carry out or plan to carry out economic activities in the field of building thermal modernization, including through the provision of partial state guarantees and reimbursement of a portion of interest on loans taken by them for building thermal modernization.
- support for the development of energy-efficient equipment production (heat pumps, air recuperators, automatic control devices, etc.) and energy-saving construction products (thermal insulation systems, high-efficiency window structures, etc.) in Ukraine;
- compensation of a portion of interest on loans taken by energy service providers for the implementation of comprehensive thermal modernization of state and municipal buildings;
- providing functioning of factoring for energy service contracts for thermal modernization of state and municipal buildings.

According to the calculations of the Ministry of Infrastructure, the total estimated financial resource requirement for the implementation of the Program is from 172.91 billion UAH to 934.25 billion UAH for the entire duration (until 2030), the majority of which is planned to be covered from non-budgetary sources (including funds from foreign financial institutions, international financial organizations, and technical support programs, etc.). The estimated amount of necessary co-financing of the Program from the state budget is from 43.31 billion UAH to 168.72 billion UAH for the entire duration (until 2030).

iii. Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

PM_EE_WEM_03 Energy service in the public sector

Objective: Attract funding for the implementation of measures to improve the energy efficiency of state and municipal property.

Legislative basis: Law of Ukraine "On the Introduction of New Investment Opportunities, Guaranteeing Rights and Legitimate Interests of Business Entities for the Implementation of Large-scale Energy Modernization"; Law of Ukraine "On Public Procurement"; Budget Code of Ukraine; Law of Ukraine "On Energy Efficiency"; Resolution of the Cabinet of Ministers of Ukraine No. 1178 of October 12, 2022. On the Approval of the Features of Public Procurement of Goods, Works and Services for Customers Provided for by the Law of Ukraine "On Public Procurement" for the Period of the Legal

Regime of Martial Law in Ukraine and for 90 Days from the Date of its Termination or Cancellation"; Resolution of the Cabinet of Ministers of Ukraine No. 845 of October 21, 2015. On the Approval of the Model Energy Service Agreement"; Methodology for Determining the Basic Annual Level of Consumption of Fuel and Energy Resources and Housing and Communal Services, approved by the Order of the Ministry of Infrastructure No. 578 of July 6, 2023.

Time limits: 2015-2030

Responsible authorities: Ministry of Infrastructure; State Agency on Energy Efficiency.

Results: By the end of June 2022, Ukraine had concluded 578 ESCO contracts for a total amount of over 1.34 billion UAH.[194]

In 2015, the Law of Ukraine "On the Introduction of New Investment Opportunities, Guaranteeing Rights and Legitimate Interests of Business Entities for the Implementation of Large-Scale Energy Modernization" was adopted, which regulates the principles of energy service for objects of state and communal property (buildings, structures, their groups, objects and/or elements of improvement). At the same time, amendments were made to the Budget Code of Ukraine, which allowed budget funds managers to enter into long-term obligations for energy services. Conclusion of energy service contracts is carried out through public procurement procedures via the Prozorro system. The main criterion for selecting a tender proposal is the efficiency indicator of the energy service contract, which is determined as the cumulative discounted difference between the customer's annual cost reductions and the contractor's annual payments for energy services. The Cabinet of Ministers of Ukraine has approved a model energy service contract, which serves as a guideline for budget institutions and investors.

The Law of Ukraine "On Energy Efficiency" expanded the scope of the energy service contracts to include engineering systems and their separate energy-consuming equipment, which are part of a single technological cycle. This law also provides that state authorities and local self-government bodies should assess the possibility of concluding an energy service contract when purchasing services for the supply of electricity, natural gas, thermal energy, and hot water supply. Such assessment shall be carried out in accordance with the methodology to be approved by the Ministry of Infrastructure.

In accordance with the Amendments to the License Terms for Economic Activities in the Heat Supply Sector, approved by the Resolution of the National Commission for State Regulation of Energy and Public Utilities No. 977 dated 31.05.2023 economic entities engaged in heat energy transportation activities must not take any measures that hinder the implementation of energy services and other energy-efficient measures, which impede the development of energy service markets and other energy-efficient measures, including by violating deadlines for issuing technical conditions for connection to networks, abusing a monopoly position, engaging in unfair competition, creating obstacles for economic entities in the competition process, and gaining unlawful advantages in competition in accordance with the law.

The State Agency on Energy Efficiency ensures the functioning of information databases of potential energy service objects and energy service providers. However, during the period of the legal regime of martial law and until its completion, open access to these information databases is temporarily blocked.

In 2023, the GEF / UNDP project "Removing Barriers to Promote Investment in Energy Efficiency of Public Buildings in Small and Medium-Sized Cities of Ukraine through ESCO Mechanism" conducted a review of 53 energy service contracts that were concluded in 2019 in 10 partner cities. The analyzed contracts aimed at modernizing heating systems and implementing remote energy monitoring of buildings, one project - at modernizing the external lighting network. Thanks to these projects, partner

[194] https://www.kmu.gov.ua/news/enerhoservis-diievyi-instrument-zaluchennia-investytsii-u-modernizatsiiu-biudzhetnykh-ustanov

cities have saved 5.6 thousand Gcal of thermal energy and 6.5 million kWh of electricity over four years. The average annual reduction of CO2 from 2019 to 2022 is 1241 tons of CO2 / year[195].

According to UNDP data, the market for energy efficiency contracts in Ukraine consists of 41 ESCOs, but approximately 68 percent of the total contract value is accounted for by five market players. The limited access to credit financing for ESCOs and the high cost of credit are barriers to expanding the use of energy services. In order to develop this policy instrument, the Ministry of Infrastructure in the Plan for the implementation of the Long-Term Thermal Modernization Strategy includes the following measures:

- compensation of part of the interest on loans taken by them for comprehensive thermal modernization of state and municipal property buildings - 1st quarter of 2024;
- implementation of the financing program from the Entrepreneurship Development Fund (introduction of "green" financial products) - 1st quarter of 2024;
- ensuring the liquidity of energy service contracts as an investment asset, including in preparation for the implementation of pension reform and filling pension funds with "green" investment assets, as well as regulating the possibility of factoring agreements - 1st quarter of 2024;
- implementation of short express courses and route maps for technical supervision in the construction sector for those responsible for public procurement and acceptance-transfer of works and services - II quarter 2024;
- amendments to the legislation regarding the implementation of demonstration projects and dissemination of experience in the use of energy services in residential buildings and other forms of investment in energy efficiency of residential buildings, primarily for households with low income - IV quarter 2025.

iv. Other planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems, consumer information and training measures, and other measures to promote energy efficiency)

PM_EE_WEM_04 Minimum energy performance requirements to buildings

Objective: Establishing the maximum allowable energy consumption per unit area or volume in new and existing buildings.

Legislative basis: Law of Ukraine "On Energy Efficiency of Buildings", Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine No. 170 dated 11.07.2018 "On Approval of the Methodology for Determining the Economically Feasible Level of Energy Efficiency of Buildings", Order of the Ministry of Development of Communities and Territories No. 260 dated 27.10.2020 "On Approval of the Minimum Requirements for Energy Efficiency of Buildings".

Time boundaries: 2021-2030

Responsible authorities: Ministry of Infrastructure.

Results: Minimum requirements for energy efficiency of buildings are taken into account in the design and construction of new buildings, as well as in the implementation of thermal modernization. The unified state electronic system in the construction sector contains 7022 energy certificates of buildings that meet the minimum requirements.

[195] https://www.undp.org/uk/ukraine/publications/ohlyad-naykrashchykh-praktyk-dyzaynu-rynku-esko-ta-rekomendatsiyi-dlya-ukrayiny

Minimum energy performance requirements for buildings are calculated based on an economically feasible level and reviewed at least every 5 years. The maximum values of specific energy consumption for heating and cooling of residential buildings should range from 65 to 120 кWh/sq.m (depending on the number of floors and temperature zone). During reconstruction or major repairs, a correction factor of 1.2 is applied to the specified values. The current minimum requirements were adopted in 2020 and came into effect on 04.01.2021.

According to the Long-Term Thermal Modernization Strategy, at least 36 percent of residential buildings must meet the minimum energy performance requirements by 2030; this share should increase to 71 percent by 2040.

As part of the practical implementation of the 'Build Back Better' principle, the Government should start reviewing the minimum energy efficiency requirements for buildings. The Implementation plan for the Long-Term Thermal Modernization Strategy includes the approval of updated minimum energy performance requirements for buildings in the fourth quarter of 2025.

PM_EE_WAM_03 Nearly zero-energy buildings

Objective: Encouraging the construction and thermal modernization of buildings to the highest level of energy efficiency.

Legislative basis: Law of Ukraine "On Energy Efficiency of Buildings", Concept for the implementation of state policy in the field of ensuring energy efficiency of buildings in terms of increasing the number of buildings with near-zero energy consumption level, and National plan to increase the number of buildings with near-zero energy consumption level.

Time limits: 2020-2030

Responsible authorities: Ministry of Infrastructure

Results: As of October 2023, the requirements for buildings with near-zero energy consumption are not mandatory for both residential and public buildings. The unified state electronic system in the construction sector contains 333 energy certificates for buildings that meet the "A" energy efficiency class.

In 2020, in accordance with the requirements of Directive 2010/31/EU and the Law of Ukraine "On Energy Efficiency of Buildings", the Concept for the Implementation of the State Policy in the Field of Energy Efficiency of Buildings was adopted, which includes increasing the number of buildings with nearly zero energy consumption level, and the National Plan for increasing the number of buildings with nearly zero energy consumption level.

According to the Concept, it is planned that no later than December 31, 2027 the energy efficiency class of all buildings put into operation must not be lower than the requirements for nearly zero-energy buildings in effect on the date of the start of construction work and no later than December 31, 2025 the energy efficiency of buildings of state and municipal ownership put into operation must not be lower than the requirements for nearly zero-energy buildings in effect on the date of the start of construction work. The Concept also defines the maximum specific energy consumption indicators for energy-independent buildings (new construction):

- from 46 to 92 kWh/m² for residential buildings (depending on the number of floors and temperature zone);
- from 21 to 33 kWh/m³ for public buildings (depending on the number of floors and temperature zone);

- from 33 to 35 kWh/m³ for educational institutions and healthcare facilities (depending on the temperature zone).

Long-Term Thermal Modernization Strategy envisages that at least 10% of public buildings will meet the requirements of buildings with near-zero energy consumption by 2030, and by 2040. It is expected that at least 25% of residential buildings will also meet these requirements.

To make compliance with the requirements for buildings with near-zero energy consumption mandatory, it is necessary to approve building regulations for the design and construction of such buildings. The Implementation Plan of the Long-Term Thermal Modernization Strategy includes the approval of requirements for buildings with near-zero energy consumption and the procedure for monitoring the number of such buildings in the fourth quarter of 2024. In the fourth quarter of 2025, monitoring compliance with requirements for buildings with near-zero energy consumption, determining categories of public buildings, and implementing regulatory measures to ensure actual compliance with such requirements are planned.

PM_EE_WEM_05 Energy performance certification of buildings

Objective: Assessing the compliance of the energy characteristics of a building and its elements with the established minimum requirements for the energy efficiency of buildings.

Legislative basis: Law of Ukraine "On Energy Efficiency of Buildings", Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine No. 169 of July 11, 2018 "On Approval of the Methodology for Determining the Energy Efficiency of Buildings", Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine No. 172 of July 11, 2018 "On Approval of the Procedure for Certification of Energy Efficiency and the Form of Energy Certificate".

Time limits: 2018-2030

Responsible authorities: Ministry of Infrastructure; State Agency on Energy Efficiency.

Results: The Unified State Electronic System in the field of construction contains 17,200 energy certificates of buildings.

Certification of energy efficiency of buildings was introduced in accordance with the Law of Ukraine "On Energy Efficiency of Buildings" in 2018.

According to the current Ukrainian legislation, energy performance certification is a type of energy audit of buildings that can be conducted by a certified energy auditor. Professional certification is carried out in accordance with the Procedure for Certification of Persons Intending to Carry out Activities in the Field of Certification of Energy Efficiency, Energy Audit of Buildings and Inspection of Technical Installations, approved by the Resolution of the Cabinet of Ministers of Ukraine No. 40 dated 16.01.2024.

Mandatory certification applies to:

- construction objects;
- buildings in which thermal modernization and/or insulation are planned, for which state support is provided;
- state-owned buildings housing executive authorities occupying more than 250 square meters of heated area;
- buildings of municipal ownership, where local self-government bodies are located, occupying more than 250 square meters of heated area;

- buildings of municipal ownership with a heated area of more than 250 square meters, which are frequently visited by citizens.

Information on issued energy certificates for buildings is made publicly available on the Portal of the Unified State Electronic System in the field of construction. On the same portal, information is provided about certified experts in energy efficiency auditing of buildings and experts in inspection of engineering systems.

Placement of energy certificates in advertisements for the sale or rental of a building is mandatory if such a certificate is available. Thus, the requirement applies to new or thermally modernized buildings.

PM_EE_WEM_06 Exemplary role of buildings of state authorities

Objective: Demonstration of the benefits of implementing energy-efficient measures, increasing demand for energy-efficient materials and technologies, increasing the number of jobs.

Legislative basis: Law of Ukraine "On Energy Efficiency of Buildings", draft Concept of the State Targeted Economic Program for the Support of Building Thermomodernization until 2030.

Time boundaries: 2021-2030

Responsible authorities: Ministry of Infrastructure; State Agency on Energy Efficiency.

Results: Adopted policy.

The requirements of Article 5 of Directive 2012/27/EU are transposed by the Law of Ukraine "On Energy Efficiency of Buildings". According to this Law, the Cabinet of Ministers of Ukraine establishes a target energy savings indicator in buildings of state authorities, which is reviewed every five years. The requirement to achieve the target energy savings indicator in buildings of state authorities applies to buildings that meet all of the following criteria:

- are in state or municipal ownership;
- occupied by a central executive authority;
- heated area exceeds 250 square meters.

In order to ensure the exemplary role of government buildings, the Concept of the program to support building thermal modernization provides the following measures:

- certification of energy efficiency of buildings in state and municipal ownership, where central executive authorities, other government authorities, their territorial bodies, local state administrations are located;
- manufacturing technical passports (conducting technical inventory) of state and municipal buildings where central executive authorities, other state authorities, their territorial bodies, and local state administrations are located;
- implementation of priority energy-efficient measures or implementation of projects for building thermal modernization (including the use of renewable energy sources)
- providing for the construction (including reconstruction of buildings damaged as a result of military actions) of public buildings owned by the state, which house state authorities, while complying with the requirements for buildings with close to zero energy consumption.

The concept of the program to support building thermal modernization does not specify the required funding for this direction, as well as the indicators of implementation of the mentioned measures. At the same time, such information should be included in the Program to support building thermal modernization, the adoption of which is the next step after the approval of the Concept.

PM_EE_WEM_07 Energy Management in Government Authorities

Objective: Planning, implementation, and monitoring of the results of energy-efficient measures, reducing the financial burden on the budget.

Legislative basis: Law of Ukraine "On Energy Efficiency", Law of Ukraine "On Energy Efficiency of Buildings", Resolution of the Cabinet of Ministers of Ukraine No. 1460 dated December 23, 2021. On the implementation of energy management systems.

Time limits: 2022-2030

Responsible authorities: Ministry of Infrastructure; State Agency on Energy Efficiency

Results: As of the end of 2022, 57 state authorities and 19 regional administrations have started working on the implementation of energy management.

The Law of Ukraine "On Energy Efficiency" obliges state authorities, enterprises, institutions, and organizations under their management to implement management systems that define energy policy, goals, energy tasks, and action plans to achieve these goals. Energy management systems in state authorities do not require certification and are implemented in accordance with the procedure approved by the Cabinet of Ministers of Ukraine.

The State Agency on Energy Efficiency monitors the implementation of energy management systems and reports to the Government twice a year on the progress achieved. As of 2022, 57 state authorities have started working on the implementation of energy management, namely:

- energy policy declarations have been approved in 15 state authorities;
- activity plans for energy management have been approved in 25 state authorities; energy consumption reduction targets have been set in 26 state authorities;
- More than 2800 government buildings are covered by energy monitoring.
- 19 regional administrations are also implementing energy management system, namely:
- 67 energy policy declarations have been approved in 10 regions;
- Activity plans for the energy management system have been approved in 16 regions;
- Over 17,000 buildings are covered by energy monitoring.[196]

The State Agency for Energy Efficiency has developed and published a sample order "On the implementation of the energy management system" and a sample plan for the implementation and functioning of the energy management system. The Agency is also actively working to raise awareness of approaches to the implementation of energy management systems: in 2022, a series of training seminars were conducted with the participation of 1800 attendees.

PM_EE_WEM_08 Energy Management in Local Self-Government Authorities

Objective: Planning, implementation, and monitoring of the results of energy-efficient measures, rational use of budget funds.

Legislative basis: Law of Ukraine "On Energy Efficiency", Law of Ukraine "On Energy Efficiency of Buildings", Resolution of the Cabinet of Ministers of Ukraine No. 1460 dated 23.12.2021. On the

[196] https://saee.gov.ua/sites/default/files/SAEE_report_2022.pdf

implementation of energy management systems", draft resolution of the Cabinet of Ministers of Ukraine "Certain issues of the functioning of energy management systems".

Time limits: 2022-2030

Responsible authorities: Ministry of Infrastructure ; State Agency on Energy Efficiency

Results: As of 2021, energy management or energy monitoring systems have been implemented in 225 local authorities, while such systems were still being developed in 113 others.

The Law of Ukraine "On Energy Efficiency" provides for the implementation of energy management systems by local self-government bodies on a voluntary basis, upon the decision of the respective council. However, a mandatory condition for obtaining state support (assistance) for the implementation of energy-efficient measures by local self-government bodies is the presence of a decision to implement an energy management system in such bodies.

The Ministry of Infrastructure has developed a draft resolution of the Cabinet of Ministers of Ukraine "Some issues of the functioning of energy management systems", which regulates the implementation of energy management systems and provides a sample procedure for using cost savings resulting from the operation of the energy management system in local self-government bodies.

PM_EE_WEM_09 Local Energy Plans

Objective: Analysis of the state of energy and other infrastructure, potential for implementing energy-efficient measures and increasing the share of renewable energy use, rational use of budget funds, identification of priority projects for attracting investments.

Legislative basis: Law of Ukraine "On Energy Efficiency".

Time limits: 2022-2030

Responsible authorities: Ministry of Infrastructure; State Agency on Energy Efficiency

Results: According to the research and practice of implementing and effectiveness of the Law of Ukraine "On Energy Efficiency" by the Westminster Foundation for Democracy as of January 2023, among 371 surveyed local self-government bodies in 198 communities, energy planning has been implemented or plans have been developed for implementing energy efficiency measures in their communities.[197]

The Law of Ukraine "On Energy Efficiency" laid the foundations for the mandatory implementation of a local energy plan. According to this Law, local self-government bodies must develop local energy plans by November 14, 2024. The Ministry of Infrastructure has approved the Procedure for the development and updating of local energy plans, which should determine the composition, content, and approach to the preparation of such plans..

The Ministry, together with U-LEAD, has piloted the development of local energy plans in accordance with the approaches defined by the Methodology project. The DiXi Group analytical center, with the support of the Dutch government program MATRA and the European Climate Foundation, is also assisting 10 communities in developing local energy plans. The EU STARTER Project also provides support to communities in preparing local energy plans, with plans to prepare 6 plans. However, not all communities can benefit from this support. Measures are needed to strengthen the capacity of communities to develop and update local energy plans and implement energy-efficient measures by the state.

The issue of obtaining information from local self-government bodies from electricity suppliers and natural gas suppliers about the volumes of energy supplied by them and information about the energy

[197] https://drive.google.com/file/d/1zog_bVhIbHofAolvaScYM1elV56S1hKa/view

consumed by consumers within the territory of the respective administrative-territorial unit remains problematic. The obligation to provide such information is enshrined in the Law of Ukraine "On Energy Efficiency", however, the experience of local self-government bodies indicates the need for additional regulation of this issue. One alternative solution to the policy problem is to include a similar requirement in the License Terms for the provision of electricity supply to consumers and the License Terms for the provision of natural gas supply.

PM_EE_WEM_10 Regional decarbonization and energy efficiency offices

Objective: Strengthening cooperation between central and local authorities in the implementation of energy efficiency measures.

Legislative basis: -

Time limits: 2023-2030

Responsible authorities: State Agency for Energy Efficiency.

Results: As of February 2024, three regional offices have been opened, with the first office opened on November 7, 2023.

It is expected that the State Agency on Energy Efficiency and Energy Saving and local government will cooperate in the following main directions:

- energy management: implementation of energy management systems, development of local energy plans, energy certification of buildings, energy audits;
- identification and utilization of the potential for replacing traditional fuels, alternative heat supply, high-efficiency cogeneration, production of biogas and biomethane;
- attracting financial resources for energy-efficient transformation of regions (energy service, municipal green finance, international financial assistance, etc.);
- awareness raising and promotion towards energy efficiency.

PM_EE_WEM_11 Energy Efficient Procurement

Objective: Efficient use of public funds, increasing demand for energy-efficient materials and technologies.

Legislative basis: Law of Ukraine "On Energy Efficiency", Law of Ukraine "On Public Procurement".

Time limits: 2024-2030

Responsible authorities: Ministry of Economy, Ministry of Infrastructure

Results: Adopted policy.

In 2020, changes were made to the Law of Ukraine "On Public Procurement", which allowed the use of life cycle cost as a criterion for evaluating tender proposals. Life cycle cost is the total cost of the procurement item or its part (lot) and other expenses that the contracting authority will incur during the use, maintenance, and termination of the use of the procurement item. Currently, the Ministry of Economy is implementing a project to expand the use of the life cycle cost evaluation method in public procurement.

In addition, the Law of Ukraine "On Energy Efficiency" has introduced energy-efficient procurements. When conducting public procurement of energy-consuming goods, the energy efficiency class of such goods should not be lower than the energy efficiency class determined by the Cabinet of Ministers of

Ukraine in accordance with the requirements of technical regulations on energy labeling, eco-design, or type I environmental labeling. This requirement applies to all customers within the meaning of the Law of Ukraine "On Energy Efficiency". As of February 2024, permissible energy efficiency classes for energy-consuming goods have not been determined.

In the fourth quarter of 2024 in accordance with the Implementation Plan for Long-Term Thermal Modernization Strategy, the Ministry of Infrastructure plans to approve sample technical specifications for the procurement of energy-consuming products, as well as to monitor the proper application of energy consumption requirements within public procurement. In addition, the Ministry of Economy is planning to develop advisory and informational materials on the financial and economic benefits of purchasing high-energy-efficient products (goods) in the case of low-value procurement of energy-consuming products (goods).

PM_EE_WEM_12 Energy Labelling and Eco-design

Goal: Reducing final energy consumption

Legislative basis: Law of Ukraine "On Energy Efficiency", Law of Ukraine "On State Market Surveillance and Control of Non-Food Products", Order of the Ministry of Energy of Ukraine No. 164 dated 27.04.2022 On Approval of the Technical Regulation on Energy Labeling of Energy-Related Products", Resolution of the Cabinet of Ministers of Ukraine No. 804 dated 03.10.2018 On Approval of the Technical Regulation on the Establishment of a System for Determining Requirements for Energy-Related Products' Eco-design

Time limits: 2024-2030

Responsible authorities: Ministry of Infrastructure, Ministry of Economy, State Agency for Energy Efficiency, State Consumer Protection Service.

In order to fulfill Ukraine's obligations under the Association Agreement between Ukraine and the European Union and the Treaty establishing the Energy Community, Ukraine is implementing a system of energy labeling and setting requirements for energy design of consumer goods in accordance with EU legislation. In Ukraine, there are currently 2 framework technical regulations, 24 technical regulations that establish requirements for energy design of specific groups of consumer goods, and 15 technical regulations for energy labeling.

Market supervision of compliance with requirements for eco-design and energy labeling is carried out by the State Consumer Service. During 2021, 118 checks of energy-consuming goods characteristics were conducted. As a result of the conducted checks, 131 restrictive (corrective) measures were adopted, namely:

- 130 decisions on restricting the provision of goods on the market;

- 1 decision on banning the provision of goods on the market.

Checks of the characteristics of energy-consuming goods were also carried out, with samples taken for expert examination (testing), including luminaires, light bulbs, and LED lamps. Out of the 68 samples taken, 35 samples did not meet the established requirements.

In connection with the introduction of martial law, the Cabinet of Ministers of Ukraine adopted Resolution No. 303 dated March 13, 2022. On the cessation of state supervision (control) and state market surveillance in conditions of martial law.

PM_EE_WEM_13 Experimental project to create favorable conditions for efficient electricity consumption in Ukraine

Goal: Reducing final energy consumption, reducing the load on the energy system, behavioral changes.

Legislative basis: Resolution of the Cabinet of Ministers of Ukraine No. 25 dated 10.01.2023 On the implementation of an experimental project to create favorable conditions for efficient electricity consumption in Ukraine.

Time limits: 2023-2024

Responsible authorities: Ministry of Economy

*Results: as of 11.10.2023, 21.56 million LED lamps were issued, including: 20.29 million to individuals; 1.27 million to legal entities (including housing cooperatives - 274,619 units). 16.39 million incandescent lamps were disposed of. The calculated energy savings achieved amount to 1.17*GW*hours.

The Ministry of Economy is implementing an experimental project to replace 50 million incandescent lamps with new LED lamps. Ukrainian citizens who have reached the age of 18 and certain categories of legal entities have the right to participate in the project: healthcare, education, culture, social welfare institutions (municipal and state-owned), physical education and sports institutions (municipal), managers of multi-apartment buildings, associations of co-owners of multi-apartment buildings. Individuals can receive up to five energy-efficient lamps, while legal entities can receive 2 or 3 lamps per 10 m2 depending on the type of premises. Lamps are delivered through the branches of JSC "Ukrposhta".

The project is being implemented with the support of the EU, which financed the purchase of 35 million LED lamps, and France, which additionally financed the purchase of another 5 million lamps.

Based on the results of the experimental project implementation, an approach to gradually phasing out incandescent lamps from the Ukrainian market will be determined.

PM_EE_WEM_14 Energy audit of large enterprises

Objective: Analysis of energy consumption profile and identification of optimal energy-efficient measures

Legislative basis: Law of Ukraine "On Energy Efficiency", Resolution of the Cabinet of Ministers of Ukraine No. 1258 dated 01.12.2023 "On Approval of the Procedure for Conducting and Requirements for Energy Audit of Processes and Transport".

Time limits: 2024-2030

Responsible authorities: Ministry of Infrastructure

Results: Adopted policy.

The Law of Ukraine "On Energy Efficiency" introduced mandatory energy audits for large enterprises every four years. As of 2022, this requirement applied to 494 companies. The first energy audits must be conducted by November 14, 2024. In December 2023, the Procedure for conducting and requirements for energy audits of processes and transport was adopted, which regulates the procedures for preparation, conduct, and documentation of results regarding energy audits of processes and transport, as well as minimum requirements for the form and content of the report and extract from the energy audit report. Energy audits must be carried out in accordance with national standards harmonized with European ones: DSTU EN 16247-3:2015 "Energy audits. Part 3. Processes (EN 16247-3:2014, IDT)" and DSTU EN 16247-4:2015 "Energy audits. Part 4. Transport (EN 16247-4:2014, IDT)". The objectives and boundaries of energy audits are determined by the customer. In the future, this may lead to a situation where mandatory energy audits of companies operating in the same industry will be incomparable.

Mandatory energy audits can be conducted by energy auditors who have undergone qualification confirmation in the areas of buildings, processes, or transportation. The procedure for confirming the qualifications of individuals intending to carry out activities related to energy audits and the qualification

requirements for energy auditors must be approved by the Cabinet of Ministers of Ukraine. As of the beginning of February 2024, such regulatory acts have not been adopted. Thus, large business entities do not have the opportunity to comply with the requirements of the Law of Ukraine "On Energy Efficiency".

Alternatively, large business entities have the right to implement energy and/or environmental management systems. Such systems must be certified according to ISO 50001 and/or ISO 14001 standards.

[198][199][200][201]During public consultations on the NECP, participants noted that the state imposes requirements for mandatory energy audits, but does not provide opportunities to implement energy efficiency measures. The main barrier to improving energy efficiency of enterprises is the complexity of and high cost of attracting financing. As of 2024, it can be noted that there is no systematic support from the state for the implementation of energy efficiency measures by enterprises. Ukraine has separate donor and IFI programs to support such measures: UNIDO Credit Guarantee Fund, "Add Energy to Your Business" Program by KfW, Finnish-Ukrainian Trust Fund (program completed). The results of these programs can be used as an analytical basis for designing state support programs. The Project of the Strategy for Recovery, Sustainable Development, and Digital Transformation of Small and Medium-sized Enterprises until 2027, developed by the Ministry of Economy, provides for the implementation of a voucher program for professional energy audits and subsidies for improving energy efficiency for micro and small businesses. In particular, energy audits are expected to be conducted at enterprises in sectors such as agriculture, forestry, fisheries, mining and quarrying, processing industry, electricity supply, natural gas supply, water supply and wastewater management, waste management, and construction. Among the measures under the direction of "Energy Efficiency", the NECP includes the launch of a state program for financial support of energy efficiency improvement for small and medium-sized enterprises.

In addition, potential support for energy efficiency measures for enterprises can be provided by the Decarbonization Fund (PM_EE_WEM_02).

v. Where applicable, a description of policies and measures to promote the role of local renewable energy communities in contributing to the implementation of policies and measures in points i, ii, iii and iv

Currently, the provisions of Directive (EU) 2018/2001 on the activity and promotion of RES communities are not fully transposed into Ukrainian legislation. The Law of Ukraine "On Alternative Energy Sources" regulates the incentive instruments for one type of RES communities - energy cooperatives. Energy cooperatives have the opportunity to receive feed-in tariff for the electricity generated or receive incentives through the self-generation mechanism (net-billing).

NEURC has developed a draft law of Ukraine "On Amendments to Certain Laws of Ukraine on Transposing Acts of the Energy Community", which, among other things, regulates the activities of energy communities. The provisions of this draft law aim to transpose the requirements of Directive (EU) 2019/944. The draft law provides for the possibility of providing energy efficiency services by energy consumer associations. However, it is not specified what exactly these services are, as well as the rights and obligations of energy consumer associations in connection with the provision of such services.

[198] http://www.ukriee.org.ua/uk/proekt/komponenti/komponent-3-finansoviy-mekhanizm/

[199] https://bdf.gov.ua/programs/prohrama-doday-enerhiyi-tvoyemu-biznesu/

[200] https://saee.gov.ua/uk/content/finland-ukraine-trust-fund

[201] https://www.me.gov.ua/Documents/Detail?lang=uk-UA&id=454b13bc-3503-4185-b59d-b60f6467748c&title=ProektStrategiiVidnovlennia-StalogoRozvitkuTaTsifrovoiTransformatsiiMalogoTaSerednogoPidprimnitstvaNaPeriodDo2027-Roku&fbclid=IwAR3tv4Zf_xZIiuhKg38ppQFaL924oxRcPygt4byALbnSC9KRu5T8mZkfRvA

vi. Description of measures to develop measures to utilise energy efficiency potentials of gas and electricity infrastructure

PM_EE_WAM_04 Assessment of the energy efficiency potential of the gas transmission system, power transmission system, gas distribution systems, power distribution systems

Objective: to increase the efficiency of energy networks, stimulate investment in energy efficiency measures.

Legislative basis: Law of Ukraine "On Energy Efficiency"

Time boundaries: 2021-2030

Responsible authorities: Ministry of Energy, National Commission for State Regulation of Energy and Public Utilities, State Agency on Energy Efficiency

Results: Adopted policy.

The transmission system operator and electricity distribution system operators, as well as the gas transmission system operator and gas distribution system operators, must assess the energy efficiency potential of their respective systems every 5 years in accordance with the Law of Ukraine "On Energy Efficiency". Such assessment should be carried out in accordance with the Methodology approved by the Ministry of Energy. As of February 2024, the Methodology is under development.

At the same time, transmission, transportation, and distribution system operators are subject to mandatory energy audits (more details: PM_EE_WEM_14 Energy Audit of Large Enterprises). The results of such audits will be taken into account when assessing energy efficiency potential. The National Commission for State Regulation of Energy and Public Utilities (NEURC) has adopted Resolution No. 4 dated 10.01.2024 "On Approval of Amendments to Certain License Conditions," which includes a requirement for conducting an energy audit as a condition for conducting economic activities in the transmission of electricity, production of electricity, supply of electricity to consumers, and distribution of electricity. Requirements for conducting energy audits have already been included in the License Conditions for the production of thermal energy, transportation of thermal energy through main and local (distribution) thermal networks, and supply of thermal energy.[202][203]

In accordance with Resolution of the National Commission for State Regulation of Energy and Public Utilities No. 222 dated January 30, 2024, "On Approval of Amendments to the Procedure for Monitoring Compliance by Licensees Engaged in Energy and Municipal Services, Legislation in the Relevant Sectors, and License Conditions," the Regulator may impose fines on licensees in the amounts provided, in particular, by the Law of Ukraine "On Energy Efficiency". At the same time, the amounts of fines for non-performance of mandatory energy audits in accordance with this Law as of February 2024 are not established.[204][205]

PM_EE_WEM_15 Smart metering

Objective: to promote active consumer participation in regulating their consumption (demand management), as well as other participants in the electricity market in providing balancing and ancillary

[202] https://www.nerc.gov.ua/acts/pro-zatverdzhennya-zmin-do-deyakih-licenzijnih-umov

[203] https://zakon.rada.gov.ua/laws/show/v0308874-17#Text

[204] https://www.nerc.gov.ua/acts/pro-zatverdzhennya-zmin-do-poryadku-kontrolyu-za-dotrimannyam-licenziatami-shcho-provadyat-diyalnist-u-sferah-energetiki-ta-komunalnih-poslug-zakonodavstva-u-vidpovidnih-sferah-ta-licenzijn-7

[205] https://www.nerc.gov.ua/storage/app/uploads/public/647/a27/0a6/647a270a68097079576461.pdf

services, obtaining accurate information for billing based on actual energy consumption and actual consumption time.

Legislative basis: Law of Ukraine "On Energy Efficiency", Code of Commercial Accounting of Electricity, approved by the resolution of the National Commission for Energy, Housing and Utilities Services Regulation No. 311 dated 14.03.2018

Time limits: 2018-2030

Responsible authorities: Ministry of Energy, NERC.

Results: As of the end of 2022, 2.2 million smart meters with remote reading and management were installed in residential consumers. For 2023, the installation of an additional 464 thousand such meters was planned. The average level of smart metering for residential consumers is 12.4%. Data on non-residential consumers is not available.[206]

In accordance with the Law of Ukraine "On Energy Efficiency," the transmission system operator and electricity distribution system operators, as well as the gas transmission system operator and gas distribution system operators, based on the assessment of technical feasibility and economic viability of installing smart metering systems, take measures to install smart metering systems.

The issue of installing smart meters and automated systems for commercial metering of electricity (ASCME) is regulated by the Code of Commercial Metering of Electricity. Commercial metering administrators must provide the National Commission for State Regulation of Energy and Public Utilities (NEURC) with the results of the economic analysis of all long-term benefits and costs for market participants from the implementation of smart meters and ASCME, functional requirements for such equipment, and proposals for an economically justified and profitable method of implementing smart meters and ASCME, as well as the timelines within which this automated metering can be implemented. Smart meters must be equipped with commercial metering platforms that include:

- power installations with a connected capacity of 150 kW or more, or a monthly electricity consumption volume of over 50,000 kW·h at consumer facilities (excluding multi-apartment residential buildings and household consumers);
- generating units and/or energy storage power installations capable of supplying electricity to the power grid;
- consumer's electrical installations at their initiative.

The issue of smart meters of natural gas is described in the PM_IMG_WAM_15 policy. Analysis of telemetry benefits and costs.

PM_EE_WEM_16 Regulation of combined heat and power generation (cogeneration)

Objective: to establish a legal framework for improving fuel efficiency in energy production processes or other technological processes, as well as the development and application of cogeneration technologies.

Legislative basis: Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Utilization of Waste Energy Potential"

Time limits: 2005-2030

Responsible authorities: Ministry of Infrastructure, NERC, Ministry of Energy

Results: As of the end of 2021, the installed capacity of thermal power plants and cogeneration units was approximately 6 GW All major thermal power plants were put into operation before Ukraine gained

[206] https://map.ua-energy.org/uk/resources/b676f89a-188b-4179-8d56-1b984a2e477f/

independence Expected results: The NECP envisages a significant increase in the capacity of thermal power plants through the construction of biomass-based plants, with the capacity of such units reaching 4.1 GW by 2050

The Law of Ukraine "On Combined Heat and Power Generation (cogeneration) and the Use of Waste Energy Potential" regulates relations related to the peculiarities of production, transmission, distribution, and supply of electrical and thermal energy from cogeneration plants. The state policy in the field of cogeneration plants is based on the principles:

- support for the conversion of existing heat generating facilities into combined heat and power plants;
- creation of distributed (local) power generation capacities as a condition for increasing reliability and security of energy supply at the regional level;
- economic stimulation of the use of cogeneration plants at enterprises regardless of ownership form and industry affiliation.

The Law defines the provision of unrestricted access to local (local) electrical networks and the sale of generated electrical energy to separate consumers by owners (users) of cogeneration plants as a means of stimulating cogeneration, including the right to supply electrical energy to the consumer during the hours of the highest or average load on the electrical network (peak and semi-peak periods of the day) simultaneously (additionally) with the main electricity supplier.

The Law of Ukraine "On Heat Supply" includes the implementation of cogeneration units, including those based on existing heating boilers, as part of the development directions for heating systems.

In 2023, a number of legislative changes were developed aimed at increasing the number of cogeneration units:

- A simplified procedure for connecting individual energy consumers to the networks of electricity producers using cogeneration units (CHP) with a capacity of up to 20 MW is provided. Such producers have the right to provide electricity to their own critical infrastructure objects through internal power supply networks or critical infrastructure objects (with the consent of local self-government bodies);
- The peculiarities of legal relations between consumers and electricity producers at CHP plants with a capacity of up to 20 MW during emergency or planned shutdowns or restrictions by the distribution/transmission system operator have been regulated. In such cases, electricity can be provided under a backup power supply agreement. Backup power supply for consumer facilities is not an activity related to electricity supply and distribution/transmission, and can only be carried out by electric networks that are separate from the power system of Ukraine.
- The features of connecting power facilities of critical infrastructure objects to the Unified Power System with a capacity of up to 20 MW have been regulated;
- The activity of producing thermal energy by economic entities has been exempted from licensing if the production of thermal energy is carried out without the purpose of its sale and is consumed for own needs, or is produced by the Unified Power System, the total nominal active electrical power (total installed thermal power) of which does not exceed 5 MW (4.3 Gcal/h), and which are used as a backup energy source during power outages from the system operator's networks for critical infrastructure objects and/or heating, water supply, sewage systems, social facilities (educational institutions, healthcare facilities (except sanatoriums)).

PM_EE_WEM_17 Heat supply schemes

Objective: planning the most economically efficient heat supply to the settlement, reducing the volume of energy resources used for the production, transportation, and supply of one unit of thermal energy to consumers.

Legislative basis: Law of Ukraine "On Heat Supply"; Order of the Ministry of Development of Communities and Territories of Ukraine No. 235 dated 02.10.2020 On Approval of the Methodology for Developing Heat Supply Schemes for Settlements in Ukraine

Time boundaries: 2005-2030

Responsible authorities: Ministry of Infrastructure.

Results: As of November 2023 In 30 settlements with a population of more than 20 thousand, approved and valid heat supply schemes were in place. Another 96 communities require the development or updating of heat supply schemes.

The heat supply scheme is a tool for long-term planning of heat supply to settlements, which is formed based on the optimal combination of centralized and autonomous heat supply systems. The general plan of the settlement serves as the basis for the development of the heat supply scheme. Heat supply schemes are developed using the method of cost and benefit analysis to select the recommended heat supply scenario. Long-term planning of heat supply to settlements aims at the development of efficient centralized heat supply systems, with a gradual replacement of traditional heat sources using natural gas for:

- combined heat and power generation plants (cogeneration plants);
- installations that use renewable energy sources;
- installations for the utilization of waste heat energy.

When developing heat supply schemes, zones of application for centralized, autonomous, and individual heat supply systems are determined.

The validity period of such documents is 10 years. Heat supply schemes for settlements with a population of more than 20,000 are approved by the Ministry of Infrastructure, and in other settlements - by local self-government bodies.

To ensure compliance with the principle of 'energy efficiency first,' projects for the modernization of heat sources and heat networks should be developed after the development of building thermal modernization. Currently, thermal modernization is being carried out in individual buildings, while the Long-Term Thermal Modernization Strategy envisages a significant increase in the scale of thermal modernization. Thermal modernization of buildings and centralized heating systems should be carried out in a coordinated manner within the framework of a comprehensive approach to addressing these interconnected tasks.

PM_EE_WAM_05 Assessment of the potential for efficient centralized heating and high-efficiency cogeneration

Objective: to increase the efficiency of heat production and transportation, identification of the optimal set of energy-efficient measures, stimulation of investments in energy-efficient measures.

Legislative basis: Law of Ukraine "On Energy Efficiency"; Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Use of Waste Energy Potential" regarding the development of high-efficiency cogeneration"

Time boundaries: 2021-2030

Responsible authorities: Ministry of Infrastructure.

Results: Adopted policy.

Assessment of the potential for the application of efficient centralized heating and high-efficiency cogeneration is carried out at the local and national levels. At the local level, the assessment of the potential for the application of efficient centralized heating and high-efficiency cogeneration is a separate section of the heating scheme, developed based on cost and benefit analysis, and includes, among other things:

- description and map of the territory indicating existing and potential heat energy consumption facilities, existing and planned objects in the field of heat supply, potential sources of heat energy, including industrial installations or other objects that generate waste heat energy;
- assessment of the energy and technical potential of efficient centralized heat supply and high-efficiency cogeneration;
- calculation of the primary energy savings target;
- assessment of local, regional, national, and international support programs for the production, transportation, and supply of thermal energy, including the potential share of non-repayable assistance, if any.

Assessment of the potential for the use of high-efficiency cogeneration is mandatory at the level of individual installations in case of significant renovation of an existing or construction of a new heat-generating installation (with a thermal capacity of over 20 MW) before the start of construction, major repairs, reconstruction, or technical re-equipment. It should be noted that this provision of the Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and the Use of Discounted Energy Potential" regarding the development of high-efficiency cogeneration" (effective from 22.03.2024) should be brought into line with Directive 2012/27/EU.

The Ministry of Infrastructure should approve a national report on the comprehensive assessment of the potential for the application of efficient centralized heating and high-efficiency cogeneration every five years and submit it to the Secretariat of the Energy Community for consideration. Currently, secondary legislation for the formation of the national report is under development.

PM_EE_WEM_18 Qualification of cogeneration units

Objective: to establish compliance with the conditions and performance indicators of the cogeneration unit according to the law.

Legislative basis: Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Utilization of Waste Energy Potential"; Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Utilization of Waste Energy Potential" regarding the development of high-efficiency cogeneration"

Time limits: 2024-2030

Responsible authorities: State Agency for Energy Efficiency.

Results: In 2022, 39 cogeneration units of 24 economic entities were qualified in Ukraine.

Cogeneration units that supply a portion or the entire amount of generated electricity to consumers can be considered qualified if they meet one of the following conditions:

- the waste energy potential of technological processes is used as the main fuel; for such units, the production of thermal energy is not mandatory.

- fossil fuel is used as the main fuel, with the volume of released thermal energy being no less than 10 percent of the total electricity and thermal energy production within one year from its commissioning and within every subsequent 12 months; during the specified period, the volume of released electricity and thermal energy in relation to the energy of the main and additional fuel should be no less than 42 percent.

The qualification of cogeneration plants is carried out by the State Agency for Energy Efficiency in accordance with the Order of the Ministry of Energy of Ukraine dated 21.07.2021. No. 155 "On Approval of the Procedure for Qualification of Cogeneration Plants".

According to the Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Use of Waste Energy Potential" regarding the development of high-efficiency cogeneration", cogeneration plants can be qualified if they are high-efficiency cogeneration plants, and qualification requirements for such plants are determined.

The stimulating policy instruments for the use of qualified cogeneration units include exemption from excise tax in the amount of 3.2% (subparagraph 213.2.8 of paragraph 213.2 of Article 213 of the Tax Code of Ukraine) for the sale of electricity generated by qualified cogeneration units and the possibility of obtaining guarantees of origin for electricity generated by highly efficient cogeneration units. From 22.03.2024. Exemption from excise tax will apply exclusively to highly efficient cogeneration.

PM_EE_WAM_06 Guarantees of origin for electricity generated by high-efficiency cogeneration units

Objective: to provide end consumers of electricity with information that the electricity is generated by a highly efficient cogeneration unit.

Legislative basis: Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Utilization of Waste Energy Potential" regarding the development of highly efficient cogeneration"

Time limits: 2024-2030

Responsible authorities: State Agency for Energy Efficiency.

Results: Adopted policy.

The owner (user) of a high-efficiency cogeneration plant has the right to receive a guarantee of origin for the electricity generated by the high-efficiency cogeneration plant. Guarantees of origin in the form of an electronic document are provided by the State Agency on Energy Efficiency and Energy Saving free of charge. The guarantee of origin corresponds to the standard volume of electricity released into the grid, which is determined with an accuracy of 1 MWh. The validity period of the guarantee of origin is 12 months. To obtain guarantees of origin for the generated electricity, the owner (user) of a high-efficiency cogeneration plant must undergo a qualification process for the cogeneration plant.

PM_EE_WAM_07 Stimulating the development of high-efficiency cogeneration

Goal: stimulating investments in high-efficiency cogeneration.

Legislative basis: Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Utilization of Waste Energy Potential" regarding the development of high-efficiency cogeneration"; Ukraine's Plan project

Responsible authorities: Ministry of Infrastructure.

Results: Planned policy. Expected results: installation of at least 300 MW of gas turbine and gas piston units.

Among the key investment priorities, the Ukrainian Plan identifies the expansion of distributed local generation through the installation of gas turbine and gas piston units. According to the Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Utilization of Waste Energy Potential" regarding the development of high-efficiency cogeneration", the guarantee of origin of electricity produced by a high-efficiency cogeneration unit is not sufficient incentive to attract financing for the construction of new capacities. In view of this, it is proposed to plan an assessment of alternative policies for the construction of new high-efficiency cogeneration capacities and the development of corresponding legislative changes.

The analytical basis for the development of the corresponding policy tool, in addition to assessing the potential for the application of efficient centralized heating and high-efficiency cogeneration , can be the results of the USAID Energy Security Project. Within the framework of this project , USAID purchases 91 cogeneration units for 32 cities in Ukraine and two universities; the total capacity of the units is 56.5 MW.

There is significant potential for interaction between RES and existing centralized heating systems to balance wind and solar power plants. To realize this potential, it is necessary to build new flexible cogeneration units to meet peak electricity demand. Such units can be supplemented with heat pumps or electric boilers, along with thermal accumulators, to utilize excess electricity during off-peak hours and store thermal energy.[207]

PM_EE_WEM_19 Heat energy metering

Objective: providing consumers with accurate information on the volume of consumed municipal services (services for the supply of thermal energy, supply of hot water, centralized water supply)

Legislative basis: Law of Ukraine "On commercial accounting of thermal energy and water supply"; Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine No. 206 dated 09.08.2018 "On approval of the Procedure for equipping buildings with commercial accounting units and engineering equipment for ensuring such accounting"; Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine No. 205 dated 09.08.2018 On approval of the Procedure for equipping separate premises in buildings with distribution accounting units/distribution devices for thermal energy and engineering equipment for ensuring such accounting"; Resolution of the Cabinet of Ministers of Ukraine No. 829 dated 10.10.2018 On approval of the Procedure for determining the technical feasibility of installing thermal energy distribution accounting units and the economic feasibility of installing thermal energy distribution devices

Time limits: 2017-2030

Responsible authorities: Ministry of Infrastructure; State Agency on Energy Efficiency

Results: as of 20.01.2024, 84.9% of residential buildings and 83.9% of non-residential buildings are equipped with commercial metering units for thermal energy.[208]

The Law of Ukraine "On Commercial Metering of Thermal Energy and Water Supply" introduces mandatory commercial metering of thermal energy and water supply. This Law prohibits the connection of residential and non-residential buildings to external engineering networks without equipping such

[207] Yevhen Nikitin. Integrated approach to electricity and centralized heating.. https://www.nas.gov.ua/UA/PersonalSite/Pages/default.aspx?PersonID=00000094122

[208] https://saee.gov.ua/sites/default/files/Oblik_20_01_2024.pdf

buildings with metering units for corresponding municipal services. Commissioning of newly constructed residential and non-residential buildings is carried out only if these buildings and premises are equipped with appropriate metering units for commercial and distribution accounting.

The responsibility for installing commercial metering points lies with the operator of external engineering networks (the owner of external engineering networks or the person to whom such networks have been transferred for use). The owner (co-owners) of the building may also independently equip the building with commercial metering points in accordance with the legislation. The costs of the operator of external engineering networks for equipping existing buildings with water and heat energy commercial metering points are included in the tariffs for the respective municipal services. If the commercial metering point was installed by the owner (co-owners) of the building, such costs must be reimbursed by the operator of external engineering networks by crediting its cost to future payments for heat energy supply, hot water supply, centralized water supply services. Considering that heat supply tariffs are sensitive to the population and are maintained at a level that does not allow for all necessary measures to be implemented, including the installation of metering points, the Law provides for the possibility for local self-government bodies to allocate funds from the local budget for equipping existing buildings with commercial metering points. The state budget can also be a source of funding for such measures.

100% commercial metering of thermal energy should be ensured within 24 months from the date of termination or cancellation of the martial law in Ukraine. Initially, the achievement of this indicator was planned for 03.08.2018, later it was postponed to 01.09.2022, and for the third time postponed by changes to Law No. 2479-IX of 29.07.2022. To ensure 100% accounting of thermal energy, it is necessary to assess the necessary financial resources and establish the obligation to include the necessary funds in the tariff for thermal energy or provide funding from other sources (direct funding from the State Budget, subsidy to local self-government bodies).

The Law of Ukraine "On Commercial Accounting of Thermal Energy and Water Supply" also regulates the distribution metering of thermal energy. Installation of thermal energy distribution metering nodes is mandatory for new residential and non-residential buildings. In case it is not technically feasible to equip the centralized heating system of a building with distribution metering nodes, the distribution metering of consumed thermal energy in individual premises in buildings is carried out using thermal energy allocators, except when it is economically non-feasible. The readings of thermal energy distribution devices are used for the distribution of the volume of consumed thermal energy in the building only if at least 50 percent of heating devices (except those located in common areas of multi-apartment buildings) in the building are equipped with such devices.

PM_EE_WAM_08 Implementation of the State Targeted Economic Program for Energy Modernization of Heat Energy Producing Enterprises in State or Municipal Ownership, for the period up to 2030

*Objective: to increase the efficiency of functioning of centralized heat supply systems in settlements, reduce specific fuel and energy costs, and increase the share of renewable energy, waste heat energy, as well as heat energy generated in the process of*cogenerationin centralized heat supply systems.

Legislative basis: Law of Ukraine "On Energy Efficiency"; Order of the Cabinet of Ministers of Ukraine No. 1093 dated 28.11.2023 On approval of the Concept of the State Targeted Economic Program for the Energy Modernization of Heat Energy Producing Enterprises in State or Municipal Ownership for the period up to 2030

Time boundaries: 2023-2030

Responsible authorities: Ministry of Infrastructure.

Results: Adopted policy. Expected Program Results:

- reduction of annual natural gas consumption by over 1 billion cubic meters;
- reduction of annual greenhouse gas emissions by approximately 2 Mt CO2-eq;
- reduction of specific fuel consumption for heat production to 150 kg u.p./Gcal;
- reducing the share of heat energy losses in heat networks to 11 percent;
- increasing the share of alternative energy sources in heat energy production to 30 percent;
- ensuring 100 percent commercial metering of heat energy.

The measures are provided for in the Concept of the State Targeted Economic Program for the Energy Modernization of State or Municipal Heat Energy Producing Enterprises for the period up to 2030 and include:

- support and stimulation of local self-government bodies in the development and updating of heat supply schemes for settlements by reimbursing a portion of the cost of work;
- reimbursement to local self-government bodies for a portion of the cost of work on the development and updating of heat supply schemes for settlements;
- stimulation of heat supply companies in equipping consumer buildings with commercial metering units (including remote data transmission) to ensure 100 percent commercial metering of thermal energy.
- providing co-financing for local self-government bodies and heat supply enterprises to equip buildings with individual heat points with automatic regulation depending on weather conditions.
- partial reimbursement of the cost of capital repairs and reconstruction of heat supply facilities to local self-government bodies and heat supply enterprises;
- partial reimbursement of the cost of measures provided for by the current heat supply scheme to local self-government bodies and heat supply enterprises.

The Ministry of Infrastructure expects the estimated cost of modernizing Ukraine's centralized heat supply systems to be in the range of 4 to 15 billion euros.

vii. Regional cooperation in this area, where applicable

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viii. Financing measures, including Union support and the use of Union funds, in the area at national level

Name of the funding program	Source of funding - not available	Time limits	Funding volume	Objective
State Targeted Economic Program for Energy Efficiency and Development of Energy Carrier Production from Renewable Energy Sources and Alternative Fuels for 2010-2021	State budget of Ukraine	2010-2021	3.8 billion UAH	Approximation of energy intensity of Ukraine's gross domestic product to the level of developed countries and European Union standards, optimization of the country's energy balance structure.
Energy Efficiency Fund	State budget of	2018-	2.8 billion	Support for implementing measures to

	Ukraine	2023	UAH	improve the energy efficiency of buildings, particularly in the residential sector, and reduce carbon dioxide emissions
Decarbonization and Energy Efficiency Transformation Fund	State budget of Ukraine	2023	759.2 million UAH	Ensuring sustainable source of funding for supporting state programs on energy efficiency, alternative energy sources, and decarbonization.
Support Program Energy Efficiency in Ukraine - EE4U	European Neighborhood Instrument	2018 - 2025	104 million euros	Supporting the activities of the Ukrainian Energy Efficiency Fund; raising awareness and investment support for energy efficiency measures from the general public at the local level, familiarizing with energy-saving measures and popularizing the support mechanisms of the Energy Efficiency Fund; training energy auditors to support the implementation of reforms in the field of energy efficiency and preparation and verification of the activities of the Energy Efficiency Fund
Urban Infrastructure Development Project - 2	International Bank for Reconstruction and Development	2014 - 2024	326.6 million US dollars	Improving the quality and efficiency of water supply, wastewater management, and solid waste disposal services in selected cities of Ukraine.
Project "Improving Energy Efficiency in the Centralized Heating Sector of Ukraine"	International Bank for Reconstruction and Development	2014 - 2023	382 million USD	Providing assistance to municipal enterprises participating in the project in improving economic and energy efficiency, minimizing fuel and energy costs, improving their institutional capacity, and investing in improving the reliability of heat supply systems through reconstruction of centralized heat supply systems (heat generation and transportation), as well as improving the environmental situation in the regions.
Project "Program for the Development of Municipal Infrastructure in Ukraine"	European Investment Bank	2016 - 2025	400 million euros	Implementation of projects aimed at the reconstruction, modernization, and/or minimization of deterioration of infrastructure in the areas of heating, water supply, and wastewater management. Energy efficiency of buildings, outdoor lighting in settlements, waste management.
Project 'Energy Efficiency	European	2021 -	300 million	Improving the energy efficiency of

of Public Buildings in Ukraine'	Investment Bank	2025	euros	buildings owned by local self-government bodies (including kindergartens, hospitals, schools, cultural and administrative buildings).
E5P Fund 'Eastern Partnership for Energy Efficiency and Environment' energy efficiency and environment	European Bank for Reconstruction and Development	2009 - 2029	137.5 million euros	Support for investments in municipal infrastructure aimed at improving energy efficiency in Ukraine, as well as positively impacting the environment and combating climate change
Project "Energy Efficiency in Communities"	KfW - German Credit Institution for Reconstruction	2021 - 2051	35.4 million euros	Increasing energy efficiency of selected buildings in the budget sector in the cities of Zhytomyr and Zaporizhia through thermomodernization of public buildings, which should contribute to significant reduction of municipal budgets' expenditures on energy carriers
Project "Refinancing of energy-efficient investments of small and medium-sized enterprises in Ukraine through the financial sector"	KfW - German Credit Institution for Reconstruction	2022 - 2052	7.4 million euros	Funding acceptable Ukrainian financial institutions by providing sub-loans to Ukrainian small and medium-sized enterprises and private entrepreneurs for financing energy efficiency investments

3.3. Dimension Energy Security

i. Policies and measures related to the elements set out in point 2.3

PM_ES_WEM_01 Development of routes for the import of petroleum products and natural gas

Objective: Preserving diversification of oil products and natural gas supply; use of infrastructure capacity (GTS, oil product pipelines)

Legal basis: Energy Strategy of Ukraine until 2050

Time limits: until 2025/2032, depending on the tasks

Responsible authorities: Ministry of Energy

Results: Before the war, the motor fuel market was 80% dependent on imports, mainly from Russia and Belarus; a significant portion of imports also came by sea. During 2022, the situation changed completely: the destruction of oil refining capacities led to almost 100% import dependence, the blockade of seaports made import through this route impossible, thus ensuring full diversification of sources and supply routes for petroleum products and liquefied petroleum gas (LPG). In the future, the speed of unblocking seaports and the restoration of oil refining will influence the geography of imports.

The Energy Strategy of Ukraine by 2050 includes among the strategic initiatives and tasks:

- by 2025: diversification of technologies and supply routes to exclude possible energy crises and shortages in case of emergencies.
- By 2032: expansion of channels for the supply of petroleum products from refineries and ports of the EU.

In the natural gas market, the task until 2025 is to diversify supply routes in order to avoid possible energy crises and shortages in case of emergencies, including the creation of routes for the import of liquefied natural gas (LNG).

A long-term initiative is the creation of a gas hub, which includes access to LNG terminals in Poland, Greece, Croatia, Turkey, Italy, and Germany. The practical implementation of the policy will depend on market participants - importing gas from LNG terminals can be realized through long-term contracts or through the purchase and reservation of available volumes on spot markets through swap operations and related routes. See sections 1.2.iii (Key cross-border issues) and 2.4.2.i (Key infrastructure projects in the field of electricity and gas transmission) for more details.

PM_ES_WAM_01 Incentives for increasing gas production for maximum self-sufficiency

Goal: Preserving the diversification of natural gas supply; use of infrastructure capacity (GTS); securing the economy with its own resource

Legal basis: Energy Strategy of Ukraine until 2050

Time limits: until 2025/2032, depending on the tasks

Responsible authorities: Cabinet of Ministers, State Service of Geology and Subsoil, Ministry of Energy

Results: Energy Strategy of Ukraine by 2050 includes, among strategic initiatives and tasks:

- by 2025:
    - Increasing production within PEC contracts;
    - Implementation of production sharing agreements signed in 2020-2022 over 11 areas with hydrocarbon deposits
    - Research and industrial development of areas obtained by extractive companies through electronic auctions
    - Active involvement of international service companies with modern technologies by extractive companies
- until 2032
    - Attracting investors to conclude new production sharing agreements
    - Amendments to legislation and granting of separate legal status to tight gas collectors as a separate valuable mineral
    - Attracting investments to increase gas production in existing fields, development of unconventional gas fields
    - Adoption of regulatory acts on the rules for the restoration of the operation of preserved and liquidated wells

Subject to the implementation of the strategic initiatives mentioned in the ESU, the projected extraction volumes by 2030 will be approximately 21.5 billion cubic meters. The start of production is projected for the period 2025-2032. By 2032, private companies are expected to reach an annual production of 5.8

billion cubic meters. State-owned companies ("Ukrnafta", "Ukrgazvydobuvannya") - approximately 15.5 billion cubic meters. The total amount of investments is estimated at about 100 billion UAH by 2030.

In an optimistic scenario, private companies are expected to reach an annual production of 6.7 billion cubic meters by 2032. and state-owned companies - 20.1 billion cubic meters. The total investment volume is estimated at around 150 billion UAH by 2030. However, achieving a total production volume of 26.8 billion cubic meters will only be possible through investments in new fields, including the development of gas deposits in tight reservoirs and on the Black Sea offshore. In addition, reaching a total production volume of 26.8 billion cubic meters will only be possible through investments in new fields, including the development of gas deposits in tight reservoirs and on the Black Sea offshore. In addition, reaching a total production volume of 26.8 billion cubic meters will only be possible through investments in new fields, including the development of gas deposits in tight reservoirs and on the Black Sea offshore.

According to information obtained during working consultations, it is realistic to maintain extraction volumes at the current level with a slight increase, which will allow to reduce dependence on imports to some extent. Transition to full coverage of own consumption by 2030 is possible with additional measures to support the production of biomethane and reduce domestic natural gas consumption. Continuation of such a policy will allow to rely on the export of residual volumes (or an increase in the production of products that require the use of gas as raw materials) in a later period.

See also the policies and measures of the Dimension Internal energy market.

PM_ES_WAM_02 Restoration of oil refining and/or construction of a new complex

Goal: Meet the demand for petroleum products through domestic oil refining

Legal basis: Energy Strategy of Ukraine until 2050

Time limits: until 2025/2032, depending on the tasks

Responsible authorities: Ministry of Energy, Cabinet of Ministers

Results: Energy Strategy of Ukraine until 2050, aiming to develop oil production and restore oil refining based on one of the existing refineries and/or construction of a new complex, includes among the strategic initiatives and tasks:

- by 2025:
    - Establishment of a stimulating tax system for the extraction of liquid hydrocarbons (oil, condensate) within five years from the start of drilling a new well;
    - Conducting technical and economic justification for the restoration of domestic oil refining and the beginning of relevant preparatory work;
- By 2032:
    - Promoting the implementation of individual oil projects through improved geological research and the establishment of competitive fiscal conditions (including PSAs);
    - Identification and elimination of legislative barriers to increase national oil production;
    - Promotion of the implementation of new technologies for oil extraction and preparation that maximize energy efficiency (particularly in state-owned enterprises);
    - Restoration of oil refining capacities through modernization/reconstruction based on one of the existing refineries and/or construction of a new complex, where it is most economically justified;

- Increasing the level of technological equipment of refineries and supplementing them with new petrochemical processes, which increases their competitiveness;
- Conducting an analysis on the development of small modular refineries;
- Restoration and expansion of LPG production capacity to 200,000 tons per year and condensate to 40,000 tons per year.

The restoration of the industry is focused on the small, relative to life cycle of refineries, time horizon, considering decarbonization in transportation, thus partially meeting the demand for petroleum products. The rest will be covered through diversified imports to ensure maximum energy security.

A clear perspective on the development of the industry is also an important component of the policy to reduce methane and non-methane volatile organic compound emissions during oil and gas processing. In particular, for this purpose, the draft Action plan for the implementation of Ukraine's Updated Nationally Determined Contribution[209] envisages the development of the Concept of the development of the gas and oil refining industry, the market of oil products and gas fuels in Ukraine (responsible - Ministry of Energy, Ministry of Economy, Ministry of Finance, Antimonopoly Committee, NJSC "Naftogaz of Ukraine" (with consent)).

PM_ES_WEM_02 Creation of facilities for the production of fuel assemblies to meet at least 50% of the needs of Ukrainian NPPs

Goal: Increasing own production capacity and increasing the share in meeting the needs of Ukraine's NPPs

Legal basis: Energy Strategy of Ukraine until 2050

Time limits: 2024-2027

Responsible authorities: Ministry of Energy, NAEK Energoatom

Results: Ukraine plans to increase the installed capacity of NPPs through the construction of new power units, as well as the implementation of a project for the production of fuel assemblies. Ukraine's energy strategy for the period up to 2050, among strategic initiatives and tasks until 2032, also includes the production of nuclear reactor fuel assemblies by NPPs.

By 2025, "Energoatom" planned to bring its separate division "Atomenergomash" to full capacity in the production of fuel assemblies to meet all the needs of Ukrainian NPPs[210]. In 2021, "Atomenergomash" started working on the establishment of nuclear fuel production (fuel assemblies) using Westinghouse technology with the aim of fully replacing Russian-origin fuel. On January 17, 2022, Energoatom and Westinghouse signed an agreement for the evaluation and qualification of production lines for fuel assemblies. In 2023, the plans were adjusted: Energoatom plans to develop its own nuclear fuel production line starting from 2024, which will cover 50% of the needs of Ukrainian NPPs; the project will take 3 years.[211]

PM_ES_WAM_03 Creation of capacities for the production of fuel assemblies to meet all the needs of Ukrainian NPPs

[209] https://mepr.gov.ua/povidomlennya-pro-oprylyudnennya-doopratsovanogo-proyektu-rozporyadzhennya-kabinetu-ministriv-ukrayiny-pro-shvalennya-planu-zahodiv-z-realizatsiyi-onovlenogo-natsionalno-vyznachenogo-vnesku-ukrayiny-d/

[210] https://www.energoatom.com.ua/setting-up-production.html

[211] https://www.energoatom.com.ua/o-3011232.html

Goal: Increasing own production capacity and increasing the share in meeting the needs of Ukraine's NPPs

Legal basis: Energy Strategy of Ukraine until 2050

Time limits: 2025-2032 years

Responsible authorities: Ministry of Energy

The implementation of the project for the construction of a nuclear power plant for the production of fuel assemblies for nuclear reactors of nuclear power plants, the capacity of which is expected to cover the needs of all nuclear power units in Ukraine, is forecasted. At least, Energoatom planned to bring its separate division "Atomenergomash" to full capacity for the production of fuel cassettes to meet all the needs of Ukrainian NPPs by 2025.[212]

The Energy Strategy of Ukraine until 2050, among the strategic initiatives and tasks until 2032, also includes the domestic production of heat-generating assemblies for nuclear reactors of nuclear power plants.

PM_ES_WAM_04 Development of uranium production

Goal: Increasing own production capacity and increasing the share in meeting the needs of Ukrainian nuclear power plants in uranium through natural resources and technological capacity

Legal basis: Energy Strategy of Ukraine until 2050, Concept of the State Targeted Economic Program for the Development of the Nuclear Industry until 2026[213]*, Draft of the State Targeted Economic Program for the Development of the Nuclear Industry until 2028*[214]

Timeframe: 2024-2028

Responsible authorities: Ministry of Energy

The development of nuclear energy in Ukraine will require an increase in uranium ore extraction and processing efficiency, taking into account the significant volume of explored reserves and prospective resources, as well as the developed efficient technology of extraction and processing.

The State Targeted Economic Program for the Development of the Nuclear Industry until 2028 provides support to the State Enterprise "SkhidGZK", the only enterprise that extracts and processes uranium ores in Ukraine, covering up to 40% of the needs. As a result of the Program implementation, it is planned to:

- fully meet the needs of domestic nuclear energy in uranium for the production of fresh nuclear fuel;
- to increase the level of energy independence of Ukraine and ensure the development of the domestic nuclear industry;
- to preserve existing capacities for the extraction and processing of uranium ores;
- to increase the volume of uranium ore extraction necessary to fully meet the needs of domestic nuclear power plants;
- to preserve the uranium production volume taking into account the decommissioning of the Vatutine uranium ore deposit;

[212] https://www.energoatom.com.ua/setting-up-production.html

[213] https://zakon.rada.gov.ua/laws/show/1804-2021-%D1%80#Text

[214] https://mev.gov.ua/proyekt-normatyvno-pravovoho-aktu/povidomlennya-pro-oprylyudnennya-proyektu-rozporyadzhennya-0

- to preserve and create new jobs, despite the decommissioning of the Smolinska mine of the Vatutine uranium deposit from 2024;
- to maintain the revenues to the State Budget of Ukraine and local budgets at all levels;
- to ensure a reduction in the negative impact of uranium production on radiation safety and the environment.

The program provides funding in the amount of 4.675 billion UAH from the state budget, among the target indicators - reaching a production of 683 tons of natural uranium concentrate in 2028, which will constitute approximately 30% of the current needs. At the initial stage, it is envisaged that uranium raw materials will be transferred to foreign producers of nuclear fuel for domestic nuclear power plants.

Energy Strategy of Ukraine until 2050 essentially repeats the provisions of the Concept and the Program project, proposing among the strategic initiatives and tasks:

- by 2025:
    - Maintenance of existing uranium mining facilities;
    - Implementation of the state investment project "Novokostyantynivska mine. Development of production capacities";
    - Development of new uranium deposits;
- until 2032:
    - Increase in uranium production volumes and reduction of production costs;
    - Improvement of uranium ore processing and uranium production efficiency.

PM_ES_WEM_03 Creation of gas reserves (filling of gas storage facilities)

Goal: Ensuring the security of natural gas supply in Ukraine

Legal basis: Law "On the natural gas market", Law "On amendments to certain legislative acts of Ukraine regarding the certification of a gas storage operator and the extension of measures to prevent bankruptcy of the State Joint Stock Company "Chornomornaftogaz"[215]

Responsible authorities: Ministry of Energy

Results: The Law "On the natural gas market" provides for the possibility of imposing an obligation on all suppliers to form a reserve of natural gas in an amount not exceeding 10% of the planned monthly supply volume to consumers for the next month. The size of the reserve is determined annually by the Cabinet of Ministers at the same level for all suppliers.

However, in recent years, this level has been zero, namely the universal obligation was difficult to fulfill due to the projected financial burden on market participants and administrative burden on government authorities. The 3% reserve level, proposed by the Ministry of Energy in 2023, assumed that the costs associated with meeting the requirements would amount to 848.5 million UAH within the first 3-6 months.[216]

Adopted in 2022, the law introduced, among other things, Articles 6a and 6c of Regulation (EU) 2017/1938, which define the target level of gas storage as the 'mandatory level of underground gas storage filling as of a specific date, expressed as a percentage of the total capacity of underground gas

[215] https://zakon.rada.gov.ua/laws/show/2850-20#Text

[216] https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-do-proektu-postanovy-kabinetu-ministriv-ukrayiny

storage, specified in the gas storage filling schedule'. The development of the schedule is entrusted to the Ministry of Energy, and monthly reports are submitted by the gas storage operator to the Ministry of Energy and the Regulator in accordance with the Rules on the security of natural gas supply.

At the same time, the regulatory framework needs improvement for the full implementation of the requirements of Regulation (EU) 2017/1938 (see PM_ES_WAM_06 Implementation of EU rules on the security of electricity and gas supply). This applies to both amendments to the Law "On the Natural Gas Market" regarding mechanisms for achieving the target level of gas storage filling, as well as Rules on the security of natural gas supply to include clear rules for calculating the target level of gas storage filling and forming a schedule for filling gas storage. In 2023, the Ministry of Energy published a draft order on amendments to the Rules.[217]

The plan of measures for the preparation of housing and utilities' facilities and the fuel and energy complex of Ukraine for the 2023/2024 autumn-winter period and its passage provides for the creation of gas reserves in underground storage facilities in the amount of 14.7 billion cubic meters by November 1, 2023[218]. Separate decision of the Energy Community Secretariat[219] approved the targets (including interim indicative targets) for the period until November 2024, submitted by Ukraine in accordance with the requirements of the law.

However, according to the estimates of JSC "Ukrtransgaz"[220], with an annual gas consumption volume of up to 35 billion cubic meters, it is sufficient to fill storages to a level of 47.5-55% (19.3-21.7 billion cubic meters of active gas) to compensate for seasonal and daily fluctuations and to ensure reliable gas supply to consumers in Ukraine. To ensure reliable supply during the winter period (February-March), active gas reserves in storages should be formed in such a way as to provide a daily withdrawal of 133 million cubic meters of active gas, as well as develop and implement technical measures to increase the daily productivity of gas storage facilities.

PM_ES_WEM_04 Creation of coal and backup fuel (fuel oil) reserves

Objective: Ensuring the security of electricity supply

Legal basis: Procedure for forming the forecast balance of electric energy of the Integrated Power System of Ukraine for the calculation year[221]*, Rules on the security of electricity supply*[222]*, government decisions in preparation for the autumn-winter periods*[223]

Responsible authorities: Cabinet of Ministers, Ministry of Energy, market entities

Results: Formation and preservation of stocks of fossil energy resources for generating plants (natural gas, coal, fuel oil) are carried out as a measure within the framework of government coordination of industry preparation for each winter season. As a rule, target indicators are determined in the form of orders of the Cabinet of Ministers.[224]

However, the basis is the projected electricity balance of the Ukrainian power system for the calculation year, which is prepared by the TSO and approved by the Ministry of Energy. According to the Rules on

[217] https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-proektu-nakazu-ministerstva-enerhetyky-3

[218] https://www.naftogaz.com/news/naftogaz-group-fulfilled-the-plan-of-the-cabinet-of-ministers-of-ukraine

[219] https://www.energy-community.org/news/Energy-Community-News/2023/11/15.html

[220] https://utg.ua/img/menu/company/docs/2021/%D0%9F%D0%BB%D0%B0%D0%BD%20%D0%9F%D0%A1%D0%93%202021-2030.pdf

[221] https://zakon.rada.gov.ua/laws/show/z1312-18#Text

[222] https://zakon.rada.gov.ua/laws/show/z1076-18#n17

[223] https://zakon.rada.gov.ua/laws/show/515-2023-%D0%BF#Text

[224] For example, https://zakon.rada.gov.ua/laws/show/586-2021-%D1%80#Text

the Security of Electricity Supply, to ensure the security of supply in the short-term perspective, the Ministry of Energy approves the Projected Electricity Balance of the Integrated Power System, as well as the type and volume of fuel reserves for certain types of power plants (no later than December 1 of the year preceding the projected year). Monitoring of supply security is carried out, inter alia, regarding the schedule and volume of supply and accumulation (reserves) of all types of fuel within the projected electricity production balances.

In accordance with a separate Procedure, calculations of the base and limit balance options should take into account assumptions regarding the volumes of own fuel extraction (production) and its processing products, forecasted prices for them, as well as the risk of insufficient fuel supply for generating capacities.

When determining the volumes of fuel supply, the following should be taken into account:

- for TPPs:
    - formation of guaranteed coal reserves corresponding to 10- or 20-day consumption volumes, depending on the distance from the extraction point;
    - prevention of reduction in reserves of backup fuel (fuel oil) below the 10-day volume necessary for the start-up of units and necessary ignition;
- for CHPs:
    - formation of guaranteed coal reserves corresponding to 20-day average daily consumption necessary to ensure the schedule of thermal load according to the concluded heat supply contracts in the forecast month (for CHPs where coal is the main fuel);
    - preventing a decrease in the reserve fuel (fuel oil) supply below the 10-day volumes necessary for the start-up of units and necessary ignition (for CHPs where coal is the main fuel);
    - preventing a decrease in the 10-day reserve fuel (fuel oil) supply to ensure the viability of CHPs and heat networks in conditions of complete suspension of natural gas supply (for CHPs where natural gas is the main fuel).

After the approval of the forecast balance, electricity producers at thermal power plants and combined heat and power plants provide the Ministry of Energy with data on the forecast fuel structure. During the development of such forecasts, electricity producers at thermal power plants are obliged to ensure:

- supply of coal in accordance with the approved forecast balance of electricity;
- formation of guaranteed coal reserves corresponding to a 10-day (for grade G+D) or 20-day (for grade ASh+P) volume of average daily coal consumption (based on consumption data for the last three years and a weighting coefficient depending on the month).
- formation of a 10-day supply of backup fuel (fuel oil) for TPPs, which primarily use coal as the main fuel, for units' start-up and possible ignition.

In turn, electricity producers at CHPs are obliged to ensure the formation of guaranteed reserves of coal and backup fuel (fuel oil) at a level similar to determining fuel supply volumes.

Based on the information received from generating companies, the Ministry of Energy compiles a consolidated forecast structure of fuel for TPPs and CHPs, and develops and approves a schedule for the accumulation of coal and backup fuel (fuel oil) at the end of each month of the calculation year for TPPs and CHPs. Electricity producers at TPPs and CHPs also monitor the implementation of the approved schedule and in case of reduction, inform the Ministry of Energy and the State Inspectorate for Energy Supervision about the reasons and measures to bring the fuel reserves in warehouses in line with the

schedule. The Ministry of Energy and the State Inspectorate for Energy Supervision also independently monitor the indicators of the forecast balance of electricity, including fuel reserves.

Reduction of guaranteed coal reserves is allowed in case of force majeure circumstances in coal supply, as well as with the consent of the Ministry of Energy (but not more than 15% and for a period of up to 20 days). The volumes of guaranteed coal reserves must be replenished within 20 days from the last day of the month when the reduction of these volumes began.

PM_ES_WAM_05 Creation of minimum reserves of crude oil and petroleum products reserves (MROP)

Objective: Ensuring uninterrupted supply of oil and petroleum products to the domestic market of Ukraine in case of a crisis situation in the oil and petroleum products market by implementing the requirements of Council Directive 2009/119/EC, which provides for the creation of a level of minimum stocks equal to 90 days of average daily net imports or 61 days of average daily consumption, depending on which indicator is higher.

Legal basis: Law on minimum oil and oil product reserves (adopted on November 21, 2023)[225]

Time limits: Gradually, with the achievement of the target volume within 8 years from the date of entry into force (within 12 months from the effective date); approximately until 2032-2033 However, the obligation to create minimum oil reserves from the MROP stock arises for market participants within 6 months from the date of termination or cancellation of martial law.

Responsible authorities: Cabinet of Ministers, Ministry of Energy, Ministry of Health, State Tax Service, State Statistics Service

Results: In Ukraine, there is currently no MROP created, which, along with the complete destruction of the Russian aggressor in the oil refining industry, poses a risk of disruptions in the supply of petroleum products. In the event of a cessation of oil and petroleum product supplies, the country will be able to meet its needs for no more than 10-30 days through its own production and existing reserves.[226]

The adopted Law defines the basic principles of creation and functioning of the MROP in Ukraine, as well as regulates relations in this field (functions and powers of state control authorities, system administrator, and reporting). The act defines the concept of a crisis situation in the oil and oil products market, its levels, the procedure for creating, storing, replacing MROP, as well as disclosure in case of a crisis, and the procedure for financing the functioning of the MROP.

The military risks of creating the MROP are mitigated by the provision that during the state of war, part of the reserves can be stored abroad in EU member states bordering Ukraine (not exceeding 50% of the total volume), and EU countries bordering such states (not exceeding 25% of the total volume). The Energy Strategy of Ukraine for the period up to 2050 includes among the strategic initiatives and tasks until 2025 the construction of protected storage facilities for oil reserves.

The formed MROP can only be used in crisis situations related to supply disruption and fuel shortage, and cannot be used as a tool for regulating market prices. The law provides for liability for violation of rules and conditions for storage of reserves.

In addition, PJSC "Ukrtransnafta" plans to implement the requirements for storage of MROP[227]. In particular, it is envisaged that the oil and petroleum product pipeline operator will act as a responsible custodian, while other companies will be the owners. At the same time, in order to implement this project,

[225] https://zakon.rada.gov.ua/laws/show/3484-IX#Text

[226] https://itd.rada.gov.ua/billInfo/Bills/pubFile/1853886

[227] https://itd.rada.gov.ua/billInfo/Bills/Card/42196

PJSC "Ukrtransnafta" will have to take additional measures by increasing the tank farm, taking into account that the storage of reserves in pipelines is prohibited by the Council Directive 2009/119/EC (similarly, the Law contains a restrictive definition of tanks).

PM_ES_WEM_05 Implementation of N-1 Standard , behavior standards for gas suppliers

Goal: Ensuring the security of natural gas supply in Ukraine through forecasting and assessing potential risks, taking measures to prevent, eliminate or reduce damage from crises. Identification of protected consumers, mandatory measures for market participants.

Legal basis: Law on the Natural Gas Market[228]*, Rules on the Security of Natural Gas Supply*[229]*, National Action Plan*

Responsible authorities: Ministry of Energy

Results: Standard N-1 provides that in case of failure of the largest main gas pipeline or the largest gas storage facility, the capacity of the remaining gas infrastructure facilities in Ukraine should ensure the ability to meet peak demand (days when there is an extremely high demand, the statistical probability of which is once every 20 years). The annual calculation of standard N-1 is entrusted to the Ministry of Energy of Ukraine.

Also, all natural gas suppliers are required to take measures to ensure sufficient gas resources for the needs of their protected consumers. Among the measures are maintaining reserves in gas storage facilities, entering into purchase-sale agreements for additional volumes, and limiting or discontinuing supply to non-protected consumers. The relevant code of conduct should be followed in the following cases:

- extreme temperatures during a 7-day peak period, with a statistical probability of occurrence once every 20 years (Standard 1);
- period of extremely high natural gas demand lasting 30 days or more, with a statistical probability of occurrence once every 20 years (Standard 2);
- failure of a main gas pipeline under normal winter conditions for a period of 30 days (Standard 3).

The Rules on the Security of Natural Gas Supply are regularly reviewed. The next update should take into account measures necessary to comply with the gas supply standard under all scenarios specified in Article 6(1) of the Regulation (EU) 2017/1938.

The Ministry of Energy is also responsible for developing the National Action Plan, which identifies measures to respond to crises of various levels and for organizing and conducting supply security monitoring. The National Action Plan should be updated annually, and reports on the results of supply security monitoring should be published. It is important to note that such a review is also possible thanks to the cooperation between the Ministry of Energy and the Joint Research Centre of the European Commission.

PM_ES_WEM_06 Implementation of minimum criteria for the security of electricity supply

Objective: Determining measures to ensure the security of electricity supply (both preventive and in case of disruptions), minimum criteria for electricity supply security, mandatory measures for market participants.

[228] https://zakon.rada.gov.ua/laws/show/z1489-15

[229] https://zakon.rada.gov.ua/laws/show/z1458-15

Legal basis: Law on the electricity market, Rules on the Security of Electricity Supply[230]

Responsible authorities: Ministry of Energy, with the participation of the Regulator and the TSO (PJSC "Ukrenergo")

Results: Most threats and measures to prevent/respond to them are within the scope of the TSO, which monitors compliance with supply operational safety standards (defined by the Transmission System Code[231]). The Ministry of Energy is responsible for organizing and conducting security of supply monitoring (together with the Regulator, the transmission system operator, and other relevant institutions). The report on the results of security of supply monitoring should be published every two years.

PM_ES_WAM_06 Implementation of EU rules on the security of electricity and gas supply

Goal: Ensuring the security of electricity and natural gas supply through risk assessment and action plans

Legal basis: EU legislation

Responsible authorities: Ministry of Energy/Regulator, with the participation of TSOs, DSOs, ENTSO-E, RCC and other stakeholders

Results: Ukraine needs to implement the requirements of EU legislation, in particular Regulation (EU) 2019/941 on risk preparedness in the electricity sector and the repeal of Directive 2005/89/EC, Regulation (EU) 2019/943 on the internal electricity market (regarding the implementation of the electricity supply standard), as well as Regulation (EU) 2017/1938 on measures to ensure gas supply security and the repeal of Regulation (EU) No 994/2010 (except for the part on gas storage filling).

Regulation (EU) 2019/941 requires the designation of an authorized body to assess the risks of electricity supply, taking into account regional risk assessments (carried out by ENTSO-E), prepare and approve a risk preparedness plan with a list of measures planned or taken to prevent, prepare for and mitigate crises. This plan should be prepared in accordance with Articles 11 and 12 of the Regulation and the template provided in the Annex to the Regulation, with the participation of all necessary stakeholders.

Regulation (EU) 2019/943 requires an adequacy assessment of resources at the national level, taking into account the results and parameters of the adequacy assessment at the EU level (carried out by ENTSO-E). The regulation also provides for the possibility of applying capacity mechanisms. The methodology for assessing the adequacy of resources takes into account components such as the calculation of the value of lost load (VoLL), cost of new entry (CoNE), and the determination of the reliability standard.

Regulation (EU) 2017/1938 requires the designation of an authorized body to carry out a coordinated regional risk assessment of gas supply, prepare and approve Preventive Action Plans and Emergency Plans. These plans should be prepared in accordance with Articles 9 and 10 of the Regulation, as well as the templates provided in the Annexes to the Regulation, with the participation of all necessary stakeholders. The implementation of the N-1 Standard and the infrastructure standard is enhanced by solidarity and cooperation measures at the regional level. In 2023, the Ministry of Energy published a draft order approving amendments to the Rules on the Security of Natural Gas Supply regarding the conduct of risk assessment in accordance with the form and requirements of the Regulation.[232]

[230] https://zakon.rada.gov.ua/laws/show/z1076-18

[231] https://zakon.rada.gov.ua/laws/show/v0309874-18

[232] https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-proektu-nakazu-ministerstva-enerhetyky-3

PM_ES_WEM_07 Creation of a national system for the protection of energy sector critical infrastructure facilities (CIF)

Objective: Creation and operation of a national system for protecting critical infrastructure of the energy sector

Legal basis: Energy Security Strategy, Law "On Critical Infrastructure"[233] and subordinate acts, Energy Strategy of Ukraine until 2050, National Plan for the Protection and Ensuring Security and Resilience of Critical Infrastructure[234] and individual decisions of the National Security and Defense Council of Ukraine

Time limits: 2023-2024 (main measures of the National Plan for the Protection and Ensuring Security and Resilience of Critical Infrastructure)

Responsible authorities: State Special Communications Service, Ministry of Energy, Ministry of Infrastructure

Results: The Energy Security Strategy identifies for achieving Strategic Goal 2 “Resilience of the energy sector” such priority tasks:

- implementation of a risk assessment and information exchange system on risks and threats to critical infrastructure of the energy sector;
- establishment of a system for preventing any type of threats and responding to crisis situations, implementation of Ukraine's energy resilience plan;
- implementation of a mechanism for cooperation and interaction between the state and CIF operators of the energy sector in case of crisis situations, including the involvement of state representatives in participation and control over the implementation of crisis response plans.
    - The crisis situation itself has the following definition: 'a violation or threat of violation of the normal functioning regime of the energy sector or critical infrastructure of the energy sector, which may result in the interruption of energy supply to consumers in two or more regions of Ukraine, or a decrease in the level of energy supply to consumers by more than 40 percent, the elimination and restoration of the normal operating regime of which require the implementation of special (emergency) measures'.

At the same time, the basis for implementing the policy of protecting critical information infrastructure is the Law "On Critical Infrastructure". According to the information from the State Special Communications Service[235] as the authorized body in the field of protecting Ukraine's critical infrastructure, the responsibility for protecting critical information infrastructure lies directly with their operators. The system operates in four modes: normal, readiness and prevention of threats, response to crisis situations, and restoration of normal functioning.

The authorized body coordinates the activities of the entities of the national protection system, ensures the formation and implementation of state policy in the field of critical infrastructure protection. Functional and sectoral bodies are responsible for the formation and implementation of state policy in specific sectors. Functional bodies (State Emergency Service, National Police, Security Service, etc.) participate in responding to crisis situations related to ensuring the security and resilience of critical infrastructure.

[233] https://zakon.rada.gov.ua/laws/show/1882-20#n132

[234] https://zakon.rada.gov.ua/laws/show/825-2023-%D1%80#Text

[235] https://cip.gov.ua/ua/news/ukrayina-pochinaye-buduvati-sistemu-zakhistu-kritichnoyi-infrastrukturi-vidpovidno-do-naikrashikh-svitovikh-praktik-ta-chinnikh-vimog-yevropeiskogo-zakonodavstva

Relevant sectoral bodies in the field of critical infrastructure protection[236] include the Ministry of Energy (fuel and energy sector) and the Ministry for Community Development, Territories and Infrastructure Development of Ukraine (municipal services, including heat supply and hot water supply).

Among the important responsibilities, it is the sectoral bodies that develop and approve requirements for the protection of CIF, project threats to sectoral-level critical infrastructure, norms and regulations for the protection of critical infrastructure in the respective sectors, compile and maintain sectoral lists of CIF, carry out categorization of CIF together with operators, provide proposals for inclusion of CIF in the national Register[237], coordinate security passports for each CIF, make decisions on declaring modes of operation of CIF, conduct verification and assessment of the security of CIF, organize personnel training and training for ensuring the resilience and protection of critical infrastructure sectors.

The system should operate in four modes: normal, readiness and prevention of threats, response to crisis situations, and restoration of normal operation. At the same time, the deployment of the CIF protection system is planned to be completed by the end of 2024 in accordance with the main measures of the National Plan for the Protection and Ensuring Security and Resilience of Critical Infrastructure, approved in September 2023. In particular, the development and approval of sectoral plans and programs to counter threats to critical infrastructure (including emergency plans, crisis response plans, interaction plans, CIF recovery plans, etc.) are planned for the second quarter of 2024.

Until the system is fully operational, in the conditions of military operations, the organization of protection and security of the functioning of CIF is also carried out under the coordination of the National Security and Defense Council of Ukraine.

PM_ES_WEM_08 Experiment on the construction, repair, and other engineering measures for the protection of critical infrastructure facilities (CIF)

Objective: Creating a multi-level engineering and technical protection of key objects of the fuel and energy sector CIF

Legal basis: Resolution of the Cabinet of Ministers of Ukraine dated December 27, 2022 No. 1482 "On the implementation of an experimental project for the construction, repair, and other engineering and technical measures for the protection of critical infrastructure facilities of the fuel and energy sector"[238]

Time limits: 2023-2024

Responsible authorities: Ministry of Communities, Territories and Infrastructure Development, State Agency for Infrastructure Restoration and Development

Results: The project coordinators are the Ministry of Infrastructure and the Agency for Restoration, participants include the Ministry of Energy, the General Staff of the Armed Forces, the State Emergency Service, CIF operators, the Administration of State Special Communications Service, regional and Kyiv military administrations, the Agency for Restoration, restoration and infrastructure development services in the regions, project and construction organizations (with consent).

As part of the implementation of the experimental project by the end of the 2023/2024 winter season, it was planned to install two levels of protection - against UAVs and against missiles - for 22 main

[236] https://zakon.rada.gov.ua/laws/show/1109-2020-%D0%BF

[237] https://zakon.rada.gov.ua/laws/show/415-2023-%D0%BF#n15

[238] https://zakon.rada.gov.ua/laws/show/1482-2022-%D0%BF#Text

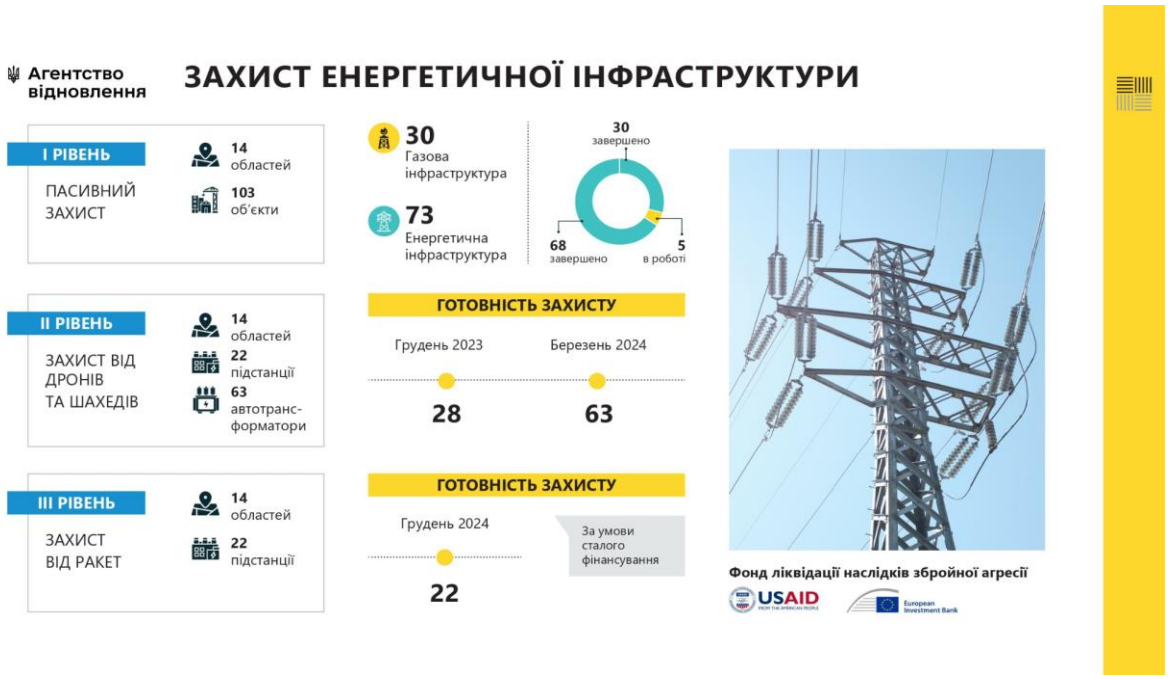
substations of the Ukrainian power system[239]. The Recovery Agency works in collaboration with the NPC "Ukrenergo", which sets tasks for design and construction.

As of December 2023, the following progress was reported in the creation of three levels of protection[240]:

1) passive protection against fragments (gabions and sandbags), protection of 103 facilities (73 electricity, 30 gas) in 21 regions;[241]

2) protection of autotransformers against fragments and drone hits (reinforced concrete structures); 28 facilities completed; a total of 63 autotransformers in 22 substations in 14 regions are planned to be protected, the main network will be completed by March 2024;[242]

3) experimental protection against missile strikes (reinforced concrete structures); designed solutions and computer modeling of loads have been carried out; a total of 22 substations in 14 regions are planned to be protected.



Source: Ministry of Communities, Territories and Infrastructure Development of Ukraine

PM_ES_WAM_07 Ensuring physical, engineering-technical and cyber protection of 100% energy critical infrastructure facilities (CIF)

Goal: The Energy Security Strategy identifies as one of the priority tasks to achieving Strategic Goal 2 "Resilience of the energy sector" ensuring cyber security and physical security of critical energy infrastructure. The Strategy of Cyber Security of Ukraine[243], among the principles of building a national cyber defense system, emphasizes reaching cyber resilience - the ability to quickly adapt to internal and external threats in cyberspace, maintain and restore the stable functioning of the national information

[239] https://focus.ua/uk/economics/599528-do-kincya-zimi-u-mininfrastrukturi-nazvali-termini-vstanovlennya-zahistu-na-klyuchovi-pidstanciyi-video

[240] https://restoration.gov.ua/press/news/58489.html , https://mtu.gov.ua/news/35069.html

[241] https://interfax.com.ua/news/economic/953814.html

[242] https://mtu.gov.ua/news/35002.html

[243] https://zakon.rada.gov.ua/laws/show/447/2021#n12

infrastructure, primarily critical information infrastructure objects. As of the end of 2023, the indicators of the implementation of the Cyber Security Strategy are under development.

Legal basis: Energy Strategy of Ukraine until 2050, Energy Security Strategy, Cyber Security Strategy of Ukraine, Law "On the Basic Principles of Cybersecurity of Ukraine", separate decisions of the National Security and Defense Council of Ukraine

Responsible authorities: State Special Communications Service, Ministry of Energy, Ministry of Infrastructure, National Coordination Center for Cybersecurity (NSDC), Computer Emergency Response Team CERT-UA, etc.

Results: The Energy Strategy of Ukraine for the period up to 2050 includes among its strategic initiatives and tasks:

- by 2025:
    - Implementation of a comprehensive approach to security (physical security, engineering security, and cybersecurity);
    - Development and approval of an effective methodology for assessing threats and the state of energy security that would meet the challenges of reliability and safety of energy supply;
    - Coordination of the placement of new energy facilities (large assets of state-owned companies) with representatives of the security and defense sector and determination of the responsible state authority;
    - Strengthening the capacity for timely detection, prevention, and neutralization of threats to the security of energy infrastructure;
    - Development of a comprehensive protection program for energy infrastructure facilities, which will include a security passport;
    - Implementation of comprehensive measures for protection in the energy sector;
    - Improvement of engineering and technical measures to prevent and/or prevent unlawful actions on energy facilities;
    - Revision of norms for ensuring the necessary equipment and machinery emergency reserve for energy facilities;
    - Review of the project threat to nuclear-industrial complex facilities and other energy facilities taking into account the results of Russia's full-scale war against Ukraine;
    - Development of a program to enhance security measures for existing energy infrastructure;
    - Ensuring the development of projects for the development of transmission systems and gas networks, taking into account all requirements for physical security;
    - Identification of the responsible authority for engineering safety and distribution of responsibilities for implementing engineering safety measures;
    - Study of the feasibility and implementation of pilot projects for the underground placement of individual elements of energy infrastructure, taking into account the feasibility and possibility of placement (e.g., substations in protected execution).
- until 2032
    - Development of an economically efficient proposal for changing state construction standards for new energy facilities, taking into account the need for climate adaptation

and minimizing its impact, which will involve making changes to the regulatory acts of design, construction of power installations, electrical networks to ensure their physical protection;

- Implementation of complex processes and modern technological solutions to enhance the protection of energy sector systems from cyber attacks;
- Stimulating investments in ensuring digitization and strengthening cybersecurity in the energy sector;
- Implementation of measures to implement the Concept of Smart Grids in Ukraine by 2035: defining the index, indicators, and methodology for assessing the state of cybersecurity of electric grids in Ukraine in accordance with international practices, including the use of the Cybersecurity Capability Maturity Model program.
- Application of solutions for ensuring cybersecurity of information and computer systems infrastructure, power grids, electricity metering systems, and communication networks.
- Ensuring regular assessment of the cybersecurity status of electric grids in Ukraine.

By the decision of the National Security and Defense Council of Ukraine dated October 17, 2023[244], the Cabinet of Ministers is tasked with ensuring the implementation of works on engineering and physical protection of critical infrastructure objects and the fuel and energy complex, approving the Plan of Measures for the Restoration of Critical Infrastructure Facilities that were destroyed or damaged as a result of Russian aggression, and developing and approving in 2023 the Energy Resilience Plan of Ukraine with the determination of sources of financing. In turn, the Ministry of Energy, together with the Ministry of Infrastructure, the State Emergency Service, operators of CIF, and military administrations, should ensure the engineering protection of CIF and their restoration in case of damage.

Responsibility for ensuring cybersecurity of CIF communication and technological systems, protecting technological information in accordance with the requirements of the legislation, for immediate reporting of cybersecurity incidents to CERT-UA, for organizing independent information security audits at such facilities lies with the owners and/or managers of enterprises, institutions, and organizations classified as CIF.

The State Special Communications Service coordinates, organizes, and conducts audits of the security of communication and technological systems of critical infrastructure objects for vulnerabilities. The Security Service of Ukraine prevents, detects, stops, and investigates cybercrime, within the framework of combating cyber terrorism and cyber espionage, covertly assesses the readiness of CIF for possible cyber attacks and cyber incidents.

To a large extent, cyber security of CIF is associated with the implementation of the requirements of the Law "On Critical Infrastructure" (see PM_ES_WEM_08). In particular, in December 2022, the Ministry of Energy approved the Requirements for cyber security of the fuel and energy sector of critical infrastructure.[245]

The Ministry of Energy of Ukraine is responsible for developing the industry-specific cyber security system for the fuel and energy complex. The respective system is based on the concentration of efforts of two specific cyber centers created at Ukrenergo and Naftogaz of Ukraine. It is envisaged that these respective cyber centers will become industry cyber security centers for the electricity and gas, and subsequently also for the nuclear-industrial, coal-industrial, and peat extraction fields[246]. In addition, at

[244] https://www.president.gov.ua/documents/6952023-48641

[245] https://zakon.rada.gov.ua/laws/show/z0249-23#Text

[246] https://mev.gov.ua/storinka/kiberbezpeka-enerhetychnoyi-haluzi

the working level, the development of an industry-specific cyber security strategy for the energy CIF and an audit of the state of cyber security provision for such CIF were planned.[247]

Thus, the creation of a multi-level cybersecurity system involves a) direct responsibility of the CIF operators, b) monitoring and expert role of sectoral cyber centers under the leadership of the Ministry of Energy, c) activities of the national cybersecurity entities (State Special Communications Service, Security Service, etc.). According to the Energy Strategy of Ukraine for the period up to 2050, the establishment of a Situational Center in the energy sector is also planned, which will enable event forecasting in the industry and improve decision-making efficiency through simulation of various scenarios.

PM_ES_WAM_08 Creation of backup power sources for critical infrastructure facilities (CIF), including those using distributed RES generation

Objective: Ensuring the resilience of critical infrastructure to security threats, continuity of vital services

Legal basis: Concept of the State Targeted Economic Program for Energy Modernization of Thermal Energy Producing Enterprises in State or Municipal Ownership for the Period up to 2030[248]*; draft Concept of the State Targeted Economic Program for Stimulating the Development of Distributed Generation of Electricity from Renewable Energy Sources for the Period up to 2030*[249]*; draft updated version of the State Strategy for Regional Development for 2021-2027*[250]

Time boundaries: 2023-2030

Responsible authorities: Ministry of Energy, Ministry of Infrastructure, local self-government authorities

Results: The Concept of the State Targeted Economic Program for the Energy Modernization of Thermal Energy Producing Enterprises in State or Municipal Ownership sets the goal of increasing the efficiency and reliability of district heating systems. In turn, the implementation of the program's planned measures will enhance Ukraine's energy security, improve the safety and quality of heat supply services for 5.3 million households (see also PM_EE_WAM_08).

Stimulus measures are provided in the form of support for local self-government authorities and district heating enterprises through partial reimbursement of the cost of measures provided for by the current heat supply scheme, including:

- construction and connection to the centralized district heating system of additional (in addition to existing) heat sources and individual heat-generating installations that use energy sources other than the main ones;
- installation of backup sources of electricity on facilities of the heat supply sector in district heating systems.

In turn, to address the challenges associated with armed aggression by the Russian Federation against Ukraine, the Ministry of Infrastructure has developed an updated version of the current State Strategy for Regional Development for 2021-2027, approved by the Cabinet of Ministers of Ukraine on August 5, 2020, No. 695. One of its operational objectives is the development of sustainable, inclusive, and resilient

[247] https://www.mev.gov.ua/sites/default/files/field/file/budget/%D0%97%D0%B2%D1%96%D1%82%20%20%D0%B1%D0%B5%D0%B7%D0%BF%D0%B5%D0%BA%D0%B0%20%D0%BF%D0%BE%D1%81%D1%82%D0%B0%D1%87%D0%B0%D0%BD%D0%BD%D1%8F_2019.docx

[248] https://zakon.rada.gov.ua/laws/show/1093-2023-%D1%80#Text

[249] https://mev.gov.ua/proyekt-normatyvno-pravovoho-aktu/povidomlennya-pro-oprylyudnennya-proyektu-rozporyadzhennya-1

[250] https://mtu.gov.ua/news/35001.html

infrastructure against security threats, and in the direction of "Energy Infrastructure," the following related tasks are proposed:

- Ensuring energy stability of territorial communities and regions through the promotion of distributed generation of electricity.
- Promoting the development of electricity generation from renewable sources and the use of energy storage systems in centralized water supply and wastewater systems.

Support for the deployment of sustainable decentralized power sources is envisaged by the draft Concept of the State Targeted Economic Program for Stimulating the Development of Distributed Generation of Electricity from Renewable Energy Sources for the Period up to 2030 (see PM_IME_WAM_05). In particular, it is envisaged that in the first stage (2024-2026), support will be provided to entities of state and municipal ownership forms for RES installations with a capacity of up to 500 kW together with energy storage systems, which will ensure autonomous power supply for critical infrastructure for 4 hours. The following critical infrastructure is considered a priority:[251]

- centralized water supply systems (pumping stations for first and second level, booster pumping stations);
- centralized wastewater systems (sewage pumping stations, treatment facilities);
- centralized heating systems (boiler rooms, central heating points);
- healthcare facilities.

The second stage (2027-2030) envisages extending support to other state and municipal properties (administrative buildings, educational institutions, etc.) for RES installations with local energy storage to cover basic needs (lighting, operation of office equipment, communication).

It is worth noting that local self-government authorities, especially at the level of large cities, have already implemented or plan to implement projects for equipping vital facilities (including boiler houses, water pumping stations) with backup power sources, as well as public buildings (healthcare institutions, educational institutions, and administrative buildings). Moreover, among the technologies used are not only diesel generators, but also gas piston units, solar panels, and hybrid systems (combination of different sources), often with energy storage installations.

Policies and measures to **increase the flexibility of the national energy system** are subject to a multi-level regulatory system - from strategic to specific mechanisms.

Inter alia, the Energy Security Strategy includes among its priority tasks

- in achieving Strategic Goal 2 'Resilience of the energy sector':
    - ensuring the balanced development of energy supply systems, taking into account the unevenness of consumption patterns and the operation of individual energy producers;
    - adapting the energy sector to the negative impact of climate change;
- in achieving Strategic Goal 3 "Economic efficiency of the functioning of the energy sector, energy supply systems, and import substitution of mineral resources":
    - updating the main assets of the energy sector, in particular by creating favorable conditions for the implementation of support mechanisms for large-scale investment projects in the development of critical infrastructure in the energy sector;

[251] https://mev.gov.ua/sites/default/files/field/file/prezentaciya.pdf

- in achieving Strategic Goal 4 "Energy efficiency of energy resources utilization and energy efficiency of the national economy":
    - implementation of a set of measures to expand the use of local alternative fuels;
    - development of a set of measures to integrate consumers using renewable energy sources for their own consumption into the operation of the Ukrainian power system.

The National Economic Strategy for the period up to 2030 is limited to the task of "ensuring guaranteed compliance of generating capacities with the volumes and modes of electricity consumption in the Ukrainian power system, in particular in terms of the availability of regulating capacities".

The Energy Strategy of Ukraine for the period up to 2050 provides for greater clarity in setting target indicators for the development of flexible generation, RES and demand response systems, and includes among strategic initiatives and tasks:

- by 2025:
    - Development of distributed generation using natural gas, through the installation of gas turbine and gas piston turbines at gas transmission system sites, CHP plants and boilers;
    - Development of RES, which includes a complex of measures for the construction of storage systems, wind generation, and promotion of the development of distributed solar generation for self-consumption;
    - Installation of wind/solar and storage systems for critical infrastructure facilities and private households;
    - Active implementation of energy storage technologies with further expansion of their use in subsequent time horizons;
    - Study the feasibility of creating microgrids and decentralized power supply to ensure the stability of the energy system;
    - Study the feasibility of creating a demand response program.
- By 2032:
    - Decentralization of the energy system by increasing the number of energy generation facilities while reducing spatial disparities in their localization, which will contribute to increasing the overall resilience of energy systems and reducing their vulnerability to physical and virtual threats;
    - Implementation of pilot projects for the creation of microgrids and decentralized power supply to ensure the stability of the energy system;
    - Implementation of pilot projects for demand response program;
    - Support for the implementation of energy storage technologies.

Among the practical tools, it is necessary to highlight

- participation in the balancing market and ancillary services market on general principles;

- competitions for the construction of generating capacity and implementation of demand response measures;

- provision of balancing services and ancillary services by aggregators and active consumers through the net billing mechanism.

For more details, see section 3.4.3. Market integration (Dimension Internal energy market).

ii. Regional cooperation in this area

The current rules for preparing and responding to crisis situations in the supply of natural gas or electricity provide for a mechanism for continuous exchange of information between Ukraine, on the one hand, and the Secretariat of the Energy Community (in particular, the Security of Supply Coordination Group) and the competent authorities of neighboring EU member states. At the same time, the development of gas and petroleum product supply routes requires active cooperation between Ukraine and the countries of Central-Eastern and South-Eastern Europe, including Poland, Slovakia, Hungary, Romania, Bulgaria, as well as the Baltic countries.

The Energy Community Secretariat and the governments of neighboring EU member states play a critical role in the mechanism of equipment supply for the energy companies in Ukraine affected by the consequences of the war. In particular, the Energy Community Secretariat, together with the European Commission, the EU Coordination Center for Emergency Response, and Ukrainian authorities, ensures the delivery of energy carriers and energy goods - both provided free of charge and purchased through the administered Ukraine Energy Support Fund; equipment procurement is carried out according to international transparency standards by the United States Agency for International Development (USAID).[252]

The implementation by Ukraine of the EU Clean Energy package involves the integration of markets and strengthening of mutual energy security based on the principle of solidarity. In particular, the Ukrainian TSO should take advantage of the opportunities offered by full membership in ENTSO-E and join the activities of the Regional Coordination Centre (RCC) for participation in seasonal and short-term adequacy assessments of resources. The implementation of Regulation (EU) 2019/941 on risk preparedness in the electricity sector and Regulation (EU) 2017/1938 on measures to safeguard gas supply involves strengthening regional cooperation - in particular, Ukraine can participate in the work of the relevant EU coordination groups (Electricity Coordination Group, Gas Coordination Group), as well as cooperate with EU member states and Energy Community Contracting Parties in the process of risk assessment and preparation of corresponding plans (consultations to ensure consistency).

Integration of gas systems and markets involving the Operator of the GTS of Ukraine, Ukrtransgaz, and other market participants is the subject of cooperation within the CESEC (Central and South Eastern Europe Gas Connectivity Initiative) and SEEGAS (South Eastern Europe Gas Initiative) initiatives. Ukrainian companies also participate in the EU joint gas procurement platform AggregateEU.

Cooperation with neighboring governments and operators in the identification and implementation of the projects of mutual interest (PMIs) and projects of common Energy Community interest (PECIs) is also promising. See more details in section 3.4. 'Internal Energy Market'.

Regional cooperation is also envisaged in the creation of minimum reserves of crude oil and petroleum products by Ukraine. The relevant law contains provisions according to which during the state of war, part of the reserves can be stored abroad in EU member states bordering Ukraine (not exceeding 50% of the total volume), and in EU countries bordering such states (not exceeding 25% of the total volume). Beyond the state of war, storage in EU member states bordering Ukraine is possible, but not exceeding 25% of the total volume of reserves, if the central storage facility or the economic entity has available tanks.

In May 2023, Ukraine officially joined the NATO Cooperative Cyber Defence Centre of Excellence (CCD COE), which provides cyber attack and information system cyber defense, as well as training and preparation of cybersecurity experts. Ukraine's participation in the Centre's work will strengthen the

[252] https://www.energy-community.org/Ukraine/Fund.html

exchange of cyber experience with other participating countries, particularly in the protection of critical information infrastructure in the energy sector.[253]

The Partnership for Transatlantic Energy and Climate Cooperation (P-TECC), involving Ukraine, the United States, the EU, and 24 European countries, is an important platform for political dialogue and technical cooperation on energy security.[254]

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The majority of funding comes from investments made by energy market entities - extraction companies, gas and electricity TSOs, DSOs, traders and suppliers (including the creation of minimum reserves of crude oil and petroleum products), oil refining operators, generating companies, etc. At the same time, a form of state aid is the creation of favorable tax and regulatory conditions, particularly for companies in the extraction sector.

Funding from the state budget is envisaged for the development program of the nuclear-industrial complex (support for uranium production by SE "SkhidGZK", totaling 4.675 billion UAH) and for separate works of the experimental project on construction, repair, and other engineering and technical measures to protect key objects of critical infrastructure. At the same time, the implementation of a comprehensive set of measures to protect these objects requires the involvement of international partners of Ukraine, including technical assistance.

Significant amounts of technical assistance, including for the preparation of bankable projects and improving the quality of public administration, can be obtained through participation in such EU programs as Horizon Europe, Connecting Europe Facility (CEF), Digital Europe Programme, LIFE. Another opportunity will be the funding within the Ukraine Facility, which is designed for 2024-2027.

3.4. Dimension Internal Energy Market

3.4.1. Electricity Infrastructure

i. Policies and measures to achieve the targeted level of interconnectivity as set out in point (d) of Article 4

Planning of interconnector infrastructure development. Development of cross-border connections with neighboring countries is ensured within the framework of the 10-year transmission system development plan (TSDP), which the transmission system operator annually develops in accordance with the procedure approved by the Regulator and submits for approval to the Regulator. TSDP should ensure the conformity of the transmission system to the market needs and the security of the electricity supply. TSDP, in particular, includes

- the main objects of the transmission system, the construction or reconstruction of which is expedient within the next 10 years, including projects for the development of interconnectors;

[253] http://twitter.com/MFA_Ukraine/status/1658432462689652738

[254] https://www.energy.gov/ia/partnership-transatlantic-energy-and-climate-cooperation-p-tecc

- information about the objects of the transmission system that need to be built and/or reconstructed within the next 10 years, the timelines for their construction and/or reconstruction, sources of financing;

- information on investments in transmission system facilities for which decisions have already been made and which are in the implementation stage, with an indication of the projected investments to be made over the next three years.

The TSO develops the TSDP based on the Generation Capacity Adequacy Assessment Report and considering the development plans of adjacent transmission systems and electricity distribution systems. TSO also develops the corresponding investment program and submits it to the Regulator together with the calculation of the tariff for electricity transmission services.

Simplification of administrative procedures and attracting investments in the infrastructure projects of mutual interest is ensured through the implementation of the policy PM_IM_WAM_01 Implementation of the TEN-E Regulation (see section 3.4.2.i).

ii. Regional cooperation in this area

In 2017, Ukrenergo signed an Agreement on the terms of future integration of Ukraine's energy system with the continental European energy system, which provided for the implementation of a catalog of measures for preparation and testing in the form of 3-day isolation from the energy systems of Russia and Belarus. The Integrated Power System (IPS) of Ukraine has been urgently integrated and operates in synchronous mode with the Continental European energy system within the framework of the European Network of Transmission System Operators (ENTSO-E) since March 16, 2022. During 2022-2023, Ukrenergo completed the implementation of the Catalog of Measures, which is part of the Agreement on the terms of the future integration of Ukraine's IPS with the continental European system. The catalog includes over 200 technical measures in 9 directions. All these measures are an integral part of the Synchronous Area Framework Agreement (SAFA) of continental Europe, to which Ukrenergo also joins. On November 28, 2023, the Regional Group ENTSO-E "Continental Europe" confirmed the full implementation by Ukrenergo of the Catalog of Measures, which means the completion of the synchronization project between the Ukrainian energy system and the European continental network.[255]

Until December 2023, Ukrenergo was an observer member of ENTSO-E and ensured the technical compliance of the operation of the Ukrainian power system with ENTSO-E standards and requirements. On December 14, the ENTSO-E Assembly approved the Ukrainian TSO's acquisition of full membership status in the organization starting from January 1, 2024. ENTSO-E membership status provides the TSO with opportunities for deeper regional cooperation:[256]

- when preparing proposals and adopting the annual working program of ENTSO-E, which determines priorities for key issues in the electricity market, development of trans-European energy infrastructure, risk management in the energy sector;
- when adopting the EU Ten-Year Network Development Plan and strategies for events that significantly affect the technical, safety, market or financial conditions of the operation of the European TSOs;

[255] https://www.entsoe.eu/news/2023/11/28/continental-european-tsos-announce-completion-of-synchronisation-project-with-ukrenergo-and-significant-increase-in-export-capacity-from-continental-europe-to-ukraine/

[256] https://www.entsoe.eu/news/2023/12/14/ukrainian-transmission-system-operator-npc-ukrenergo-joins-entso-e-as-new-member/

- when preparing recommendations for the ENTSO-E Assembly on strategic cooperation priorities of the TSO and key decisions;
- participate in the committees and working groups (committees on market issues, network development, research, development and innovation, information and communication technologies), in the development of network codes, regional investment plans and work in the group on legal and regulatory issues.

Ukraine's TSO carries out bilateral and multilateral communication and cooperation with neighboring TSOs in terms of increasing capacity and developing interconnectors, taking into account the provisions of EU Regulation 347/2013 on the guiding principles for trans-European energy infrastructure (TEN-E).[257] The TSO also organizes cooperation in accordance with the Interaction Plan between Ukrenergo and stakeholders within the framework of reconstruction/construction projects.[258]

For the development of regional cooperation, cooperation between Ukraine's TSO and TSOs of other countries in the region will be carried out in the format of interaction with the Regional Coordination Centre (RCC) provided for in EU Regulation 2019/943 on the internal market for electricity. The interaction will be carried out within the functionality defined in Annex 1 to this Regulation, in particular, in terms of creating a regional network model, coordinated calculation of regimes, and determining corrective actions in the region, as well as determining the capacity of cross-border crossings for distribution, etc.[259]

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The revenues that TSO receives from auctions for the allocation of cross-border transmission capacity are used for the purposes of ensuring the availability of allocated transmission capacity, technical maintenance, and increasing capacity through investments in the transmission system, including the construction of new cross-border power lines.[260]

For the development and financing of the transmission system projects, the TSO collaborates with leading international financial institutions, including

- World Bank;
- European Bank for Reconstruction and Development;
- European Investment Bank;
- KfW.

Credit resources are provided by international financial institutions (IFIs) under state guarantees for 15-20 years or more, with low-interest rates compared to the terms of lending by Ukrainian commercial banks and the cost of other financial instruments. The credit portfolio with IFIs amounts to approximately 1.7

[257] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex%3A32013R0347

[258] https://ua.energy/wp-content/uploads/2023/08/Plan_vzayemodiyi_NEK.pdf

[259] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0943-20220623#M1-1

[260] Temporarily, due to the introduction of martial law in Ukraine, funds received by the TSO from the allocation of interconnection capacity, except for revenues from congestion management, during the period from January 1, 2023 to December 31, 2023, are used for the following purposes: 10% - to ensure the actual availability of allocated capacity, technical maintenance and increase of capacity through investments in the transmission system, repayment of debt under access contracts to interconnection capacity; 45% - to repay TSO debt formed on the balancing market; 45% - to repay TSO debt to the guaranteed buyer for the services provided and to increase the share of electricity production from alternative sources.

billion euros. The most significant investment projects are financed, which ensure the reliability of electricity supply to industrial and household consumers, energy security, development of the national economy, and also have social and environmental orientation.[261]

It also involves Ukraine's participation and attracting funds for the implementation of interconnector development projects within the EU Connecting Europe Facility (CEF) program. The respective agreement between Ukraine and the EU was ratified by the Verkhovna Rada of Ukraine in November 2023.[262]

3.4.2. Energy transmission infrastructure

i. Policies and measures related to the elements set out in point 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects

PM_IM_WAM_01 Implementation of the TEN-E Regulation

Since 2015, within the framework of the Energy Community, Ukraine has committed to implementing the TEN-E Regulation (formerly Regulation 347/2013). Its main provisions relate to the criteria and legal status of projects of mutual interest / Energy Community interest, the establishment of a coordinated transparent procedure for obtaining all necessary permits for the implementation of such projects, granting regulatory authorities the power to make decisions on cross-border cost allocation, etc. These projects are registered on the Energy Community Infrastructure Transparency Platform (PLIMA).[263]

In order to provide a legal basis for accelerating and simplifying the implementation of infrastructure projects, a draft Law of Ukraine "On projects of national interest in the energy sector" has been developed, which is under consideration by the Verkhovna Rada of Ukraine and provides for the implementation of Regulations (EU) 347/2013 and 2022/869 on guiding principles for trans-European energy infrastructure (TEN-E).[264] The draft law provides for the introduction of a transparent procedure for the implementation of projects of national interest in the energy sector, including the determination of the procedure and criteria for the selection of projects; the establishment of an interdepartmental commission to ensure the implementation of projects; the preparation of a project implementation plan and a schedule for obtaining a comprehensive decision in order to meet project implementation deadlines (3.5 years); the determination of the possibility and procedure for cross-border distribution of investment costs for projects of common interest of the Energy Community between countries with the most positive impact from project implementation; the stimulation of projects; the development of a manual of procedures for project implementation in order to increase their attractiveness to investors.[265]

At the same time, in the EU in 2022, the TEN-E Regulation was replaced by a new EU Regulation (currently - Regulation 2022/869), which contains significantly amended provisions. The Energy Community is in the process of adapting this Regulation, which is expected to be completed by its consideration or approval in 2023-2024. In this regard, the Regulation within the Energy Community is

[261] https://ua.energy/yevrointegratsiya/spivrobitnytstvo-z-mfo/

[262] https://itd.rada.gov.ua/billInfo/Bills/Card/43091

[263] https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA.html

[264] https://itd.rada.gov.ua/billInfo/Bills/Card/41623

[265] The draft of the act has been approved by the Secretariat of the Energy Community in a letter dated November 23, 2022. No. UA-MC/O/alo/31/23-11-2022.

most likely to apply only to projects between the Contracting Parties of the Energy Community, not to EU Member States.

For Ukraine, it is important to implement the TEN-E Regulation, which is in force in the EU, as Ukraine has recently reached official agreements on access to financing through the Connecting Europe Facility. One of the conditions for receiving such financing is that Ukraine supports the project by giving it priority status within the permitting procedure, environmental assessment procedure, and appeals process, and commits to meeting accelerated project implementation deadlines and other supporting procedures applicable to projects of common interest in the EU.[266] In addition, Ukraine should provide a letter of support or other non-binding agreement to confirm support for the project.[267]

Thus, it is necessary to verify the submitted draft law for compliance with the norms of the new EU Regulation and, if necessary, develop and submit a new draft or amendments to the draft sufficient for the full implementation of this Regulation in Ukraine, preferably in coordination with the European Commission.

Planning for gas infrastructure development.

The Law of Ukraine "On the Natural Gas Market" provides for the development and approval by the Regulator of plans for the development of gas transmission and distribution systems, gas storage facilities, and LNG installations for the next 10 years, as well as the provision of their assessment in the Regulator's annual report, including indicating the necessary changes to such plans (**PM_IMG_WEM_1 Plans for the development of gas infrastructure for the next 10 years**). The relevant plans are prepared by operators and approved by the NEURC every year.

In addition, according to paragraph 1 of chapter 1 of section XX of the GTS Code, immediately after the start of the annual capacity allocation auction of each odd year, the TSO cooperates with the respective adjacent operator(s) of the gas transmission system(s) of other country(-ies) in the process of market demand assessment for capacity increase and conducting technical studies of new (increased) capacity projects for points of interstate connection (**PM_IMG_WEM_2 Market demand assessment for interstate connection capacities**). The first market demand assessment was conducted in 2021. The second market demand assessment was conducted in 2023.

At the same time, additional measures may be necessary:

- adapting gas infrastructure planning procedures to ensure compliance with the principle of energy efficiency first (**PM_IMG_ADD_1 Ensuring energy efficiency during energy infrastructure planning**). Thus, the ESU2050 recognizes the principle of "energy efficiency first" (energy efficiency first), which is enshrined in several EU legal acts. Accordingly, plans for expanding natural gas physical capacity must adhere to this principle, which includes prioritizing investments in energy efficiency and reducing consumption, rather than building new energy and energy resource delivery infrastructure. At the same time, the relevant risks to energy security must be analyzed.
- forecasting similar plans for oil and petroleum transportation infrastructure (**PM_IMG_ADD_2 Plans for oil infrastructure development**) and hydrogen (**PM_IMG_ADD_3 Plans for hydrogen infrastructure development**), with certain adaptation of content and regulatory approval of such plans, as well as possible integration of planning processes in different sectors (**PM_IMG_ADD_4 Integrated energy infrastructure planning**).

[266]Regulation TEN-E, Article 4(2)(f).

[267]Regulation TEN-E, Article 2(6), Annex III, point 2(1)(e).

- ensuring the connection of gas, oil, and petroleum infrastructure development plans, as well as hydrogen, with the ownership policies of the respective state companies (**PM_IMG_ADD_5 Connection between infrastructure development plans and state ownership policy**).

PM_IMG_WAM_1 Creating a regulatory framework for the formation of future markets and the construction of future energy infrastructure

ESU2050 defines the tasks of creating legal, economic, and organizational foundations for the functioning of hydrogen energy in Ukraine. Considering the strategic course towards integration with the EU, it is logical for this process to follow the EU practice (including changes to legislation on renewable energy sources and gas legislation, the latter expected to be implemented in early 2024) and the EU member states with the most advanced hydrogen and CO2 markets.

As of 2023, in Ukraine at the legislative level:

- there is no definition of hydrogen, its possible compounds (LOHC), and its environmental characteristics (renewable, low-carbon), there is no definition of carbon dioxide as a substance subject to transportation and storage:

The Law of Ukraine "On Alternative Fuels" contains the definition of "biohydrogen", which, however, does not cover hydrogen produced by electrolysis, which is expected to be the main method of hydrogen production;

- lack of powers of state authorities to shape and implement policies in this area, as well as to regulate relations between future market participants:

The Law of Ukraine "On the Natural Gas Market" regulates relations in the natural gas market. Part 1 of Article 19 of this Law provides that the provisions of this Law regarding natural gas apply on a non-discriminatory basis to biogas or other types of gas from alternative sources, if biogas or other gas from alternative sources meets the requirements for access to gas transmission and distribution systems, gas storage facilities, LNG facilities. However, considering the other physical and chemical parameters of hydrogen and CO2, this provision cannot be applied to expand the scope of powers of state authorities over hydrogen, taking into account the requirements of Article 19 of the Constitution of Ukraine. Moreover, it would be inadequate, considering the different level of market development.

The Law of Ukraine "On the National Commission for State Regulation of Energy and Public Utilities" lists the areas within which the National Commission for State Regulation of Energy and Public Utilities carries out its powers, and hydrogen is not among them. This means that the National Commission for State Regulation of Energy and Public Utilities cannot exercise its supervisory functions regarding projects and proposals related to hydrogen and CO2 (for example, including the relevant project in the 10-year development plan of the gas transmission system/gas storage system or granting the right to use the tariff revenue of the gas transmission system/gas storage system operator for these purposes).

- absence of duties and powers of future hydrogen infrastructure operators:

Currently, the most active role in the development of hydrogen infrastructure is played by LLC "Operator of the GTS of Ukraine", which is a certified TSO according to the ISO model. In this regard, there is a legal question whether the gas TSO has the right to engage in the development of networks for hydrogen transportation. Combining the functions of the natural gas and hydrogen transmission system operator can theoretically lead to a conflict of interests. This is reflected in the proposals for amendments to EU gas legislation, which discuss the need for legal separation of gas and hydrogen transportation activities (although business is against such a requirement).

In this regard, in order to achieve the goals of the Plan, it is necessary to take such measures, taking into account the approaches that will be finally adopted in the changes to EU law:

- providing the necessary legislative definitions;
- legislative expansion of powers of state authorities (including the Ministry of Energy, State Energy Supervision and the National Commission for State Regulation of Energy and Public Utilities) in the field of hydrogen and CO2 relations;
- legislative consolidation of the basic structure of the hydrogen market and, if necessary, CO2.

PM_IMG_WAM_2 Creating legal conditions for optimizing oil and gas infrastructure

The draft law No. 6133 "On Amendments to the Law of Ukraine "On Oil and Gas" regarding the definition of critical gas storage facilities and critical gas transportation pipelines" is being prepared for the second reading in the Verkhovna Rada for a long time, which should allow for the corresponding work by some operators and authorities.

The need to adopt a draft law and create a regulatory framework based on it (resolution of the Cabinet of Ministers, other bodies of state property management) is emphasized by natural gas market participants, as it is a prerequisite for projects to optimize the oil and gas infrastructure, as well as for the expansion opportunities of its operators to other types of gases (such as hydrogen and CO2). The latter is related to the fact that the repurposing of such facilities for the transportation/storage of hydrogen and CO2 may also be considered contradictory to the current Law of Ukraine "On Oil and Gas".

The feasibility of including other types of infrastructure (such as state highways, oil pipelines) that may also be subject to decommissioning restrictions should be considered within the scope of this law.

Establishing systematic involvement of the Ukrainian side in EU processes related to future energy infrastructure.

Planning the energy infrastructure in the EU is a continuous and complex process, which includes stages of development, discussion, and approval of 10-year development plans for EU networks (TYNDP) and lists of EU joint/mutual interest projects (PCI/PMI list), submission of applications and receipt of coordinated decisions on cross-border cost allocation, submission and review of funding applications from the Connecting Europe Facility, as well as submission of applications and participation in funding projects for prospective research in this field, including through the EU Innovation Fund.

At the level of strategic EU documents, Ukraine's potential is not always taken into account. Ukraine and Ukrainian companies rarely participate in large-scale research projects (with exceptions, such as the Biomethaverse project, in which non-state players from Ukraine are participants). The participation of Ukrainian companies in TYNDP, PCI/PMI list, and, accordingly, Connecting Europe Facility is situational; in the context of state sector companies' participation, it is not coordinated, despite the fact that the GTS operator is an observer in ENTSOG.

Measures should be taken from the Ukrainian side to consider the Ukrainian energy infrastructure during the processes:

- formation of strategic documents and relevant internal research of the EU (including those conducted at the JRC level) (**PM_IMG_ADD_6 Integration into EU strategic documents**);
- planning and implementation of large-scale research projects (such as IPCEI projects, projects funded by EU public funds, such as Innovation Fund or Horizon Europe) (**PM_IMG_ADD_7 Integration into EU research projects**; see also PM_RIC_WAM_02 Expansion of funding for scientific research in the field of renewable energy and climate innovation);
- Planning and financing critical elements of future energy infrastructure (including through TYNDP procedures, PCI/PMI list, Connecting Europe Facility, European Hydrogen Bank) (**PM_IMG_ADD_8 Integration into EU infrastructure planning processes**);

- Creation and operation of decarbonized energy market infrastructure, including systems for mutual recognition of guarantees of origin and other cross-border mechanisms in accordance with RED III Directive (**PM_IMG_ADD_9 Integration into EU green energy exchange mechanisms**).

To achieve this, operational agreements with the European side should be reached, as well as additional organizational measures taken on the Ukrainian side.

ii. Regional cooperation in this area

Electricity infrastructure

Regional cooperation in the development of Ukraine's electricity transmission system is mainly envisaged within the planning and implementation of projects that enhance cross-border electricity connections between Ukraine's IPS and ENTSO-E member countries to improve their level of integration. Such projects are coordinated by the TSOs within the Energy Community and implemented in the form of projects of mutual interest (PMI). Currently, Ukraine does not implement projects aimed at developing the transmission system in the format of EU projects of common interest (PCI) or Energy Community Interest (PECI).

For the development of regional cooperation, cooperation between the NCC of Ukraine and the NCCs of other countries in the region will be carried out in the format of interaction with the Regional Coordination Center (RCC) provided for by Regulation (EU) 2019/943 on the internal market for electricity. Interaction will be carried out within the functionality defined in Annex 1 to this Regulation, in particular, in terms of creating a regional network model, coordinated calculation of regimes, and determining corrective actions in the region, as well as determining the capacity of cross-border crossings for distribution, etc.[268]

Oil and gas infrastructure

LLC "Operator of the GTS of Ukraine" is an observer in the European Network of Transmission System Operators for Gas (ENTSOG); however, full membership in this organization is impossible due to the prohibition in the ENTSOG statutes on the participation of GTS operators from non-EU countries.

The main international initiatives related to this direction are:

- High Level Group for Gas Connectivity of Central and South-east Europe (CESEC);
- South-East European Gas Initiative (SEEGAS);
- European Hydrogen Backbone and other hydrogen initiatives;
- Biomethane Industrial Partnership, including the recently launched thematic area 'target area 6'.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Electricity infrastructure

Several sources are used to finance the development of the transmission system, the main ones being:

- tariff for electricity transmission services, which includes an investment component for financing modernization and development of the transmission system projects;
- revenues obtained by TSOs from auctions for the allocation of cross-border transmission capacity;

[268] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0943-20220623#M1-1

- payment for connecting customers' facilities to the electricity transmission system;
- funds raised by the TSO under international technical assistance programs and other funds raised from IFIs.

The tariff for electricity transmission services by the TSO is determined in accordance with the Procedure for establishing (forming) the tariff for electricity transmission services and is subject to approval by the Regulator.[269] The transmission tariff includes costs for implementing the TSO investment program, which determines the volumes and sources of financing for planned projects for the transmission system development. The investment program is formed in accordance with the Procedure for forming investment programs of licensees for electricity transmission through main and cross-border power network and for the production of thermal and/or electrical energy by nuclear power plants, hydroelectric power plants, and pumped-storage power plants;[270] it is also considered and approved by the Regulator.

According to Article 43 of the Law of Ukraine "On the Electricity Market," any income from the distribution of cross-border transmission capacity can be used for the following purposes: ensuring the actual availability of distributed transmission capacity; technical maintenance and increasing transmission capacity through investment in the transmission system, including the construction of new cross-border power lines.

Alongside the need for the construction and modernization of the transmission system, there are also contractual obligations of TSO for the construction of the transmission system to connect customer facilities. At the same time, the financing of the necessary transmission system construction for connecting customer facilities is carried out through connection fees paid by the customers. The calculation of the connection fee to TSO networks is determined in accordance with the Methodology (Procedure) for calculating fee for the connection to transmission and distribution networks.[271]

Methods of financing the projects of modernization and development of the transmission system using funds from the IFIs are described in section 3.4.1.iii.

Oil and gas infrastructure

Funding the costs of oil and gas infrastructure facilities is possible through tariff revenue or from external sources. For example, the Central European Hydrogen Corridor project is eligible for CEF funding; funding for hydrogen projects is also possible through Horizon Europe, Innovation Fund (including the European Hydrogen Bank), and others.

In this regard, as mentioned above, funding for expenses related to the infrastructure of natural gas and oil transportation and storage, which will not be further repurposed for hydrogen activities, will no longer fall under the funding of the main EU financing mechanisms (including CEF). Thus, tariff revenue can be the main source of funding for the necessary measures.

ESU2050 envisages the need to adapt tariff and regulatory policies to the actual volumes of gas transportation and the socio-economic environment in order to ensure the long-term financial stability of the GTS operator. In 2025-2029, the second regulatory period for the purposes of RAB-tariff formation for LLC "Operator of the GTS of Ukraine" will last, during which the necessary revenues should include the costs of projects specified in the NECP. At the same time, starting from 2025, the transit of gas from russia to the EU is expected to be discontinued, and a reduction in the transit of oil from russia and belarus can also be expected.

[269] https://zakon.rada.gov.ua/laws/show/v0585874-19#Text
[270] https://zakon.rada.gov.ua/laws/show/z0840-15#n12
[271] https://zakon.rada.gov.ua/laws/show/v1965874-18#Text

Even if it is assumed that the martial law will end by the end of 2024, according to the current law, a moratorium on raising tariffs for natural gas distribution will be in effect during the first half of 2025, which will limit the possibilities for financing the expenses of such operators.

Thus, sources of funding for the implementation of projects outlined in the NECP should be provided, including through the inclusion of relevant expenses in the tariff of corresponding operators.

3.4.3. Market integration

i. Policies and measures related to the elements set out in point 2.4.3

Electricity market

In 2019, Ukraine carried out a fundamental reform of the wholesale and retail segments of the electricity market, transitioning from the 'single buyer' model to a competitive market based on the EU model by establishing the corresponding institutional environment and market set-up provided for in the EU Third Energy Package. Further transformation of the electricity market is taking place within the framework of the EU Clean Energy Package. In terms of reforming and developing the electricity market, Ukraine implements the following basic policies and measures:

- Deepening integration with the markets of EU and ENTSO-E countries by increasing the capacity of interconnectors and introducing European rules for its allocation through joint auctions using the pan-European Joint Allocation Office (JAO) trading platform. It is also planned to quickly integrate the spot markets of Ukraine and EU countries, including the day-ahead market and the intraday market (market coupling).

- Ensuring proper functioning of the competitive electricity market by deepening its liberalization in combination with temporary regulatory measures aimed at stabilizing the market at the stage of insufficient maturity of the competitive environment and limited integration with the markets of EU and ENTSO-E countries. At the same time, gradual harmonization with the EU markets is envisaged in terms of regulation areas, methods, and other parameters, including the application of price caps on the spot (DAM, IDM) and balancing electricity markets.

- Development of exchange trading of electricity with the introduction of standardized trading products, implementation of market pricing in all market segments, including real-time prices and gradual abandonment of cross-subsidization.

- Introduction of tariffs for electricity transmission and distribution services based on the RAB regulation (RAB tariffs) for the transmission system operator (TSO) and distribution system operators (DSOs) in order to provide economic conditions for the modernization of network infrastructure and smart grid rollout.

- Increasing the resilience and flexibility of the power system through the development of distributed generation, the implementation of flexible generating capacities, energy storage facilities, and demand-side management measures. Based on the priorities of technological development of Ukraine's power system, determined by the TSO within the framework of resource adequacy assessment, including the structure of generating and other capacities, the possibility of conducting contests for the construction of generating capacity and the implementation of demand response measures with corresponding incentive mechanisms (support) is envisaged.

- Deepening the market integration of electricity producers with RES by ensuring their active participation in organized market segments and the possibility of direct trading of electricity taking into account responsibility for imbalances.

- Ensuring the protection of vulnerable consumers through direct monetized subsidies and preferential prices provided by mechanisms of imposing public service obligations (PSO) on individual market participants to ensure public interests in the functioning of the electricity market, which should have a temporary, targeted, and non-discriminatory nature.

More detailed policies and measures are disclosed in sections 3.4.3.ii-3.4.3.v.

ii. Measures to increase the flexibility of the energy system with regard to renewable energy production such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets

Electricity market

PM_IME_WAM_01 Implementation of the Concept of Smart Grids in Ukraine until 2035

The development of smart grids will be carried out within the framework of the Concept for the implementation of smart grids in Ukraine until 2035 and the corresponding action plan.[272] The implementation of pilot projects specified in the action plan is envisaged based on the assets of economic entities (ESS operators, TSO, DSOs, electricity producers). The implementation of projects is carried out under the procedures for the formation of development plans and investment programs for electricity producers, TSO, and DSOs, and plans for the reconstruction and modernization of TPPs and CHPs, approved by the NEURC.

The Concept involves the implementation of pilot projects for a 'smart city', namely the integration of information and communication technologies for efficient management of city infrastructure. Efforts are aimed at improving the quality of life for city residents and reducing infrastructure maintenance costs.

The implementation of the Concept does not require expenditures from the state and local budgets. The main current source of financing for the development of smart grids is the TSO tariff for electricity transmission and the DSO tariffs for electricity distribution. Tariffs are regulated by the Regulator (NEURC), subject to annual review and approval, and in particular, should take into account the costs of implementing measures for network development as provided in the medium- and long-term development plans for the transmission and distribution systems, as well as the respective annual investment programs of network operators. Network development plans and investment programs are subject to approval by the Regulator.

Coordination, control, and monitoring of the Concept and the action plan implementation are carried out by the Ministry of Energy. The implementation of the Concept is facilitated by a corresponding action plan with defined performance indicators.

PM_IME_WEM_01 RAB regulation of distribution system operators (RAB tariffs)

[272] https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text

Tariffs for distribution services for the majority of electricity DSOs are based on the principle of regulatory asset base regulation (RAB tariffs), which aims to stimulate investment in network modernization and development, as well as achieve target indicators for the quality and reliability of electricity supply.

PM_IME_WAM_02 Development of aggregation

Aggregation requires licensing, except in cases where the market participant holds a license for production and/or storage, and/or electricity supply to consumers, and/or for performing the functions of a guaranteed buyer. To avoid excessive concentration, a key restriction on the aggregator's activities is that an electricity generation facility with a capacity exceeding 20 MW cannot be included in the aggregation unit.[273]

From a market participation perspective, an aggregator can buy and sell electricity on the electricity market on a non-discriminatory basis, taking into account responsibility for imbalances, as well as provide balancing and ancillary services (in accordance with the legislation).[274]

Market participants have the right to freely join and leave the aggregated group. Exiting the aggregated group should be done as soon as possible while complying with the conditions of the contract, but not exceeding 21 calendar days. In contracts for participation in the aggregated group, it is allowed to provide penalties (fees) for the withdrawal of the electrical facility from the aggregated group. Such penalties (fees) should be proportionate and should not exceed the direct losses and/or expenses of the aggregator due to the termination of the contract, including the cost of already provided services under the contract. Penalties (fees) cannot be applied to household and small non-household consumers.

PM_IME_WAM_03 Application of pilot projects and demand-side management programs

ESU2050 envisages the implementation of pilot projects and the establishment of a demand response management program by 2032. The program will include a set of regulatory and technical measures, including centralized procurement by the state and controlled sale at preferential prices to household consumers of ESS of the minimum standardized capacity (one per private house/apartment), smart sockets, smart meters, as well as the use of time-bound prices for household consumers in different time zones. This will allow shifting energy consumption to off-peak hours when energy prices and/or greenhouse gas emissions from electricity generation are lower.

PM_IME_WAM_04 Development of energy storage facilities

The development of energy storage systems (EES) is at an initial stage (two industrial EES with a capacity of 1 MW each are operating in the power system of Ukraine). Since the installed capacity of RES in Ukraine until 2023 is based on weather-dependent technologies (especially wind and solar) and operates at a low level of utilization factor, the expansion of grid infrastructure and the development of EES are planned. According to ESU2050, among the strategic tasks until 2025 is the intense implementation of energy storage technologies with further expansion of their use in subsequent time

[273] https://zakon.rada.gov.ua/rada/show/v1909874-23#Text

[274] https://zakon.rada.gov.ua/laws/show/2019-19#n2968

horizons. It is also planned to create incentives/market conditions for the construction of utility-scale EES.

Energy storage activities are provided for in the basic Law of Ukraine "On the electricity market". The Regulator has approved the licensing conditions for economic activities in energy storage. To simplify the permitting procedures, the licensing conditions specify cases where EES do not require licensing.[275]

To simplify the procedure for connecting EES to the networks during the period of martial law, according to the Procedure for temporary connection of electrical installations to the distribution system during the period of martial law in Ukraine, the TSO provides connection of EES customers by January 1, 2025, without a connection fee.[276]

From the market perspective, the EES operator (as well as the aggregator) can buy and sell electricity on the electricity market on a non-discriminatory basis, taking into account responsibility for imbalances, as well as provide balancing and ancillary services (in accordance with the legislation).[277]

Partial development of small-scale EES will be supported through the State economic program to stimulate the development of distributed generation of electricity from renewable energy sources until 2030 (see below).

PM_IME_WEM_02 Support for active consumers through self-generation/consumption mechanism (net billing)

Support for active consumers under the self-generation/consumption mechanism (SGM) is provided by guaranteeing the purchase of the volume of electricity mainly generated from alternative sources and released by SGM based on the concluded electricity purchase and sale agreement under the self-generation mechanism, which is an appendix to the electricity supply contract with the consumer.[278] The SGM is a support scheme for active consumers aimed at promoting the consumption of self-generated electricity, under which the cost of supplying electricity to the grid by the generating facilities of such consumers is offset against the cost of their electricity consumption from the grid, taking into account the cost of transmission and/or distribution services.

The self-generation mechanism allows household and non-household consumers to install generating capacities within their contractual capacity (but not exceeding 30 kW for household consumers and 50 kW for small non-household consumers). Technical requirements related to the connection of generating units to the distribution system and transmission system are determined by the distribution and transmission system codes. The permitted power output of generating units (except for household consumers and small non-household consumers) cannot exceed 50% of the allowable (contractual) power of the electrical installations intended for electricity consumption. Generating units with a capacity of more than 1 MW should not supply more than 50% of their total electricity consumption for the corresponding year to the grid. Otherwise, such a consumer loses the status of an active consumer under the SGM for the calendar year.

Active consumers under the SGM must conclude a contract for the purchase and sale of electricity under the self-generation mechanism with its electricity supplier. The price of electricity sold to household and small non-household consumers is determined at the level of prices established at the day-ahead

[275] https://zakon.rada.gov.ua/rada/show/v0798874-22#Text
[276] https://zakon.rada.gov.ua/rada/show/v0352874-22#Text
[277] https://zakon.rada.gov.ua/laws/show/2019-19#n2968
[278] https://zakon.rada.gov.ua/laws/show/555-15#n505

electricity market during the corresponding period. The price of electricity sold to non-household consumers is determined by agreement between the parties. The universal service supplier (USS) cannot refuse household and small non-household consumers to enter into a contract for the purchase and sale of electricity under the SGM, provided that a contract for the supply of electricity has been concluded with such consumer.

The sale and metering of electricity generated by active consumers, as well as the calculations for it, must be carried out in accordance with the approved Regulator's Procedure for the sale and metering of electricity generated by active consumers and the settlements for it.[279]

PM_IME_WAM_05 State economic program to stimulate the development of distributed generation of electricity from renewable energy sources until 2030

The draft of the Concept of the program provides for the stimulation of the installation of photovoltaic panels and/or wind power plants with a hybrid inverter, which can operate both in autonomous mode and in synchronization with the grid, including together with energy storage systems, to cover own electricity consumption by critical infrastructure facilities and households in autonomous mode. If necessary, the respective facilities can be equipped with heat pumps.[280]

The establishment of such local power supply systems is planned through the introduction of state support mechanisms in the form of

- partial compensation of the loan for the acquisition and installation of a local power supply system, as well as a heat pump (if feasible);
- partial compensation of the loan interest;
- supply of equipment within the framework of international technical assistance;
- other mechanisms not prohibited by law.

In the first stage (2024-2026), support will be provided for:

1) business entities of state and municipal ownership to install photovoltaic panels and/or wind power plants up to 500 kW (per object) together with hybrid inverters and energy storage systems, which will ensure autonomous power supply to critical infrastructure objects for at least 4 hours. Such critical infrastructure objects include centralized water supply and sewage systems; district heating systems (boiler houses, central heating points); healthcare facilities;
2) associations of co-owners of multi-apartment buildings for the purpose of supplying electricity to common-use power consumers that ensure the vital functions of multi-apartment buildings (heating systems/individual heat points, water supply, elevators, circulation/fire pumps, lighting, alarms, smoke extraction, etc.);
3) for households in private buildings to install photovoltaic panels and/or wind power installations with a capacity of up to 10 kW, together with hybrid inverters and energy storage systems with a ratio of at least 1 kW of installed capacity of the generating unit to 0.5 kWh capacity of the ESS.

The second stage (2027-2030) envisages expanding support to other objects of state and municipal ownership (administrative buildings, educational institutions, etc.) and extending the provision of state support to household consumers for the installation of local power supply systems in private buildings.

[279] https://zakon.rada.gov.ua/rada/show/v2651874-23#Text

[280] https://www.mev.gov.ua/proyekt-normatyvno-pravovoho-aktu/povidomlennya-pro-oprylyudnennya-proyektu-rozporyadzhennya-1?fbclid=IwAR3joj5zMtABsALIEyu-6P9Ksao48cA91xlxgSGUaT-ydYA_REaaQVrX1vI

The goal of the Program is to stimulate the achievement of 200,000 local power supply systems installed by active consumers during the first stage of the Program, with a further increase to 500,000 systems based on the results of the second stage by 2030. The operation of local power supply systems in the electricity market is envisaged through the self-generation mechanism (Net Billing). The Program's implementation period is 2024-2030.

PM_IME_WAM_06 Contests for the construction of generating capacity and implementation of demand-side management measures

To ensure the resource adequacy and flexibility of the energy system based on the priorities of technological development of Ukraine's power system, as determined by the TSO within the framework of resource adequacy assessment, particularly in terms of the structure of generating and other capacities, the state plans to conduct competitive tenders for the construction of generating capacity and implementation of demand response measures in accordance with the approved procedure for their conduct.[281] Contests are conducted based on the principles of non-discrimination and fair competition; openness and transparency; objective and unbiased evaluation of participants' competitive proposals; prevention of corrupt practices and abuses during the competition.

The TSO, on the basis of the Generation Capacity Adequacy Assessment and monitoring of the security of electricity supply, submits to the Ministry of Energy conclusions and proposals on the need to conduct a contest, the volume of procurement of generating capacity and/or demand-side management (DSM) measures, the minimum and maximum additional capacity, and/or the impact on the electricity load profile as a result of DSM, technical requirements and characteristics of generating capacity and/or equipment for DSM.

The decision to hold the contest is made by the Cabinet of Ministers upon the submission of the Ministry of Energy and determines:

1) the deadlines for the contest;
2) the volume of procurement of necessary generation capacity and/or DSM measures;
3) incentives and their application procedure for the contest winner, including the maximum marginal price of procurement of the development of generating capacity service and the minimum payment period for the provided service;
4) deadline for commissioning generating capacity and/or starting DSM measures;
5) minimum and maximum additional capacity and/or values of the impact on the electricity load profile as a result of DSM measures;
6) requirements for the minimum guaranteed (projected) operating time (hours of operation) of equipment after commissioning generating capacity and/or DSM measures;
7) basic technical requirements for ensuring the necessary operating modes of generating capacity and/or equipment for implementing DSM measures.

The following support mechanisms may be applied to stimulate contest winners:

- payment for the service of ensuring the development of generating capacity and/or DSM measures, which does not exceed the maximum marginal price set for purchasing the service. The corresponding expenses are to be included in the electricity transmission tariff of the TSO;
- mechanism of public-private partnership (the contest is conducted in accordance with the Law of Ukraine "On Public-Private Partnership");

[281] https://zakon.rada.gov.ua/laws/show/677-2019-%D0%BF#Text

- facilitating the allocation of a land plot and/or site for the construction of a new generating capacity (involves the conclusion of a contract between the local authorities and the contest winner for the provision (transfer) of a land plot from state or municipal property to ownership or use and a contract with the TSO for the provision of services for the development of generating capacity and/or DSM measures);
- provision of state support at the expense of state or local resources.

PM_IME_WAM_07 Application of long-term contracts for the provision of ancillary services

To stimulate the deployment of new flexible generating capacities and energy storage systems necessary for the power system, as well as to ensure their bankability, the long-term contracts for the provision of ancillary services on the ancillary services market (ASM) with a duration of more than one year may be applied. The long-term payment for ancillary services, determined on a competitive basis, should cover the investor's capital costs for the construction of a generating capacity or EES. The operating expenses of the electricity producer or EES operator will be covered by their participation in the balancing electricity market and provision of balancing services.

PM_IME_WEM_03 Simplification of permitting procedures for distributed generation entities (temporary measures)

The Regulator amended the License Terms for heating (from November 2, 2023) in order to simplify the conditions for the operation of cogeneration units with a total capacity of up to 5 MW, which are used as backup energy sources for critical infrastructure facilities and will not require licensing.[282] This provision is temporary and applies during the period of martial law in Ukraine and for six months after its completion or cancellation. The aim is to reduce the regulatory burden on developers of cogeneration units for powering heating systems, water supply and drainage systems, and social facilities (education, healthcare (excluding sanatoriums)) during emergency power outages.

The Regulator amended the License Terms for the production of electricity (from April 25, 2023), according to which the production of electricity by mobile (autonomous) power plants (self-propelled or non-self-propelled, which can be moved by road, rail, sea, or inland water transport without their depreciation and change of purpose) will not require a license for electricity production. This norm is temporary and applies during the period of martial law in Ukraine and for six months after its completion or cancellation.[283]

PM_IME_WEM_04 Prioritization of RES dispatching

According to the Transmission System Code (TSC), the following priorities are provided during the dispatching of RES facilities:

- inclusion of all declared generating capacities in the dispatch schedule for the next day;
- priority loading of RES generating capacities when implementing the dispatch load schedule;

[282] https://www.nerc.gov.ua/acts/pro-vnesennya-zmini-do-licenzijnih-umov-provadzhennya-gospodarskoyi-diyalnosti-z-virobnictva-teplovoyi-energiyi

[283] https://www.nerc.gov.ua/acts/pro-vnesennya-zmin-do-licenzijnih-umov-z-virobnictva-elektrichnoyi-energiyi

- deferment of unloading or disconnection of RES generating capacities if the operational safety of the grid is ensured.

At the same time, priorities are not given to RES facilities in case of operational safety violations of the grid, occurrence of emergency or extraordinary situations, if measures necessary for normalization of the operation mode of the power system involve partial load shedding, unloading or disconnection of these power installations.

Also, when dispatching generating capacities the TSO applies non-discriminatory, competitive, and transparent market mechanisms for planning and implementing schedules for the load of generating capacities and EES.

PM_IME_WEM_05 Compensation for curtailments of RES producers (under the "green" tariff) during redispatching

In case of RES curtailments to ensure the power system operational safety, the TSO must inform the Regulator on such curtailments, indicating the reasons and measures it plans to take to prevent curtailments.[284] Also, the application of systemic curtailments of RES facilities, which operate under the "green" tariff scheme, is compensated to these producers by the TSO in the form of purchasing services for reducing the load by the producer who sells electricity at the "green" tariff; corresponding costs are included in the electricity transmission tariff.[285]

At the same time, such compensation to producers operating under the "green" tariff mechanism will be provided until 2029 (while the "green" tariff mechanism is in effect). Starting in 2030, financial compensation for RES curtailments by the TSO will be carried out on a non-discriminatory basis, according to market rules and at unloading prices determined on the balancing market.

PM_IME_WAM_08 Introduction of real-time prices

Reducing the duration of settlement periods

Competitive marginal pricing is applied to the organized segments of the spot electricity market in Ukraine (DAM, IDM) and the balancing market. Prices in all three market segments are the result of the interaction of supply and demand in each specific settlement period of the day and are determined on an hourly basis. For a more detailed reflection of the dynamics of supply and demand in the market, the possibility of applying a larger number of settlement periods on the DAM, IDM, and balancing market is considered by reducing their duration to 30 and 15 minutes.

Introduction of negative prices

Full implementation of real-time pricing will allow for the possibility of negative electricity prices on the DAM, IDM, and balancing market depending on the dynamics and supply-demand interaction in each settlement period. This will provide more accurate signals to market participants to stimulate electricity consumption, invest in flexible generation and energy storage facilities, demand-side management, and forecasting.

[284] https://zakon.rada.gov.ua/laws/show/v0309874-18#Text

[285] https://zakon.rada.gov.ua/laws/show/2019-19#n2968

PM_IME_WEM_06 Harmonization of price caps application on wholesale market segments

Gradual harmonization of price regulation is envisaged, which is carried out in the form of setting maximum and minimum price caps on the DAM, IDM, and balancing electricity market, with the European approach to determining price caps. This will provide correct price signals to all market participants regarding investment and market behavior optimization and is also an important prerequisite for deepening integration (market coupling) with European electricity markets.

PM_IME_WAM_09 Integration of spot markets (market coupling)

To increase transparency, competitiveness, and liquidity of the electricity market in Ukraine, ensure more efficient allocation of available transmission capacity of interconnectors, and improve power system operational safety, it is crucial to integrate the organized segments of the electricity market in Ukraine (day-ahead market, intraday market, and balancing market) with European markets (market coupling). Such market integration should take place in the medium term (next 2-3 years).

To implement the market coupling (DAM and IDM), the Market Operator has developed a draft law aimed at implementing Regulation (EU) No 2015/1222 on establishing guidelines for the allocation of capacity and congestion management (CACM) and EU Regulations No 2019/942 on the establishment of the Agency for the Cooperation of Energy Regulators (ACER) and No 2019/943 on the internal market for electricity. The draft document has been agreed with Ukrenergo in terms of cooperation with European TSOs and sent for processing to the Energy Community Secretariat.[286]

To ensure the integration of spot markets, problematic issues related to the taxation of export-import operations within the framework of market integration must be legislatively resolved. In particular, the calculation and sources of payment of value-added tax on electricity exports, the calculation and sources of payment of excise tax, and import duties on electricity imports need to be resolved. Legislative solutions are also needed for the issue of payment sources for transmission services in electricity exports and for dispatching services in electricity exports and imports.

PM_IME_WAM_10 Integration (coupling) of balancing market

To ensure regional cooperation of TSOs and further integration of Ukraine's balancing market with ENTSO-E countries for their integrated operation and exchange of balancing electricity and capacity in real-time mode, the document provides for the definition of such European concepts as System Operation Region (SOR)[287] and Congestion Calculation Region (CCR),[288] contractual relations of TSOs within SOR and CCR, involvement of TSOs in the Regional Coordination Centre (RCC) operation, defining the role of RCC in the electricity market and RCC tasks, specifying the list of pan-European rules that are mandatory for Ukrainian electricity market participants, the list of regional rules and the procedure for their adoption, as well as determining the powers of ACER in the electricity market.

[286] https://www.oree.com.ua/index.php/newsctr/n/20627

[287] SOR - a geographical region within which TSOs carry out operational and technological management of energy systems.

[288] CCR - a geographical region that includes the boundaries of neighboring countries' trading zones, for which coordinated calculations of maximum possible volumes of electricity export and import are carried out.

Gas market

Policies and measures to achieve adequate levels of domestic production

At the state level, measures have been implemented in recent years to stimulate an increase in domestic natural gas production. Thus, the Law of Ukraine No. 2805-IX dated 01.12.2022 "On Amendments to Certain Legislative Acts of Ukraine Regarding Support for the Development of Domestic Subsoil Use" has been adopted, the main positive aspects of which are:

- establishment at the legislative level of cases of granting special permits for subsoil use without conducting an auction and on the basis of an auction, grounds for making changes to them, extending their validity period, as well as grounds for refusal to grant and make changes to special permits and make changes to agreements on the terms of subsoil use, which are an integral part of special permits; based on this Law, the Cabinet of Ministers of Ukraine has adopted the Procedure for conducting an auction (electronic trading) for the sale of a special permit for subsoil use (**PM_IMG_WEM_3 Increasing transparency of granting special permits and controlling their use**);
- the possibility of buying and selling rights to use subsoil (special permits to use subsoil) (**PM_IMG_WEM_4 Right to alienate / include special permits in joint activities**);
- the possibility of assessing mineral reserves according to international standards (in addition to mandatory assessment according to national standards) (**PM_IMG_WEM_5 Conducting assessment of reserves according to international standards**);
- digitization of the subsoil use sector and the creation of a Single State Information System for subsoil use (**PM_IMG_WEM_6 Digitization of the subsoil use sector**).

The Law of Ukraine No. 2545-VI "On Ensuring Transparency in the Extractive Industries" has been adopted, which defines the legal framework for regulation and organization of collection, disclosure, and dissemination of information to ensure transparency in the extractive industries in Ukraine, taking into account the requirements of the Extractive Industries Transparency Initiative (**PM_IMG_WEM_7 Ensuring transparency in the extractive industries**).

The Law of Ukraine No. 2139-IX "On Amendments to the Tax Code of Ukraine and Certain Other Legislative Acts of Ukraine Regarding the Introduction of Differentiated Rent for Natural Gas Extraction" was adopted on March 15, 2022. The main element of the law is the differentiation of rent rates for new and old wells based on price levels (up to $150/thousand m3, from $150 to $400, and above $400), while the rent rate for "new wells" is guaranteed by the state until 2032 (**PM_IMG_WEM_8 Rent for new wells**).

By the Law of Ukraine dated September 20, 2022 No. 2606-IX "On Amendments to Subsection 10 of Section XX "Transitional Provisions" of the Tax Code of Ukraine regarding the peculiarities of taxation of rent for the use of subsoil for natural gas extraction," a deferral of rent payment is established for volumes of gas extracted but not realized, as well as special rules for determining the actual selling price to which rent rates apply during the period of the ban on natural gas exports (**PM_IMG_WEM_9 Tax measures during the period of martial law / export ban**).

The order of the Ministry of Economy of Ukraine dated 27.04.2023 No. 2610 "On Approval of Safety Rules in the Oil and Gas Extraction Industry" has been accepted, which establishes organizational and technical safety requirements during the design, drilling, construction and operation, major repairs and research of oil, gas and other wells related to oil and gas extraction, industrial and interfield collection systems for oil and gas, preparation of oil and gas for transportation by main pipelines and for technological equipment of oil and gas extraction facilities, and allows the use of "Air drilling" technology (**PM_IMG_WEM_10 Safety Requirements for Oil and Gas Extraction**).

However, to ensure production volumes at the level of 21.5 billion m3, existing policies and measures may be insufficient. In this regard, it is necessary to take a number of additional measures:

- increasing transparency and predictability of the procedure for concluding and implementing production sharing agreements (Draft Law of Ukraine No. 4344 "On Amendments to Certain Legislative Acts to Stimulate the Development of the Oil and Gas Extraction Industry") (**PM_IMG_WAM_3 Transparency of production sharing agreements regime**);
- Demining of the de-occupied territory before conducting operational activities (**PM_IMG_ADD_10 Demining of the de-occupied territories for gas production restoration**).

Further significant increase in natural gas production up to 26.8 billion cubic meters is possible through the development of new prospective areas (Black Sea shelf, extraction in non-occupied territories) or the use of new extraction methods (unconventional deposits). For this purpose, additional measures should be taken, as well as issues regarding the requirements for reservoir pressures and the quality of natural gas supplied to the GTS (see separate section) and the availability of equipment and technologies for extraction (see Measure "Research, Innovation, Competitiveness").

While some policies and measures may incur insignificant marginal costs (e.g. administrative measures), others will require significant investments to achieve new extraction volumes. Considering that the implementation of additional measures will only lead to new extraction volumes in a minimum of 3-5 years, new investments in gas extraction, especially if it concerns funds from the state budget or the state sector of the economy, should be compared in terms of alternative uses for more sustainable activities. Furthermore, even non-financial measures (e.g. land use rights) may, in certain cases, limit the development opportunities for RES.

In accordance with the recommendations of the European Commission,[289] the NECP should systematically describe and calculate all types of explicit and implicit subsidies for fossil fuels, provided in the form of grants, support measures, tax measures, subsidies arising from regulatory obligations, in accordance with the definition of energy subsidies in the EU and in the world. In particular, approaches to identifying similar subsidies, jointly applied by the International Energy Agency and the Organization for Economic Cooperation and Development, are widely used. Currently, Ukraine lacks a policy for monitoring, reducing and/or phasing out subsidies for fossil fuels. All various types of similar subsidies must be properly systematized, described, and their application controlled, taking into account the objectives of this Plan (**PM_IMG_ADD_11 Monitoring, reduction and phasing out of subsidies for fossil fuels system**).[290]

At the same time, it is not excluded that the sale of natural gas during the period of expected high prices (peak in 2035-2037) may be financially beneficial for the state, including for further investment of these funds in decarbonization. To obtain maximum benefits, measures are necessary for organizing the sale of products, as well as for further use of the funds obtained for new green projects. In addition, in order to export gas to the EU and potentially other countries, it will be necessary to comply with environmental and social standards that may apply during imports to these countries.

Ensuring the possibility of gas exports

In accordance with the resolution of the Cabinet of Ministers of Ukraine dated December 27, 2022 No. 1466 "On approval of the lists of goods, the export and import of which is subject to licensing, and quotas for 2023" (as amended), a zero quota volume for CN code 2711 11 00 00, 2711 21 00 00 "Natural gas of Ukrainian origin" has been approved for 2023. In practice, this export ban also covers biomethane.

[289] COM(2019) 285 final, 18.06.2019, p.14

[290] https://www.oecd.org/fossil-fuels/

The lifting of the ban on natural gas exports is a prerequisite for exports to the EU, as envisaged by the EU and the National Recovery Plan (**PM_IMG_WAM_4 Opening natural gas exports to the EU**). At the same time, no strategic document adopted since 2022 provides for specific measures to create conditions and overcome risks associated with the lifting of such a ban.

It can be argued that the ban exists, in particular, because there is uncertainty about ensuring the security of natural gas supply to consumers in the event of its cancellation. At the same time, Article 5 of the Law of Ukraine "On the Natural Gas Market" and Chapter 3 of Section I of the Rules on the Safety of Natural Gas Supply establish supply standards for natural gas suppliers, which require sufficient gas even to meet crisis situations for a period of 7 to 30 days. There are several factors that need to be taken into account.

Firstly, there is uncertainty whether NEURC has the right to impose sanctions for violations of these standards.

Secondly, punishing violators of these standards is not sufficient to ensure supply security. Many countries use additional measures to prevent violations, for example, in France, the gas supply license to consumers is renewed annually, subject to confirmation of the necessary resources for this. Similar practice exists in Austria.

In this regard, it is advisable to consider the need for the development of additional measures to ensure the security of natural gas supply to consumers, which would create conditions for opening up exports (**PM_IMG_ADD_12 Strengthening the responsibility of suppliers for supply security**).

Currently, the possibility of allowing the export of biomethaneis also being considered. For this purpose, draft law No. 9456 has been developed, which is under consideration by the Parliament (**PM_IMG_WAM_5 Opening up exports of biomethane to the EU**).

PM_IMG_WEM_11 Establishing a technical safety system in the gas market

The competence of the Ministry of Energy in Ukraine is defined by the Law of Ukraine "On the Natural Gas Market" in terms of:

approval of technical norms and safety standards applicable to gas transmission and distribution systems, gas storage facilities, LNG installations, including safety rules, minimum technical requirements for design and operation, requirements for technical inspection, requirements for professional qualifications and experience of individuals and legal entities involved in construction, engineering works and technical maintenance of gas transmission and distribution systems, gas storage facilities, LNG installations (Article 8);

establishment and approval of requirements for the components of the natural gas metering units, rules for the operation of metering devices, procedures for measuring volumes and determining the quality of natural gas (part 3, article 18).

The main secondary legal act regulating this issue is the Safety Rules for Gas Supply Systems, approved by the Ministry of Energy before the entry into force of this Law. At the same time, acts of other state authorities (including the GTS, GDS and UGS Codes) contain separate provisions on technical issues. The technical regulation for natural gas has not yet been approved. Thus, there is currently a dispersion of relevant norms and a lack of a unified system for ensuring technical safety (which includes technical requirements for the operation of networks and equipment, as well as interaction between market participants) at the state level.

In addition, for a long time, the Law of Ukraine "On the Natural Gas Market" provided for the authority of the Ministry of Energy to formulate policies in the field of technical safety (approval of the mentioned rules), but not for their implementation (monitoring of compliance) of this policy. In July 2023, amendments were made to this Law, which defined the term "state energy supervision (control)", as well

as the authority of the state authority (State Energy Supervision) for the implementation of the corresponding policy. The relevant changes were made at the beginning of the year to the Regulation of Derzhenergonaglyad.[291] Work is underway to build the institutional capacity of this body and adopt the necessary regulatory acts. This work is being carried out in parallel with the technical assistance project from the EU, which is provided to the Ministry of Energy for the construction of a technical safety system (the work will continue from April to November 2024).

PM_IMG_ADD_13 Determining optimal technical parameters for gas injection into networks

According to available information, technical issues related to the injection of domestically produced natural gas to the GTS concern maintaining the gas quality parameters during its injection into GTS and maintaining pressures at the field level.

In general, cooperation between the GTS operator and gas production companies takes place within the framework of technical agreements, which include pressure values, as well as quality standards, physico-chemical indicators, and other characteristics of natural gas at entry points. The TSO receives natural gas at the entry points from gas production companies for further transportation, and the technological process of natural gas transportation through the main gas pipelines of LLC "Operator of the Gas Transmission System of Ukraine" does not involve processes for comprehensive preparation and modification of the quality indicators of the transported gas.

According to the information of LLC "Operator of the GTS of Ukraine", the natural gas injected into GTS from gas production enterprises contains CO2 that does not meet the quality requirements. In addition, a significant amount of natural gas that does not meet the requirements of paragraph 13 of Chapter 1 of Section III of the GTS Code in terms of the following indicators enters the GTS:

- dew point temperature by humidity,
- dew point temperature for hydrocarbons,
- gross calorific value.

The main violations are recorded for the dew point temperature on moisture and on hydrocarbons of natural gas supplied to the GTS in the summer period. The dynamics of deterioration of gas quality indicators during the period from 2020 to 2023 are as follows:

- In 2020, 6 to 16% of gas that did not meet the requirements of the GTS Code was supplied;
- In 2021, 3 to 24% of gas was supplied, which does not meet the requirements of the GTS Code;
- In 2022, 6 to 33% of gas was supplied, which does not meet the requirements of the GTS Code;
- In 2023, 11 to 67% of gas was supplied, which does not meet the requirements of the GTS Code.

Reports on non-compliance with the quality parameters of natural gas are constantly sent to GTS operator's counterparties, and an additional fee is charged for poor quality gas.

It should be noted that the supply of natural gas to the GTS with indicators that do not meet the requirements of the GTS Code leads to significant risks and negative factors, primarily in terms of the ability to transport natural gas to consumers in Ukraine, through interconnection points and to underground gas storage facilities. The mismatch of gas quality leads to the accumulation of liquid (condensate) in the main gas pipelines, which creates conditions for corrosion of pipelines, formation of hydrate plugs, and increases the risks of failure of technological equipment at the gas distribution stations and compressor stations.

[291] https://zakon.rada.gov.ua/laws/show/1-2024-%D0%BF#n2

The issue of maintaining pressures at the level of fields is the most relevant for JSC "Ukrgazvydobuvannya" considering the significant depletion of the main part of the Company's deposits, as well as historical chains of gas sales to ensure the activities of the guaranteed supplier / performance of special obligations in the natural gas market at a price lower than the market price.

Pressures at the level of gas fields of JSC "Ukrgazvydobuvannya"

Поточні тиски родовищ набагато нижчі за початкові рівні

Родовище	Рік	Тиск			Початкові запаси, млн м³	Залишкові запаси, млн м³
		Початковий, МПа	Поточний, МПа	Зниження, %		
Шебелинське	1950	24	2	**90%**	757 300	76 761
Західно-Хрестищенське	1968	36	4	**88%**	350 151	33 679
Єфремівське	1965	35	6	**82%**	100 949	16 406
Мелихівське	1967	40	9	**78%**	80 729	13 342
Яблунівське	1977	41	10	**75%**	80 075	16 532
Битків-Бабчинське	1958	19	4	**77%**	49 566	2 453
Розпашнівське	1973	46	4	**92%**	48 641	3 156
Медведівське	1969	21	9	**56%**	42 386	6 857
Машівське	1962	41	8	**80%**	40 960	3 889
Тимофіївське	1973	42	13	**70%**	33 391	11 179
Опішнянське	1969	38	6	**85%**	28 783	4 408
Кегичівське	1963	31	7	**77%**	24 628	3 291
Хідновицьке	1942	9	2	**77%**	23 174	2 301
Солохівське	1954	41	17	**59%**	13 975	2 835
Ланнівське	1979	40	15	**62%**	12 809	4 838

Source: PJSC "Ukrgazvydobuvannya"[292]

The issue of maintaining gas quality when it is supplied to the GTS/GDS also applies to biomethane producers. Some GTS and UGS operators (Germany, Denmark, France) in the EU report problems that may arise when supplying biomethane in increased volumes to existing gas networks, as well as additional measures that need to be taken. It has already been found that as a result of significant biomethane supply, there is an increase in the content of oxygen, hydrogen, terpenes, cellulose, ammonia, etc., and operators must take additional measures to transport gas from GDS to GTS (reverse compressors) and deodorize the gas that comes from GDS to GTS.

In this direction, it is necessary to determine and control the compliance with parameters that are optimal in terms of the reliability of the GTS/GDS operation and increasing extraction/production, as well as balanced in terms of the financial burden on the GTS/GDS operator and producers.

PM_IMG_WAM_6 Transition to energy units

The Law of Ukraine dated November 2, 2021 No. 1850-IX "On Amendments to Certain Laws of Ukraine Regarding the Introduction of Energy Unit Accounting and Settlements for Natural Gas Volume" provides for the comprehensive use of energy units in the settlements of natural gas. In July 2022, the date of entry into force of this Law was postponed to May 1, following the date of termination or cancellation of martial law in Ukraine.

Parallel accounting of the same volumes in volume units and energy units creates additional problems for companies storing gas in customs warehouses, as well as creates a number of other negative phenomena. In the case of energy units, it will be necessary to make a number of changes to subordinate regulatory acts, including the Ministry of Finance.

[292] https://ugv.com.ua/uploads/UGV_Prez_16x9_ALL_Out3.pdf

Ensuring the attractiveness of the use of Ukrainian oil and gas infrastructure for customers from the EU

ESU2050 sets tasks for the use of tariff policy and the creation of new commercial products for further use of Ukrainian gas infrastructure by customers from the EU.

It should be noted that there are already some commercial products in place, developed to meet the needs of new customers: this includes the storage of natural gas in Ukrainian UGS facilities in customs warehouse mode (**PM_IMG_WEM_12 Commercial product - customs warehouse**), as well as the transportation of natural gas by the GTS over short distances (**PM_IMG_WEM_13 Commercial product - short-haul**).

In the future, as part of the optimization of the gas infrastructure and considering the likely cessation of gas transit from russia to the EU, it may be necessary to develop new commercial products (**PM_IMG_WAM_7 New commercial products for GTS and UGS**). In addition, it is important to anticipate the possibility of fulfilling the obligations of EU customers regarding the storage of mandatory gas reserves in Ukrainian UGS (**PM_IMG_ADD_14 Possibility of storing mandatory gas reserves of the EU in Ukraine**), which requires changes to EU legislation.

Ensuring effective management of the GTS

The NES provides for the introduction of incentive tariff formation in the gas market. The National Action Plan on Energy Efficiency sets tasks for the fourth quarter of 2021 for the Ministry of Energy, the State Agency on Energy Efficiency and Energy Saving, and the National Commission for State Regulation of Energy and Public Utilities, regarding the introduction of a mechanism for mandatory incentive regulation (incentive tariff formation) in the energy and utilities sectors through the development of draft acts amending legislation to expand incentive regulation, particularly in the heating sector (**PM_IMG_WAM_8 Incentive tariff formation for the GDS**). The GDS modernization and effective management needs are determined by the ESU2050. However, both incentive tariff formation and the development or modernization of networks will not be successful without ensuring predictability of the basic legal regime for relevant activities and assets (**PM_IMG_ADD_15 Creating a permanent predictable legal regime for the assets of the GDS and their operators**).

During 2022-2023 significant changes have occurred regarding the management and operation of natural gas distribution. Based on a series of decisions by state authorities and courts, the shares of gas DSOs were transferred to the management of NJSC "Chornomornaftogaz", which is part of the Naftogaz Group. Such management is temporary, as it is appointed for the duration of the imposed arrest on these assets.

In parallel with this, a number of other decisions have been sanctioned to conclude agreements on the operation of GDS and its components, owned by the state, and those that are on the balance sheet of NJSC "Naftogaz of Ukraine", with LLC "Gas Distribution Networks of Ukraine" and termination of similar agreements with previous operators. This decision also has a temporary nature as by the resolution of the Cabinet of Ministers of Ukraine dated 25.11.2022 No. 1335 for the period of martial law in Ukraine and for five years after its termination or cancellation these networks were exempt from the need to conclude lease agreements in accordance with the Procedure for the Transfer of State and Municipal Property for Lease, approved by the resolution of the Cabinet of Ministers of Ukraine dated 03.06.2020 No. 483. Legal appeals are currently underway in both directions.

Such a situation does not contribute to the creation of a predictable stable environment capable of attracting new investments of transparent foreign and domestic capital. Accordingly, a permanent stable solution regarding the legal status of the GDS should be implemented.

PM_IMG_WAM_9 Setting effective balancing rules

The development of the short-term wholesale market is the main task of the balancing system established by Regulation 312/2014 (hereinafter - the EU Balancing Network Code, BAL NC), which is mandatory for Ukraine since the end of 2020. The implementation of BAL NC in Ukraine began in 2016, and in 2017, major changes were made to the subordinate acts for this purpose. At the same time, the functioning of the balancing system in Ukraine does not comply with the best practices of the EU, partly due to errors in the design of the balancing system in Ukraine.

ACER defines the following main elements of the balancing system design according to BAL NC:[293]

1) Enabling measures, namely: the establishment of a virtual trading point and the provision of the possibility to trade imbalances through trading notifications, fulfill the obligations to provide sufficient information to customers for self-balancing, provide access to system flexibility through the right to submit renominations close to real time;
2) The GTS operator has access to and uses a trading platform where short-term standardized products are available and used as a first priority during residual balancing by the GTS operator;
3) There is daily closure of imbalances at the end of each gas day, and the application of prices during daily closure of imbalances is not hindered by permissible deviations (tolerances), nor other tools;
4) The neutrality of the GTS operator's activities in balancing is ensured, which means that customers receive money back or pay the GTS operator additional funds depending on the balance of the neutrality account. Transparent reporting on neutrality is carried out, and funds related to neutrality are accounted for in separate accounts compared to tariff funds.
5) Temporary measures such as permissible deviations, balancing platform, alternative price (other than market price) for daily imbalances closure, etc. are not applied.

The balancing system design in Ukraine needs improvement for most of these elements. Thus, the information provided to customers for self-balancing is not sufficient. The GTS operator does not provide information about the state of the GTS as required by the Regulation. Full implementation of the BAL NC provision regarding the methodology for forecasting non-measured off-takes is also required. In particular, it is necessary to develop and publish such methodology for suppliers to have the opportunity to familiarize themselves with it and, including, to complain about its incorrect application. The use of balancing services is the main method of balancing, while the Regulation requires the use of short-term standardized products. While daily closure of customer imbalances is fundamentally applied, certain exceptions and tools are used to limit its effect (e.g., within the PSO regime). Finally, the ESU2050 separately identifies the need to address balancing neutrality.

iii. Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

Electricity market

Ukrainian legislation provides for non-discriminatory integration of RES into the electricity market and ensures their priority participation in the market.

PM_IME_WEM_07 Possibility for RES producers to choose a model of participation in the market and freely switch between them

[293] ACER Report on Enabling Short-Term Gas Markets After Interim Balancing Measures, 27/11/2020, Volume I, para 90.

Producers of electricity from RES, who operate under the "green" tariff (feed-in tariff), have the opportunity to choose the form of their participation in the market. In particular, they can be part of a balancing group of a guaranteed buyer and operate under the mechanism of the "green" tariff or sell electricity on competitive market segments (through bilateral contracts, on the "day-ahead" market, intraday and balancing markets) at free prices or under the market premium (feed-in premium) mechanism. Producers of RES can sell electricity independently or within balancing groups or use other forms of participation in the market (e.g. energy cooperatives, active consumers under the self-generation mechanism (net billing), aggregation (for RES installations with a capacity of up to 20 MW), etc.).

PM_IME_WEM_08 Application of guarantees for purchasing "green" electricity

The guaranteed buyer is obliged to buy from RES producers, who operate under the "green" tariff, or who have acquired the support based on the auction results, all the electricity generated (while using hydropower - only micro, mini, and small HPPs), at the established "green" tariff, auction price, taking into account the surcharge to it during the entire period of the "green" tariff application or the period of support, if such facilities are included in the balancing group of the guaranteed buyer. For RES producers who leave the balancing group of the guaranteed buyer for entering competitive market segments and trade at free prices, the possibility of returning to the balancing group of the guaranteed buyer using the "green" tariff mechanism is provided.[294]

According to the Law of Ukraine "On the Electricity Market" (Article 63), the universal service supplier (USS) cannot refuse a household and/or small non-household consumer who generates electricity from alternative energy sources and is located in the USS's area of activity, to enter into a power purchase agreement under the self-generation mechanism, provided that a contract for the supply of electricity is concluded between the consumer and the USS. Accordingly, household and small non-household consumers (with a capacity of up to 50 kW) - active consumers operating under the self-generation mechanism - can sell their excess electricity generated from RES to the USS at hourly day-ahead market prices. Non-household consumers operating under the self-generation mechanism can sell excess electricity generated by them to suppliers at free prices.[295]

PM_IME_WEM_09 Non-discriminatory integration of demand-side management, energy storage, and aggregation into the energy system and market

The national policy in the electricity sector of Ukraine, among other things, is aimed at providing conditions and implementing measures for the development of energy efficiency in the electricity sector, demand-side management; promoting the production of electricity from alternative energy sources and the development of distributed generation and energy storage facilities.

Legislation provides that preference is given to attracting investments aimed at increasing energy efficiency and DSM, rather than investments in increasing generating capacity, if the former is a more efficient and economical option, taking into account the positive impact on the environment due to energy consumption reduction and security of supply and associated distribution costs. In particular, the government has introduced a Procedure for conducting a contest for the construction of generating capacity and the implementation of demand-side management measures.[296] In terms of DSM, the TSO,

[294] https://zakon.rada.gov.ua/laws/show/2019-19#n2651

[295] https://zakon.rada.gov.ua/laws/show/3220-IX#Text

[296] https://zakon.rada.gov.ua/laws/show/677-2019-%D0%BF#Text

based on the Generation Capacity Adequacy Assessment Report and the monitoring of the security of supply, submits conclusions and proposals to the Ministry of Energy regarding 1) the need to conduct contests; 2) the volume of procurement of demand management measures; 3) the impact on the electricity load profile due to the DSM measures implementation; 4) technical requirements, including the technical characteristics of the equipment used for DSM measures.

When planning the distribution system development, distribution system operators (DSOs) should anticipate the need for construction and/or reconstruction of the distribution system to implement energy efficiency measures, demand response, and/or distributed generation and energy storage development.

Gas market

Measures to promote and increase biomethane production

Considering the plans for hydrogen production from 2032, as well as its main focus on exports, policies and measures regarding non-discriminatory access for renewable and alternative gases should primarily apply to biomethane.

Existing policies and measures adopted for this purpose are as follows:

- **PM_IMG_WEM_14 Legal right to access and connect to gas networks:**

According to Article 19, Part 1 of the Law of Ukraine "On the Natural Gas Market," biogas or other types of gas producers from alternative sources have the right to access gas transmission and distribution systems, gas storage facilities, LNG installations, provided they comply with technical standards and safety requirements in accordance with the legislation and provided that biogas or other types of gas from alternative sources meet the physicochemical characteristics specified in the regulatory acts for natural gas. In addition, it is noted that the provisions of this Law regarding natural gas apply on a non-discriminatory basis to biogas or other types of gas from alternative sources, if biogas or other gas from alternative sources meets the requirements for access to gas transmission and distribution systems, gas storage facilities, LNG installations. The GTS Code unambiguously applies this provision to biomethane producers.[297]

- **PM_IMG_WEM_15 Easing the quality requirements for the injection of biomethane:**

Simplified supply of biomethane to the GTS by increasing the allowable oxygen content in the gas supplied to the GTS and GDS to 0.2 mol.% for the GTS and 1% for the GDS (Resolution of the NERC dated 02.08.2022 No. 847). Overall, this level is within the average range in the EU and the Energy Community (in Germany, values of 1/3 mol.% are applied for high-calorific/low-calorific gas networks, respectively):

[297]GTS Code, Annex I, Chapter 3, Paragraph 2.

Presentation of the map of territories for potential placement of biogas installations

TABLE A 102: Oxygen (O_2) content, maximum value and monitoring frequency

Oxygen (O_2)	Max	Unit	Measurement frequency	Publication frequency
BE	1,000	ppm	Continuously	Daily/Yearly [293]
CZ	0.02	% mol	Continuously	Monthly
EE	2.5	% mol	NA	Monthly
EL	0.2	% mol	5 minutes	Daily
ES	0.01	% mol	Daily	NA
GE	0.0005	% mol	NA	NA
HR	0.001	% mol	Twice per month	Twice per month
HU	0.2	% V/V[294]	Occasionally	Occasionally
IE	0.2	% mol	Monthly	Monthly
LT	0.5	% mol	NA	NA
LV	1	% mol	Continuously	On request
NL	0.5	% mol	5 minutes	Yearly
PT	No limit	% mol	Hourly	Monthly
RO	0.02	% mol	Daily/every 10 days/monthly [295]	No obligation
SI	0.02 [296]	% mol	Daily	Not published
SK	0.01	% mol	NA	NA
UA	0.02	% mol	Daily/Weekly [297]	Monthly

Source: CEER/ECRB[298]

In this regard, the Action Plan for the Implementation of Ukraine's Climate Policy within the framework of participation in the global initiative on methane emissions reduction, the Global Methane Pledge, includes a proposal to update the requirements with the establishment of a maximum normative value for the molar fraction of oxygen in biogas at 0.5%.

- **PM_IMG_WEM_16 Approval of the standard for biomethane:**

By order No. 55 dated 03.04.2023, the standard DSTU EN 16723-1:2023 for natural gas and biomethane for use in transportation and biomethane for injection into the natural gas network was adopted.

- **PM_IMG_WEM_17 Legal prerequisites for gas reverse flow between GTS and GRM:**

Clarification of the conditions for connecting biomethane installations to the networks of GTS and GDS operators, including the introduction of the concepts of "biomethane" and "reverse compressor station", and the establishment of specific features for connecting this group of customers (Resolution of the NERC dated 08.06.2023 No. 1021).

- **PM_IMG_WEM_18 Supporting large-scale biomethane production projects:**

According to the Law of Ukraine No. 3311-IX dated 09.08.2023 "On Amendments to Certain Legislative Acts of Ukraine Regarding the Implementation of Investment Projects with Significant Investments",[299] exemptions from certain taxes and fees, VAT on the import of new equipment, preferences for the allocation of state and municipal land, compensation for certain types of expenses are provided.

- **PM_IMG_WEM_19, PM_IMG_WEM_20 Register of biomethane, Guarantees of origin:**

[298] 7th CEER-ECRB Benchmarking Report on the Quality of Electricity and Gas Supply, p.297.

[299] https://zakon.rada.gov.ua/laws/show/3311-20#Text

By the Law of Ukraine dated October 21, 2021 No. 1820-IX "On Amendments to Certain Laws of Ukraine on the Development of Biomethane Production"[300] and the Law of Ukraine dated June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of the Energy System of Ukraine":[301]

- the definition of biomethane as a gas that complies with the regulatory acts for natural gas for supply to gas networks or for use as motor fuel is provided;
- concepts of biomethane guarantee of origin and biomethane certificate of origin are defined;
- the existence of a biomethane register (both for biomethane supplied to gas networks and for liquefied or compressed biomethane) and the procedures and powers for its creation and operation are provided.

In particular, it is envisaged that the creation of an account in the biomethane registry is carried out after an independent audit of the biomethane production facility, confirming its ability to produce biomethane and regulated by the Biomethane Registry Operation Procedure.

Simultaneously with the cancellation of the biomethane guarantee of origin, a biomethane certificate of origin is issued, with these procedures being regulated by an international agreement on registry interaction, if it concerns the export of biomethane. The procedure for canceling the biomethane guarantee of origin and issuing a biomethane certificate of origin in case the consumption of biomethane is carried out outside the customs territory of Ukraine.

To implement this Law, the Procedure for the functioning of the biomethane registry was approved by the resolution of the Cabinet of Ministers of Ukraine dated 22.07.2022 No. 823. However, as of December 2023, the biomethane registry is not operational, and therefore, corresponding guarantees of origin are not issued.

- **PM_IMG_WEM_21 Statute of an observer in the Association of Issuing Bodies:**

The State Agency on Energy Efficiency and Energy Saving has had the status of an observer in the Association of Issuing Bodies since 2022. By the Law of Ukraine dated 30.06.2023 No. 3220-IX 'On Amendments to Certain Laws of Ukraine Regarding the Restoration and 'Green' Transformation of the Energy System of Ukraine,'[302] Part Two of Article 6 of the Law of Ukraine 'On the Electricity Market' is supplemented with a new subparagraph 14, which includes among the main tasks of the Regulator in the electricity market, in particular, facilitating Ukraine's full membership in the Association of Issuing Bodies. Considering that the certification system within AIB also applies to gas, this measure also applies to the gas market. However, according to Part 11 of Article 19 of RED III, full membership in AIB does not guarantee the recognition of guarantees of origin issued in Ukraine; on the contrary, this provision of the Directive explicitly prohibits Member States from recognizing guarantees of origin issued in third countries, in the absence of an agreement with the EU for this purpose and the presence of a compatible system of guarantees of origin in the third country (as well as in the case of direct export/import from a third country). In addition, there are other cooperation bodies for the administration of guarantees of origin (e.g., ERGaR).

At the same time, according to the information obtained during public consultations, existing policies and measures are capable of stimulating the production of biomethane at a level of 50-100 million m3/year by 2030.[303] These volumes are significantly lower than the declared potential for biomethane production in Ukraine, as well as the goals announced by other countries with a similar sector development base (France - 4 billion m3, Netherlands - 2 billion m3) by 2030. According to estimates by the NGO

[300] https://zakon.rada.gov.ua/laws/show/1820-20#n39

[301] https://zakon.rada.gov.ua/laws/show/3220-IX#Text

[302] https://zakon.rada.gov.ua/laws/show/3220-IX#Text

[303] Public consultations held on 13.12.2023.

"Bioenergy Association of Ukraine," under an optimistic scenario of events in Ukraine by 2030, it is possible to achieve a production of 1 billion m3/year of biomethane, distributed in a 50/50 proportion between domestic consumption and export.

Additional measures are necessary to increase production volumes, some of which are already planned. Additional planned policies and measures in this direction include the following:

- **PM_IMG_WAM_5 Opening of biogas export to the EU:**

Paragraph 4 of Section II "Final Provisions" of the Law of Ukraine dated June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and "Green" Transformation of the Energy System of Ukraine" requires the Ministry of Finance of Ukraine to make changes to its regulatory acts regarding the inclusion of biomethane (including liquefied or compressed) in the list of goods subject to customs clearance within three months from the date when this Law comes into force. For this purpose, draft law No. 9456 is being considered.[304]

- **PM_IMG_WAM_10 Launch of the biomass market:**

The ESU2050 notes the need to create a legislative framework for the development of trade in solid biofuels, which involves the creation of a biomass market and the development of regulatory acts to regulate its activities.

- **Access to financing from the Decarbonization Fund (see PM_EE_WEM_02);**

- **PM_IMG_WAM_11 Financial support for biomethane producers:**

By the Law of Ukraine No. 3311-IX dated 09.08.2023 "On Amendments to Certain Legislative Acts of Ukraine Regarding the Implementation of Investment Projects with Significant Investments",[305] support for significant biogas production projects is provided. At the same time, the results of public consultations have shown that small-scale biogas producers (up to 3 million m3/year) are the main producers, while significant producers are large companies potentially capable of attracting capital on favorable terms. Thus, the support allocated to large biogas producers may be reviewed for its distribution among small enterprises.

Thus, the Action Plan for the Implementation of Ukraine's Climate Policy within the framework of participation in the global initiative to reduce methane emissions, called the Global Methane Pledge, provides for partial reimbursement of the cost of facilities (up to 50 percent of the cost, and up to 70 percent for agricultural cooperatives) for processing by-products of animal origin belonging to categories II and III, as well as reducing the cost of construction by agricultural producers of animal complexes with biogas installations for the production of biomethane to diversify energy sources, accelerate the transition to "clean" energy, increase energy efficiency, and replace imports of natural gas.

Additional, currently unplanned but necessary measures include:

- **PM_IMG_ADD_16 Simplification of conditions for connection to gas networks (regarding time and cost of connection):**

The ESU2050 includes a measure to simplify the connection to gas networks for biomethane producers, but does not provide sufficient details on this measure. During public consultations, market participants mentioned that the main problem for the development of the biomethane market is the "lawlessness" of the gas and electricity distribution operators (taking into account that biomethane producers are often also electricity producers). The specific issues mentioned relate to the time and costs of connection to the network.

[304] https://zakon.rada.gov.ua/laws/show/3220-IX#Text

[305] https://zakon.rada.gov.ua/laws/show/3311-20#Text

In the context of time, it is possible to consider various options for regulatory stimulation of reducing deadlines for issuing technical conditions for connection or using the principle of silent consent for connection. Another approach could be the use of existing research, in particular the creation of "renewable go-to zones" based on zoning, which has already been carried out by the Bioenergy Association of Ukraine (UABIO) with the support of the EBRD.[306]

In the context of connection cost, it is possible to consider a significant reduction or at least stabilization of the connection cost, especially for small producers (up to 3 million m3/year), taking into account that the GTS and GDS operators will benefit from the transportation/distribution of gas from these producers. In general, in EU countries, the costs of connecting biogas projects can be covered by the respective operator by 60-75% (France, Germany).

One of the options (analogous to Germany) could be the determination of the maximum connection fee that the customer can pay in case of connection at a certain distance from existing networks, while the rest of the costs will be covered by the respective operator. This approach creates cost predictability for the investor, while incentivizing the operator to reduce costs for overcoming obstacles to connection. To cover the remaining costs of the GTS/GDS operator, taking into account the potential tariff deficit of the GTS operator in the second regulatory period, as well as obstacles to the implementation of RAB-tariff formation at the GDS level, a separate financing program may be developed with the participation of the state budget or international partners.

In addition, it is necessary to build understanding between investors and TSOs: conducting joint seminars to explain existing rules and develop proposals for improving the regulatory framework, important role of the Ministry of Energy/NEURC as a mediator in this process, if necessary - creating an electronic window for submitting documentation for connection, which can improve the process of loading and processing the document package, as well as strengthen NEURC's control over the process;

- **PM_IMG_ADD_17 Review of the approach to the legal regulation of reverse compressor stations:**

The decision on financing the installation of reverse compressor stations, as stipulated by the resolution of the NERC dated 08.06.2023 No. 1021, requires further refinement taking into account the goal of developing a competitive market and preventing conditions for monopolistic abuses of access to important infrastructure.

- **PM_IMG_ADD_18 Establishment and application of sustainability criteria for renewable/low-carbon gases:**

ESU2050 provides for the implementation of a procedure for verifying the compliance of liquid biofuels with sustainability criteria, but does not sufficiently detail this measure. On the other hand, the establishment and application of sustainability criteria is necessary not only for liquid biofuels (motor fuels), but also for solid or gaseous fuels from biomass or liquid biofuels for use in sectors other than transportation. NES indicates the need to align national legislation, standards, and practices with the general principles of sustainable agriculture and proper agricultural practices in Europe, gradually harmonizing state agricultural policy with the European Green Deal in agriculture; however, visible work in this direction has not been carried out to date.

iv. Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market

PM_IM_WEM_01 Targeted monetized subsidies for partial compensation of energy service costs

[306] https://saf.org.ua/wp-content/uploads/2022/02/BM-Zoning-Final-Report-version-2022-02-01.pdf

Key consumer protection policies include non-cash monetization of subsidies for vulnerable household consumers and regulated electricity prices for households, as determined by the Cabinet of Ministers. Ukraine has transitioned from indirect subsidies to non-cash monetized subsidies for households to compensate for the cost of consumed electricity, gas, heat, and other communal services. The Cabinet of Ministers has established criteria, conditions, and rules for providing subsidies to households for payment of energy and other communal services bills. Payments for energy and other communal services that exceed a certain threshold share of households' average monthly income are covered by subsidies. In addition, the draft plan for the Ukraine Facility includes additional measures to reform the housing subsidy system in Ukraine.[307]

PM_IM_WAM_02 Institutional support for the protection of vulnerable consumers

According to the Law of Ukraine "On the Natural Gas Market" (Article 16), vulnerable consumers are defined as residential consumers who are entitled to state assistance in accordance with the procedure established by the Cabinet of Ministers of Ukraine, which, in particular, establishes criteria for classifying consumers as vulnerable. Vulnerable consumers have the right to a subsidy to compensate for the costs of consumed natural gas and other targeted assistance provided in accordance with the procedure established by the Cabinet of Ministers of Ukraine, as well as special measures to protect vulnerable consumers regarding disconnection during critical periods in order to meet the needs of such consumers for natural gas. As of December 2023, such a procedure has not been adopted by the Cabinet of Ministers.

The Law of Ukraine "On the Electricity Market" (Article 61) provides general principles of protection for vulnerable consumers. At the same time, the supply of electricity to vulnerable consumers is carried out by the universal service provider.

In addition, the development of the Procedure for the application of special additional protection measures for categories of vulnerable electricity consumers is underway.[308]

PM_IM_WAM_03 Application of online services for consumers (eConsumer)

The ESU2050 provides for the creation of an energy consumer cabinet - eConsumer, which will use information from Datahubs to identify the reasons for discrepancies between meter readings and the readings that DSOs provide as the final bill, as well as a set of automated functions. Among them are switching the electricity supplier, automatic transfer of the consumer to the supplier of universal services or the supplier of last resort.

Electricity market

PM_IME_WEM_11 Application of service quality standards and compensation to consumers for their non-compliance

To protect consumer rights, the Regulator has approved the Procedure for ensuring the standards of electricity supply and compensation to consumers for their non-compliance (defines the standards of service quality for the electricity transmission system operator, distribution system operators, and

[307] https://zakon.rada.gov.ua/laws/show/848-95-%D0%BF#Text

[308] https://www.msp.gov.ua/projects/838/

suppliers),[309] as well as Minimum requirements for the quality of service for electricity consumers in call-centers.[310] The mentioned Procedure, in particular, establishes the amounts of compensation for non-compliance with guaranteed standards of service provision by the electricity distribution system operators and suppliers. The rules of the retail electricity market determine the procedure for actions of the retail market participants during the consideration of appeals, complaints, and claims of consumers.

The Regulator monitors compliance by electricity suppliers and DSOs with general and guaranteed quality of service standards by analyzing the relevant reports regularly provided by licensees.

PM_IME_WEM_12 Regulation of retail prices for households

In addition to direct support for vulnerable household consumers through subsidies, Ukraine keeps affordable regulated electricity prices for households within the PSO mechanism.[311] This policy is temporary, meaning that there is a planned gradual alignment of electricity prices for households with market-based prices, while simultaneously applying direct subsidization to vulnerable consumers in a monetized form to provide partial compensation for the total end-user cost of electricity supply. At the same time, time-bound electricity prices for households (depending on the time zone) are in place (see section 3.4.3.v for more details).

In accordance with the Plan for the implementation of reforms within the framework of the European Commission's proposal for the Regulation of the European Parliament and of the Council of the European Union on the establishment of the Ukrainian Facility fund, the Cabinet of Ministers of Ukraine will adopt a Roadmap for the gradual liberalization of the gas and electricity market with steps that need to be taken and corresponding deadlines that should be implemented after the end of the martial law. The Roadmap will be based on technical analysis to understand the financial condition of the sector and will include:

- steps for reforming the energy sector to gradually liberalize market prices after the lifting of the martial law;
- steps to be taken to ensure proper protection of vulnerable consumers after the liberalization of prices for households, including a new design of the subsidy system for vulnerable consumers that improves targeting and ensures adequate protection, as well as preparatory steps to be implemented before the end of the martial law, such as identifying vulnerable consumer groups and the associated digital solutions.

The reform will be implemented by the Ministry of Energy and the Regulator (NEURC) and will start before the 2nd quarter of 2026.

PM_IME_WEM_13 Supply of electricity to protected consumers

The Law of Ukraine "On the Electricity Market" (Article 60) defines a category of protected consumers to whom a special regime of disconnection and/or restriction of electricity supply is applied to prevent the occurrence of emergencies of a technological nature. Disconnection of protected consumers is carried out in accordance with the Procedure for Ensuring the Supply of Electricity to Protected Consumers, approved by the Cabinet of Ministers of Ukraine, which determines: 1) the procedure for compiling a list of protected consumers; 2) the procedure for restricting, disconnecting the electricity supply to protected

[309] https://zakon.rada.gov.ua/laws/show/v0375874-18#Text
[310] https://zakon.rada.gov.ua/laws/show/v0373874-18#Text
[311] https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text

consumers; 3) mechanisms for ensuring full current payment by protected consumers for electricity consumption by advance payment for the projected consumption volume and/or providing a financial guarantee of payment or in another way.[312]

PM_IME_WEM_14 Provision of universal services to consumers

The universal service supplier (USS) cannot refuse to enter into a contract for the supply of electricity with a household and/or small non-household consumer who is located within its area of USS activity, which will guarantee household and small non-household consumers the opportunity to receive electricity supply services.

PM_IME_WEM_15 Ensuring consumers' access to important information

The interaction between electricity suppliers and consumers, including the procedure for switching suppliers, are regulated by the Retail Electricity Market Rules.[313]

To ensure proper transparency of suppliers' operation, they must provide consumers with key information on their official websites, including general terms of electricity supply; proposed electricity prices and their components; quality indicators for service provision, procedure and amount of compensation for non-compliance with quality indicators; procedure for supplier switching; procedure for submitting and reviewing complaints and claims regarding service provision, including contact information; procedure for disconnecting/reconnecting consumer's electricity supply, etc.

PM_IME_WEM_16 Application of tools to facilitate comparison of commercial offers and consumer choice (price comparison tools)

To improve the accessibility of information on available commercial offers from suppliers to consumers, the Regulator acts as an aggregator of public commercial offers and publishes relevant links on its website.[314] Independent price comparison tools (online services) are also being introduced in Ukraine to facilitate the comparison of prices and enable consumers to make decisions regarding supplier choice or switching.[315]

To indirectly stimulate competition, the Regulator applies a rating tool and publishes a ranking of companies based on the indicators of the quality of electricity supply.[316] The rating includes an assessment of the performance of distribution system operators (DSOs) and universal service suppliers (USSs) for 2021 and 2022. The analysis covers indicators of the reliability of electricity supply (System Average Interruption Duration Index - SAIDI; achieving the target reduction of SAIDI is one of the essential conditions for RAB regulation of DSOs) and the commercial quality of service provision (average response time to consumer inquiries/complaints/claims, call center service level within 30 seconds, and the percentage of lost calls in the call center queue).

[312] https://zakon.rada.gov.ua/laws/show/1209-2018-%D0%BF#Text

[313] https://zakon.rada.gov.ua/laws/show/v0312874-18#Text

[314] https://www.nerc.gov.ua/sferi-diyalnosti/elektroenergiya/publichni-komercijni-propoziciyi/publichni-komercijni-propoziciyiyi

[315] https://rep.oree.com.ua/index.php?route=product/category&path=115

[316] https://www.nerc.gov.ua/news/nkrekp-publikuye-rejting-kompanij-za-pokaznikami-yakosti-elektropostachannya

PM_IME_WEM_17 Simplification of the supplier switching procedure

The procedure for switching the electricity supplier is determined by Section VI of the Retail Electricity Market Rules. One of the essential conditions of the electricity supply contract to the consumer is the procedure for switching the supplier. No provision of the electricity supply contract shall restrict the consumer's right to switch suppliers.

The consumer can switch suppliers free of charge. In addition, the contract cannot contain provisions that impose additional financial obligations on the consumer who switches the supplier. Otherwise, such provision shall be considered invalid from the moment of contract conclusion. An important condition for exercising the right to choose a supplier freely is the consumer's conclusion of a distribution (transmission) services agreement with the system operator.

If the consumer chooses another supplier, the consent of the previous supplier is not required to terminate the electricity supply contract with them. Before the termination of the supply contract, the previous supplier is obliged to ensure the supply of electricity to the consumer on the terms of the current contract.

Switching suppliers at the consumer initiative must be completed within a period of no more than three weeks from the date of notification by the consumer of the intention to switch the supplier. Also, at the request of the consumer, supplier switching must be completed under an expedited procedure within a period of no more than 3 calendar days (provided that the actual meter readings of the consumer are read by an automated commercial metering system or the consumer agrees with the previous and new suppliers on the forecasted meter readings on the date of the supplier switching).

To facilitate and expedite the process of supplier switching, the TSO has introduced the central information and telecommunications platform DataHub, as well as the centralized registry of metering points (MPs) in the electricity market, administration of processes for supplier switching, as well as centralized management and metering data exchange for providing settlements.[317]

Gas market

Policies and measures for setting gas prices for household and certain related consumer categories.

According to the Law of Ukraine No. 2479-IX dated 27.07.2023 "On the peculiarities of regulation of relations in the natural gas market and in the field of heat supply during the state of war and subsequent restoration of their functioning", it is established that during the state of war in Ukraine and six months after the month in which the state of war is terminated or canceled:

- it is prohibited to increase tariffs for: natural gas distribution services for all categories of consumers; heat energy (its production, transportation, and supply) for the population, supply of heat energy for the population, and supply of hot water for the population (**PM_IMG_WEM_22 Moratorium on tariff increase for distribution**);
- the price of natural gas for household consumers, as well as for associations of co-owners of multi-apartment buildings, housing cooperatives, other persons authorized by law who, by self-provision, maintain systems of autonomous heat supply of a multi-apartment building owned by co-owners on the basis of joint and several ownership in a multi-apartment building, in their interests, concludes a contract for the supply of natural gas for the operation

[317] https://ua.energy/datahub/

of gasboilers (roof, attached, and/or located on the adjacent territory) to meet the needs of co-owners of a multi-apartment building (except non-residential premises), heat energy producers - if they use natural gas for the production of heat energy for the population and have concluded a contract with a natural gas market participant, who, in accordance with Part One of Article 11 of the Law of Ukraine "On the Natural Gas Market," has special obligations, shall not be increased from the price applied in relations between suppliers and respective consumers as of February 24, 2022 (**PM_IEMG_WEM_23 Moratorium on gas price increase for household consumers, housing associations and similar consumers**);

- it is prohibited to include conditions regarding prepayment, provision of a bank guarantee for the amount of the consumer's financial obligations, and unconditional withdrawal of funds from the consumer's bank account in contracts for the supply of natural gas by associations of co-owners of multi-apartment buildings for heating and hot water supply to the co-owners' apartments (except non-residential premises);
- The natural gas supplier is prohibited from taking any actions to force the household consumer to pay off the debt (including including the debt in the payment invoice, filing lawsuits, enforcing debt collection, taking measures to disconnect gas supply due to the presence of debt, etc.), which is regulated in accordance with paragraph two of part three of Article 2 of this Law.

Apparently, these provisions create significant obstacles to the development of a competitive gas market, as it restricts price formation through the forces of supply and demand. Currently, there are no measures in place to ensure a gradual liberalization of gas prices, despite the requirements of Article 12 of the Law of Ukraine "On the Natural Gas Market".

According to the draft plan to the Ukraine Facility, by the 2nd quarter of 2026, the Cabinet of Ministers of Ukraine is expected to approve a Roadmap for the gradual liberalization of the gas and electricity market, which should focus on the necessary steps for reforming the Public Service Obligation (PSO) in order to gradually liberalize market prices after the lifting of the state of war, as well as measures to ensure proper protection of vulnerable consumers after the liberalization of prices for households, including a new design of the subsidy system for vulnerable consumers, which improves targeting and provides adequate protection, as well as preparatory steps to be implemented before the end of the state of war, such as identifying vulnerable population groups and the related digital solution (**PM_IEM_WAM_12 Ensuring market pricing for gas**).

Policies and measures for setting gas prices for non-household consumers.

The Law of Ukraine "On Capital Markets and Organized Commodity Markets" in the new version of Law No. 738-IX lays the foundations for the creation of organized wholesale markets in Ukraine according to the European model, including energy markets. This law provides updated powers for state authorities and requirements for operators of such markets, including the concept of clearing. In this context, attention should also be paid to the SEEGAS initiative, which brings together representatives from Southeastern and Eastern Europe (including Ukraine) with the support of the Secretariat of the Energy Community and the EBRD, with the aim of creating an efficient clearing system for gas operations and related derivatives.

In June 2023, the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Prevention of Abuse in Wholesale Energy Markets" was adopted, which, among other things, introduces mandatory registration of natural gas market participants who carry out or intend to carry out activities in the wholesale energy market, as well as other measures to promote transparency in the wholesale energy market. Work is underway to develop the necessary subordinate regulatory acts and create the necessary

infrastructure for the implementation of the law (**PM_IMG_WEM_24 Adoption of REMIT Regulation**).

Policies and measures to protect consumers and enhance competition in retail markets.

The main policies and measures to protect consumers and enhance competition in retail markets are as follows:

- provision of housing subsidies to certain categories of citizens **(PM_IM_WEM_01 Targeted monetized subsidies for partial compensation of the cost of energy services);**
- licensing of gas suppliers (**PM_IMG_WEM_25 Licensing of suppliers**);
- simplified procedure for changing suppliers (both household and non-household) (**PM_IMG_WEM_26 Procedure for changing suppliers**);
- basic annual offer that suppliers are obliged to offer to all consumers, as well as the right to offer other options (**PM_IMG_WEM_27 Basic annual offer**);
- function of the 'last resort' supplier (**PM_IMG_WEM_28 Function of the 'last resort' supplier**).[318]

In addition, the liberalization of prices for household consumers in 2020 has prompted the launch of separate non-governmental initiatives to provide information support to consumers, such as the 'Gas Library' service by DiXi Group[319] and the consultation center for the population 'Gas Truth' by the All-Ukrainian Industry Association 'Federation of Employers in the Oil and Gas Industry'.[320]

The planned measures include the creation of an energy consumer cabinet - 'eConsumer', as provided by the EEU (**PM_IM_WAM_03 Application of online services for consumers**).

At the same time, additional measures should be taken to create proper conditions for competition in the retail market, in particular strengthening the requirements for the separation of gas distribution operators (PM_IMG_ADD_20 Strengthening the requirements for the separation of gas distribution operators). According to the recommendations of the Energy Community,[321] there are several verticals of unbundling, including management unbundling, which includes the separation of governing bodies, independence and efficiency of decision-making, separate identity, communication and branding, and confidentiality preservation. In particular, there are no legislative rules that would be clearly controlled by the NEURC and would apply to a large part of these rules (in particular, regarding the use of shared services and premises, separate communication with the consumer, non-disclosure of information to related parties). For example, it is common practice for gas distribution operators and their affiliated suppliers to use shared premises, advertising, and other resources, which should be clearly controlled by the NEURC.

v. Description of measures to enable and develop demand response, including those addressing tariffs to support dynamic pricing

Electricity market

PM_IME_WEM_18 Time-bound prices for household consumers

[318] According to the order of the Cabinet of Ministers dated 12.09.2023 No. 793-r.

[319] https://gasoteka.ua-energy.org/?_ga=2.96846620.2046844725.1696501319-501792254.1693297960

[320] https://gazpravda.com.ua/pro-tsentr

[321] UNBUNDLING OF DISTRIBUTION SYSTEM OPERATORS GUIDE AND REQUIREMENTS FOR PRACTICAL IMPLEMENTATION.

To encourage household consumers to implement smart meters and demand-side management, in addition to a regulated price for electricity, the government has also established time-bound prices – two-zone or three-zone prices, which allow for partially shifting electricity consumption from peak periods to other periods of the day. If there is smart metering of electricity consumption, a fixed electricity price for household consumers is defined with the application of coefficients (at the consumer's choice):

- *two-zone price:* during the hours of minimum nighttime system load (from 23:00 to 7:00), a coefficient of 0.5 is applied to the fixed electricity price; during other hours of the day, a full fixed price is applied.

- *three-zone price:* during the hours of minimum nighttime system load (from 23:00 to 7:00), a coefficient of 0.4 is applied to the fixed price of electricity; during the semi-peak period (from 7:00 to 8:00, from 11:00 to 20:00, from 22:00 to 23:00), a full fixed price of electricity is applied; during the hours of maximum system load (from 8:00 to 11:00, from 20:00 to 22:00), a coefficient of 1.5 is applied to the fixed price of electricity.[322]

PM_IME_WEM_19 Dynamic prices for non-household consumers

Since the launch of the new model of the retail electricity market on January 1, 2019, dynamic pricing for non-household consumers has been subject to contractual relations between suppliers and consumers. Suppliers have the right to purchase electricity in different segments of the wholesale market at time-bound prices, including on the day-ahead market at hourly prices, and sell it to non-household consumers equipped with smart meters (consumers of group "A") at dynamic prices, which enables demand-side management.

According to the Retail Electricity Market Rules, public commercial offers of electricity suppliers must be clearly distinguished according to their terms and method of determining the electricity price. In particular, suppliers' commercial offers may include prices differentiated by time periods of the day or hourly prices, etc.[323]

Gas market

PM_IMG_WAM_13 Ensuring 100% gas metering

According to Article 2 of the Law of Ukraine "On Ensuring Commercial Metering of Natural Gas", by January 1, 2023, all natural gas consumers must be equipped with meters. Apparently, this goal needs to be reviewed, and the reasons for the constant non-compliance by operators should be identified and addressed.

PM_IMG_WAM_14 Analysis of telemetry benefits and costs

In addition, according to part 4 of Article 18 of the Law of Ukraine "On the Natural Gas Market," the state should encourage the implementation of modern systems, including hardware for natural gas metering, particularly those that enable consumers to actively manage their consumption. Within its competence, the Ministry of Energy coordinates the comprehensive analysis of long-term economic benefits and costs of implementing such measures and their optimal list. Based on the results of this

[322] https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text

[323] https://zakon.rada.gov.ua/laws/show/v0312874-18#Text

analysis, the same authority should approve the plan for implementing the selected set of measures. Currently, the corresponding comprehensive analysis has not been conducted, so the question of the justification for equipping gas consumers with intelligent metering systems remains open.

It should be noted that the task of analyzing the benefits and costs of implementing such systems comes from the requirements of point 2 of Annex I to Directive 2009/73/EC. Relevant studies have been conducted in all EU countries, based on which decisions were made on the feasibility or infeasibility of large-scale implementation of smart metering systems. For example, such widespread implementation is planned in France and Italy.[324]

In this way, the mentioned comprehensive analysis should be conducted and based on it, a decision should be made on the feasibility or inexpediency of equipping consumers with intelligent gas metering systems.

PM_IMG_WAM_15 Creation of Datahub in the gas market

To simultaneously achieve the goals of achieving synergies between energy sectors and improving the commercial metering system, the ESU2050 envisages the creation of a Datahub similar to the electricity market to address gas commercial metering issues and automate information exchange between natural gas market participants.

The creation of an information database on natural gas consumption is already provided for by Article 2-1 of the Law of Ukraine "On Ensuring Commercial Accounting of Natural Gas". The Cabinet of Ministers of Ukraine should approve the provisions on this information database, which should include the main tasks, functional capabilities, market participants of natural gas, responsible for entering information about natural gas consumers, deadlines and procedure for entering such information, as well as other issues of its functioning. The holder of the information database and the administrator of the information database are determined by the Cabinet of Ministers of Ukraine. The protection of information contained in the information database is carried out by the holder of the information database in accordance with the requirements of legislation on information protection in information and telecommunication systems and on the protection of personal data.

The draft Regulation on the information database has been published on the Ministry of Energy's website, but it has not been adopted yet.

An important principle in the creation and functioning of this information database should be its integration with information on other energy sectors. In particular, the most appropriate approach for the synergistic development of energy sectors would be the creation of a unified database for the electricity and gas markets based on the existing central information and communication platform, Datahub. In fact, for the electricity and gas sectors, Datahub can contain standardized data packages, such as consumer EIC codes, their identity and address, active operators and suppliers, meter readings, data on commercial metering devices, their temporary absence or replacement, and so on. In addition, such a solution will significantly save costs on creating a new digital solution for the gas market.

To fill the Datahub with information about heat, additional legislative actions will be required (for example, assigning separate codes to heat consumers that are allocated to each address), as well as determining a separate list of information that can be included in the unified Datahub.

PM_IMG_ADD_21 Creating other elements of the gas commercial metering system

[324] European Commission, Benchmarking smart metering deployment in the EU-28, Final Report, December 2019.

Creating a functioning commercial metering system is not enough to create a Datahub. It is necessary to integrate a separate function of the commercial metering administrator into the operation of the gas market in order for it to be responsible for monitoring the application of current commercial metering rules and developing necessary changes to them, coordinating the development of the methodological basis for forecasting in the natural gas market, having the authority to resolve or provide expert assessments to resolve technical issues between market participants, and also being a legitimate source of data for suppliers, consumers, and other players. In addition, other measures can be considered for integrating gas and electricity commercial metering, in particular in terms of harmonizing metering rules and enhancing competition in the installation and technical support of metering devices.

PM_IMG_ADD_22 Creating conditions for the use of contractual practice of voluntary gas consumption reduction

In order to increase the flexibility of the gas infrastructure, the experience of France in creating legislative conditions for the contractual practice of voluntary gas consumption reduction can be used. France not only approved the relevant rules, but also set a target for the percentage of consumers to be covered by this regime. Thus, according to the mentioned rules, consumers have the right to conclude an agreement with the system operator for voluntary interruption of consumption. The legislation further details which consumers can exercise this right, as well as the verification procedure by the operator of the possibility of operational consumption reduction.

3.4.4. Energy poverty

i. Where applicable, policies and measures to achieve the objectives set out in point 2.4.4

PM_IM_WAM_04 Monitoring and overcoming energy poverty

ESU2050 defines energy poverty as a situation where the cost of energy consumed by a household consumer constitutes a large portion of their income, making it impossible for them to pay for the energy consumed and/or reduce its consumption, which in turn negatively affects their quality of life. At the legislative level, there is currently no similar definition, as well as quantitative and qualitative indicators that provide grounds for classifying them as energy poor.

In the context of combating energy poverty, it is necessary to:

- legally define what constitutes energy poverty, including the quantitative and qualitative indicators that justify categorizing individuals as energy poor;
- assess the level of energy poverty (the number of consumers falling under the category of energy poverty);
- to determine the desired level of reduction in the number of consumers falling under the category of energy poverty, including taking into account the priority of overcoming energy poverty in specific population groups or in specific territories.

To reduce energy poverty, it is common practice for the state to implement measures aimed at supporting the incomes of vulnerable segments of the population, as the link between household income levels and the level of energy poverty is the highest. Such measures include:

- socially oriented tariffs for energy carriers (temporary policy requiring gradual minimization and subsequent abandonment);

- programs of targeted monetized subsidies to compensate households for energy consumption expenses;
- measures for thermal modernization, energy efficiency, and energy saving;
- implementation of "smart" digital solutions, including demand management for energy resources consumers;
- conducting targeted information campaigns to improve consumers' understanding of the causes and possible ways to overcome energy poverty.

The operational plan of measures for the implementation of the Long-Term Strategy for the Thermal Modernization of Buildings until 2050 for the period of 2024-2026 includes the following measures in terms of overcoming energy poverty in 2024:

- development of conceptual principles of state policy to overcome energy poverty, definition of the term 'energy poverty';
- definition of criteria for energy poverty, vulnerable categories of citizens, individuals who are below the energy poverty line;
- determination of the number of individuals below the energy poverty line, according to established categories;
- establishment of medium-term and long-term goals for reducing the number of people living in energy poverty, including reducing the need for benefits and subsidies for housing and utilities;
- approval of a comprehensive plan of measures to overcome energy poverty, including increasing the energy efficiency of buildings taking into account the system of providing housing subsidies.

ESU2050 defines the following possible measures:

- increasing households' awareness of their energy consumption and providing financial support, namely by installing energy consumption monitoring and providing detailed reports with individual recommendations;
- studying the feasibility of introducing subsidies for small energy renovations for vulnerable households based on the principle of "first in line for repairs" with priority given to vulnerable consumers. In addition to financial support, personalized consultations may be conducted;
- feasibility study for providing financial support for the installation of photovoltaic systems to supply households with electricity.

3.5. Dimension Research, Innovation and Competitiveness

i. Policies and measures related to the elements set out in point 2.5

Implementation of programs in the field of energy decarbonization, green energy transition, hydrogen export, energy storage facilities,microgrids and smart grids, projects in the field of green metallurgy require both large-scale retraining of existing workers in the energy sector and other related sectors, as well as training a new generation of professionals for the design, implementation and operational activities of new projects in the energy and related sectors.

PM_RIC_WEM_01 Modernization of educational programs to address skills gap in the green transition and renewable energy sector

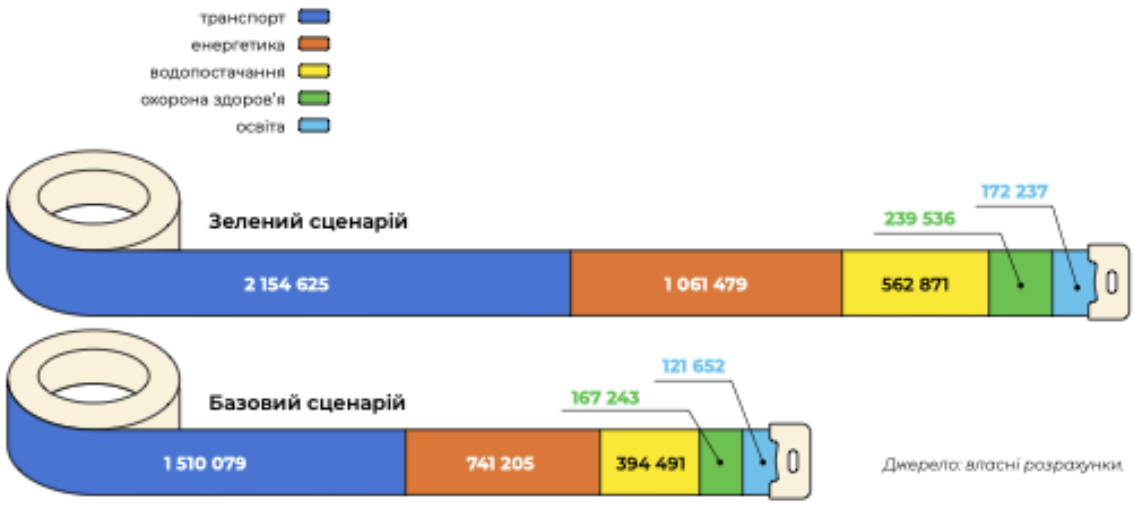
Post-war reconstruction of the energy sector with advanced technologies specified in the government's strategic documents will require cooperation between the Ministry of Energy, the Ministry of Education and Science, the Ministry of Digital Transformation, and other stakeholders to create and modernize relevant educational programs in higher and vocational education. Another important task is the modernization of the material and technical support of scientific and educational institutions used for training energy industry professionals, and the establishment of international partnerships in this direction.

Among the national strategic documents that prioritize the modernization of educational programs for the transition of the Ukrainian economy to a new level of development, one of the key ones can be the "Innovation Development Strategy", the development process of which was launched by the Ministry of Digital Transformation together with the Ministry of Education and Science.[325]

Currently, the document is at the stage of initial public discussions, but the preliminary versions of the "Innovation Development Strategy", posted for public discussion, already pay significant attention to addressing the skills gap and preparing professionals for the jobs of the future.[326]

According to experts from the resource-analytical center "Society and Environment", the "green" vector of post-war reconstruction creates significantly more jobs than the "business as usual" approach. In the case of the "green" reconstruction scenario, these are also "green" jobs with a focus on climate and energy innovations.

Calculation of the need for jobs for the reconstruction of Ukraine under the base and green scenarios



Source: "Green Jobs and Post-War Reconstruction of Ukraine"[327]

[325] The presentation of the global innovative vision WinWin took place on December 15, 2023. Retrieved from https://mon.gov.ua/ua/news/vidbulasya-prezentaciya-globalnoyi-innovacijnoyi-viziyi-winwin

[326] https://winwin.gov.ua/

[327] Green jobs and post-war reconstruction of Ukraine. Author. Col.: Andrushevych A., Andrushevych N., Kozak Z. Ptashnyk I., Romanko S.. - Analytical document. - October 2023

One of the biggest barriers to green recovery after a capital shortage is the lack of qualified personnel, which can only be partially offset by attracting external human resources. Therefore, the development of human resources is one of the priorities in the research, innovation, and competitiveness sector.

PM_RIC_WAM_01 Development of corporate and international partnerships in the energy and climate sector

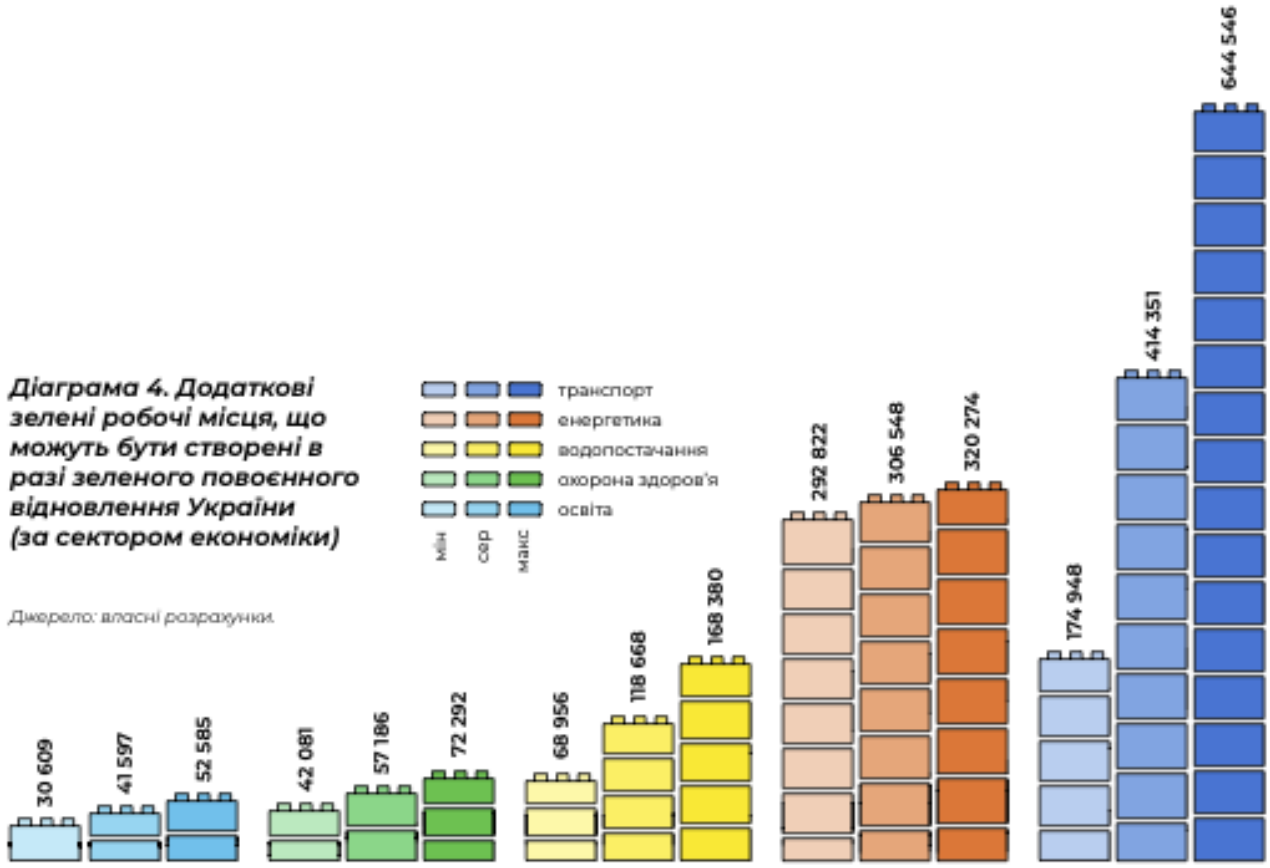
Considering the long duration of the training cycle for energy professionals through the higher and vocational education system, it is extremely important for (jointly with Ukrenergo, system operators, Naftogaz Ukraine, other players in the energy market of state and private ownership) to plan and implement professional development programs for professionals working in the energy sector to ensure their capacity to implement and operate projects in such areas as:

- Decentralized generation and microgrids
- Smart grids
- Energy storage systems
- Electrolyzers, hydrogen synthesis, safe hydrogen storage and transportation
- Green ammonia, its production, storage and transportation
- Energy efficiency and energy-efficient construction
- Cybersecurity in energy systems and others.

The implementation of such qualification enhancement programs will require the involvement of state funds, as well as funds from international donors, international financial organizations, and energy sector companies.

To accelerate the launch of specialized educational programs, it is relevant to involve leading international educational institutions that have successful programs in the areas of distributed generation, decarbonization of energy, artificial intelligence for energy, hydrogen energy, and other areas defined by strategic government documents, in the creation of joint educational courses and accredited educational programs. Exchange programs and academic mobility are also effective tools for accessing advanced knowledge in the field of energy modernization.

Possible dynamics of creating innovative jobs under different scenarios of recovery in the base and



green scenarios

Source: "Green Jobs and Post-War Reconstruction of Ukraine"

Special attention will be required for the modernization of training specialists in the field of nuclear energy, as the implementation of small modular reactors and reactors with flexible power will rely on a different culture of operation and management, a different technological base than the reactors of the Soviet model built in Ukraine.

PM_RIC_WEM_02 Accessibility of grant funding for scientific research in the field of renewable energy and climate innovations

A significant portion of the technologies planned for implementation in the relevant government program documents are still in the stages of scientific research or experimental operation. The development of international cooperation in energy science, innovative metallurgy, and other sectors is an important direction for overcoming the technological gap that has characterized the sector over the past decades.

The status of a candidate country for accession to the European Union provides additional opportunities for access to the European innovative and scientific ecosystem, which includes significant mechanisms for financing energy and climate science, particularly in the areas of decarbonization, green hydrogen, distributed generation, cybersecurity and other relevant areas.

[328]The establishment of the Office "Horizon Europe" in Ukraine based on the National Research Fund of Ukraine (NRFU) opens up new opportunities for cooperation between Ukrainian researchers, scientists, innovative enterprises, and ecosystem organizations with European research, scientific, and innovation centers and institutions such as the European Innovation Council, European Institute of Technology and Innovation, and EURATOM. With a budget of 95.5 billion euros for the period 2021-2027, "Horizon Europe" is a powerful source of funding for scientific research cooperation among European innovators and has the direction "Climate, Energy, Mobility" as one of its key priorities (as part of Pillar II). It is expected that the direction of green transformation will be among the priority areas of grant programs implemented by the National Research Fund in cooperation with "Horizon Europe".

Existing grant programs of the National Research Fund, which include, in particular, grants of up to 50,000 / 100,000 euros for scientific projects of Ukrainian researchers, are also a significant mechanism for financing research and innovation projects relevant to the decarbonization and modernization of Ukrainian energy.

PM_RIC_WAM_02 Expansion of funding for scientific research in the field of renewable energy and climate innovations

NFDO promotes the establishment of scientific connections between Ukrainian and foreign research institutions, which is relevant for the development of modern directions in energy and climate science. However, in order to achieve a significant effect in energy and climate research, a significant increase in funding is necessary, according to expert estimates, at least up to 250 million euros per year.

In this direction, the development of scientific and research diplomacy with key partner countries for Ukrainian energy and green reconstruction is important. In addition to the European Union, the United States, Great Britain, Japan, South Korea, Scandinavian countries, Switzerland, and other leading countries in the field of energy innovation and green transformation can become key partners in this direction.

Cooperation with the listed partners in the field of energy research and innovation will allow to attract critically important knowledge and technologies to overcome the technological gap in the sector. Joint projects with them also create a basis for further funding for research and innovation in the field of energy and climate.

The ambitious plans declared by the Ukrainian government in the development of renewable energy, hydrogen energy, localization of energy equipment production, localization of small modular reactors and fuel assemblies for nuclear power plants and other areas, are extremely knowledge-intensive and require the formation of a new research and innovation ecosystem. For full deployment, the funding needs for research and innovation activities will amount to 750 million euros per year.

The scale of tasks facing Ukraine in the context of research and innovation in the field of energy and climate is not unique. These tasks are faced by all countries that are restructuring their economies to become carbon neutral. According to the data provided by the IEA (International Energy Agency) in their ETP Clean Energy Technology Guide database, there are currently over 550 innovative technologies and components that are present throughout the entire energy system and contribute to achieving the goal of zero emissions.[329]

[328] https://nrfu.org.ua/news/vidbulasya-urochysta-czeremoniya-vidkryttya-ofisu-goryzont-yevropa-v-ukrayini/

[329] ETP Clean Energy Technology Guide https://www.iea.org/data-and-statistics/data-tools/etp-clean-energy-technology-guide

PM_RIC_WEM_03 Development of corporate investments in the purchase of climate technologies and renewable energy solutions

Increasing energy efficiency in industry

Reducing energy consumption in the industry per unit of GDP in Ukraine is an important reserve for decarbonization, energy security, and enabling the export of energy resources as one of the growth factors of the Ukrainian economy.

Outdated production base, lack of adequate energy management mechanisms, high capital cost for capital investments reduce the competitiveness of Ukrainian enterprises in international markets, especially considering the implementation of the Carbon Border Adjustment Mechanism (CBAM).

Solving this challenge is possible by stimulating businesses that implement energy-efficient solutions and modern construction standards for production complexes (such as BREAM) through financial instruments (interest rate compensation, targeted subsidies), tax mechanisms (tax incentives for import or production of energy-efficient equipment and technologies), and the introduction of new regulations in line with European energy-efficient construction regulations, building standards with corresponding confirmation and certification mechanisms.

Also an important task for competitiveness through efficiency is educational programs for owners and management of enterprises, modernization of relevant educational programs in higher and vocational education, conducting appropriate communication and educational events.

One of the drivers of energy efficiency is also the desire of business owners to ensure energy security and continuity of enterprise activities through the development of their own generation in the context of Russian attacks on Ukraine's energy facilities.

Green chemistry

The direction of 'green chemistry' is an important component for the implementation of decarbonization and green transition projects, as the development of research and development in this field is necessary for waste and biomass processing, for the production of biomethane and 'green ammonia', green products of basic chemical synthesis (syngas, methanol, propylene, butylene, etc. to replace fossil raw materials).

Research in the field of green chemistry is also necessary for the low-carbon modernization of the oil industry, the capture, storage, and conversion of carbon dioxide (including biomethane), the development of new solutions in the field of hydrogen technologies and energy efficiency.

Green transformation and climate adaptation of the agricultural sector

The full-scale Russian invasion of Ukraine not only destroyed two of Ukraine's largest metallurgical enterprises (Azovstal and MMK), but also caused significant damage to the country's most important export sector - the agricultural industry. Blocking of maritime export routes, systematic attacks on grain storage facilities and processing plants, occupation and destruction of a large part of the agro-processing industry, seizure and mining of arable land, destruction of irrigation systems through the blowing up of the Kakhovka Hydroelectric Power Station dam, and environmental crimes committed by Russian occupiers have led to enormous human casualties, as well as job losses, currency inflows to Ukraine, shrinking markets, and overall pessimism among owners of agricultural enterprises.

In addition to this, agricultural enterprises in the south of Ukraine suffer from climate change and increasingly rely on artificial irrigation of land, suffer from abnormal climatic phenomena and the appearance of invasive species, which reduces the productivity of agricultural enterprises, increases their capital costs and limits the possibilities of attracting capital to this sector.

On the other hand, the development of bioenergy, production of biomethane , bioethanol, active implementation of agrovoltaics and precision agriculture and irrigation technology can provide Ukrainian farmers with new opportunities for export, ensure their energy self-sufficiency by transitioning transportation and land processing equipment to self-produced biofuels, reduce greenhouse gas emissions from land use, and reduce the dependence of agricultural production on artificial irrigation.

Considering the capital intensity of implementing climate-friendly agricultural innovations, an important direction for supplementing research and development is ensuring accessibility of funding through interest compensation programs, tax incentives, grant programs funded by government partners and international financial organizations.

Carbon dioxide capture and storage technologies

Considering the current structure of generation and industry in Ukraine, long cycles of green economic transformation, rapid implementation of carbon capture, storage, and utilization systems are significant factors in decarbonizing the economy. The existing research and technological base for CO2 capture and storage technologies in Ukraine is at an embryonic level, so stimulating research in this field and implementing relevant technologies are significant elements in reducing emissions in the near future.

Artificial intelligence technologies for energy

[330]Increasing the share of renewable energy sources in the Ukrainian energy mix, developing decentralized generation, the need for the implementation of demand-side response solutions, the proliferation of energy storage facilities, microgrids and smart grids will require fast decision-making, which will often be unavailable to the operators of the Ukrainian power system. Artificial intelligence should assist human intelligence in this field, ensuring both frequency stability and prompt response to dynamic changes in the energy system, as well as protection against cyber threats and cyber attacks on the power grid, which will remain relevant for a very long time. Supporting innovation in this field and responsible implementation will help increase the flexibility of the energy system and create new, dynamic response mechanisms to challenges. Further development of artificial intelligence systems for energy, together with new pricing mechanisms, can create conditions for the active development of virtual power plant technologies and the integration of small distributed energy assets into the power system.

Innovation leapfrogging / innovative leap

In Ukraine, the capacity for innovative sectors was demonstrated primarily by those sectors that were less dependent on the legacy of past investments and complex state regulation.

It is precisely because Ukraine has practically 'leapfrogged' the stage of development of internet networks based on telephone networks and DSL technology that we have the fastest and cheapest internet service sector in Europe.

The lack of a good education system and absence of state regulation (and practical absence of an internal market) contributed to the start and rapid growth of the IT services industry, the third largest industry in terms of scale in Ukrainian exports.

The absence of heavy and expensive reconnaissance drones enabled the construction of an aerial reconnaissance system based on affordable drones for household use, and then launched the production of reconnaissance and combat drones domestically.

The practical absence of a fleet in Ukraine has created a sector of maritime strike drones, which is why a significant part of the Black Sea Fleet decided to relocate to Novorossiysk and Ochamchire.

[330] Distributed generation, development of 'smart' microgrids and systems, https://www.kmu.gov.ua/news/rozpodilena-heneratsiia-rozvytok-rozumnykh-mikromerezh-ta-system-nakopychennia-pryskoriat-zelenyi-perekhid-v-ukraini-minenerho.

The absence of a tradition of paper checks and an electronic banking clearing system created in the 90s enabled extremely fast and cheap banking transactions and launched Ukrainian digital banks.

The transition to mobile identification technologies (in particular, based on digital banks) has made it possible to launch digital passports, driver's licenses, and many electronic services in the "Diia" ecosystem of the Ministry of Digital Transformation.

Innovation leapfrogging becomes possible in sectors where the innovation system skips several stages of development, overcoming regulatory constraints and taking advantage of the availability of the latest solutions, which have become mass-produced.

Such an opportunity exists for the Ukrainian energy sector, as many technologies in the areas of smart grids, microgrids, energy storage systems, renewable energy, and data accounting and transmission for consumption have significantly improved over the past decade and have drastically reduced in price. And where price reductions are insufficient, mass production of certain solutions can trigger economies of scale and reduce the cost of these innovations.

PM_RIC_WAM_06 Development of exports of climate technologies and renewable energy technologies

Government program documents of Ukraine provide for a transition to domestic production of technologies and equipment for the energy sector, from transformers to components of wind power plants and floating platforms. This ambitious task requires significant capital involvement and effective public-private partnerships. Considering the state of many enterprises in the energy sector, obsolescence of many technological developments and production facilities, effective development of competitive production of energy equipment is possible under the following conditions:

- Development of enterprises oriented towards both domestic and export markets
- Use of a technology and standards base that is compatible with the requirements of EU regulations and other potential markets
- Insurance of military risks and implementation of special security standards for such enterprises (including inclusion in the list of critical infrastructure objects and creation of enhanced protection areas with air defense systems)
- Involvement of leading international corporations in organizing such production in Ukraine
- Implementation of modern corporate governance standards for state-owned enterprises, their recovery and profitability restoration
- Privatization of state-owned enterprises, whose operation has become impractical due to production shutdown and technological backwardness.

Since the government's program documents also allow us to conclude the need for designing such equipment in Ukraine, it is necessary to provide qualification enhancement programs for relevant specialists and modernize educational programs for energy equipment engineers, involve foreign experts, and license technologies of leading international manufacturers for production in Ukraine.

The speed of launching and scaling up such productions will be a priority for the recovery of Ukraine's energy sector, which in some cases will require unpopular decisions: creating new modern flexible ones instead of attempting to revitalize giants of the past.

PM_RIC_WEM_04 Competitiveness of the Ukrainian economy against the backdrop of the implementation of European technical regulations

Adopting and bringing technical regulations applied in the energy sector in line with EU legislation, adapting Ukrainian legislation in the field of energy labeling and eco-design to EU legislation, forming and approving national standards, methodological recommendations for the application of technical regulations opens up new opportunities for the Ukrainian economy, but at the same time creates significant challenges for Ukrainian manufacturers.

Changing key standards and regulations that regulate the production of equipment, technologies, and materials for the energy, construction, metallurgical, agricultural, and other sectors will require significant investments from Ukrainian enterprises in employee training, establishment of production and business processes, implementation of new production standards, and obtaining certifications. In some cases, this may require significant modernization of production facilities and prolonged production shutdowns.

Preserving the competitiveness of Ukrainian enterprises and mitigating the economic stress from regulatory changes requires active informing of economic entities about the process of changes, wide deployment of educational and certification programs, and financial support (including from the state budget and international donors), financial and tax incentives for modernization of production capacities of companies operating in this market.

It is also important to have clear planning for the transitional period between existing and new regulations and an easy procedure for confirming such a transition.

Effective change in the system of regulatory standards can create new export sectors for the Ukrainian economy and compensate for the losses of traditional markets with post-Soviet standards.

PM_RIC_WAM_04 Monitoring, reduction and/or cessation of subsidies for fossil fuels

[Planned for the next stages of work on the NECP]

PM_RIC_WAM_05 Active involvement of venture investments in companies in the climate innovation and renewable energy sector

The Ukrainian venture financing sector has strengthened and supported many breakthrough companies in various sectors, but innovation in the software and IT sector remains its key focus. If we compare the field of energy solutions with IT, it is much more capital-intensive, has longer investment return cycles, and is more risky due to the high level of regulation in the sector.

Currently, most companies that have successfully attracted venture investments in the energy and climate innovation sector primarily operate in export-oriented markets. Among the Ukrainian venture funds that have investments in 'green startups' in their portfolios are investors such as Startup Network, SMRK Venture Fund, Angel One Fund, and Vesna Capital. The capital volume and the number of deals in the IT-centric startup market in Ukraine are an order of magnitude higher.

However, this trend is not unique, as corporate funds and accelerators are key players in the energy and climate sector on global venture markets, rather than traditional venture funds. Yes, among the companies that have invested the most in 'green startups', giants like Shell Technology Ventures and BP Ventures actively invest in the sector, the Bill Gates-backed Bright Technology Coalition/Bright Technology Ventures is actively working in the sector, Vinod Khosla's Khosla Ventures is an IT entrepreneur, and there are many focused funds of various sizes, such as Amazon's Cleantech Fund, Braemer Energy

Ventures, Chrysalix Venture Capital, Emerald Ventures, Lowercarbon Capital, InveN Capital, Ecosummit Ventures, and others.

Regarding acceleration services for green startups, the global trend in this field is either the formation of corporate accelerators (such as E.On Agile, the German energy giant E.On, or TechX Clean Energy Accelerator, created jointly by the municipality of Aberdeen, Scotland, and companies engaged in oil and gas extraction in the North Sea), or partnerships between leading accelerator networks and corporate partners (for example, the creation of TechStars Energy in collaboration with the Norwegian corporation Equinor or RockStart Energy Program jointly with Shell, Orsted, Alliander, and CEZ Group).

Considering the leading global experience, the development of venture financing for the energy sector is possible based on existing mechanisms, such as the creation of specialized grant programs by the Ukrainian Startup Fund, which operates at the pre-seed stage, as well as the stimulation of corporate innovation development programs in the energy sector and the launch of corporate accelerators by Ukrainian businesses, and active involvement of international venture funds and accelerators focused on climate and energy directions in Ukraine.

ii. Where applicable, cooperation with other Member States in this area, including, where appropriate, information on how the SET Plan objectives and policies are being translated to a national context

See above (section 3.5.i), in particular PM_RIC_WAM_01 Development of corporate and international partnerships in the energy and climate sector.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Currently, in Ukraine, several grant programs supporting companies that create and implement climate and energy innovations are being implemented with the funding from international donors and international financial organizations. Among such programs are the EBRD project funded by the EU "Climate Innovation Vouchers", USAID program "Competitive Economy of Ukraine", European Innovation Council project "Seeds of bravery" and others.

These programs and projects provide significant assistance to Ukrainian small and medium-sized enterprises, but the scale of support they provide is not attractive to large enterprises due to funding limitations (up to 50/100 thousand euros) and significant administrative efforts required for such grants.

Increasing the grant support amounts in this area is possible through expanding the potential donor pool, attracting co-financing from the state budget, as well as reducing business expenses through mechanisms for subsidizing the lease of state property, creating and accessing technology and equipment parks, equipment leasing, and other support tools for grant recipients of such programs.

Another important tool for the development of energy sector enterprises that contribute to decarbonization and green transition can be financial innovations in the field of green banking and the creation of corresponding financial products (credit, leasing, export) with the involvement of financing from international financial organizations to increase financing accessibility and reduce capital costs.

In particular, see above (section 3.5.i), PM_RIC_WEM_02 Availability of grant funding for research in the field of renewable energy and climate innovations, PM_RIC_WAM_02 Expansion of funding for research in the field of renewable energy and climate innovations, PM_RIC_WEM_03 Development of corporate investments in the purchase of climate technologies and renewable energy solutions.

SECTION B. ANALYTICAL BASIS

4. CURRENT SITUATION AND AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES

4.1. Projected evolution of main exogenous factors influencing energy system and GHG emission developments

The war in Ukraine has caused significant damage to the country's economy, leading to population migration, destruction of production infrastructure, a corresponding decline in business activity, and obviously creating high uncertainty regarding the path of post-war recovery. The current state of the economy largely remains unknown, as most statistical data is unavailable. Overall, energy demand is determined by macroeconomic factors such as gross domestic product (GDP), sectoral output or value added, population size, and others.

However, due to a lack of current information and a high level of uncertainty, the prospective dynamics of energy demand factors discussed below may not always be properly assessed using traditional approaches and should largely rely on assumptions and indirect information from open sources.

i. Macroeconomic forecasts (GDP and population growth)

Since 2014, Ukraine's economy has been functioning under the conditions of a hybrid war initiated by Russia against Ukraine. However, the unprovoked full-scale military invasion of Ukraine by Russia in 2022 has become a new test of the resilience and stability of Ukrainian society and economy. In addition to the loss of lives and destruction, Ukraine's economy had to adapt to:

- mass migration of population and decrease in purchasing power;
- significant narrowing of logistic routes, narrowing of economic activity of enterprises, including export-oriented ones;
- significant electricity shortage in certain periods and implementation of power outage schedules from October 2022 to the beginning of 2023;
- growth in defense spending, which led to an expansion of the state budget deficit to 914.9 billion UAH in 2022;
- enormous losses incurred due to Russian aggression, estimated at trillions of hryvnias.

However, the successes of Ukraine's defense forces, coordinated efforts of the government and business, unwavering spirit of the population, the speed of recovery of destroyed and damaged critical infrastructure objects, as well as systematic financial support from international partners have allowed to maintain economic stability. As a result:

- the decline in GDP turned out to be significantly smaller than expected, amounting to 29.1% (at the beginning of the full-scale invasion, estimates ranged from 40-50%);
- the increase in consumer prices also turned out to be lower than expected at the beginning of the war and conditionally comparable to price changes in a number of European countries, amounting to 26.6% (in annual calculation);

● businesses quickly adapted to the difficult conditions and resumed work after the suspension in February-March 2022, with almost 86.1% of enterprises returning to operation.

Despite all the difficulties and challenges, the economy managed to maintain relative macroeconomic and price stability in the conditions of war, overcome a massive production shutdown, and the consequences of the outflow of labor resources caused by relocation to safe places.

The macroeconomic forecast of the NECP is based on the Forecast of Economic and Social Development of Ukraine for 2024-2026 and the assumptions of the macroeconomic scenarios of Ukraine's Plan until 2033, which were extrapolated by experts from the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine (Table 4.1).

Table 4.1. Macroeconomic forecast: annual average GDP growth rates by sectors, %

	2022	2023-2025	2026-2030	2031-2040	2041-2050
Agriculture, forestry and fishing	-28,4	1,9	9,1	3,3	2,0
Mining industry	-30,0	6,9	1,0	-1,1	0,0
Manufacturing industry	-43,1	5,0	6,1	3,1	2,2
Supply of electricity, gas and steam	-32,5	5,8	5,2	1,6	1,0
Construction	-67,6	19,4	15,5	9,3	3,9
Wholesale and retail trade; repair of motor vehicles and motorcycles	-30,9	6,2	6,4	3,4	2,0
Transportation, storage, postal and courier activities	-44,3	2,8	6,4	3,3	2,0
Other types of economic activity	-14,2	5,7	3,8	2,7	2,2
GDP	**-29,1**	**5,5**	**5,6**	**3,1**	**2,1**

Macroeconomic scenarios determine the prospective structure of the economy, the corresponding energy use and GHG emissions, as well as establish conditions for demographic development.

At the beginning of 2022, the population of Ukraine was 41.2 million people (excluding the territory of the Autonomous Republic of Crimea and the city of Sevastopol) or about 37.3 million people (excluding the territories of the Autonomous Republic of Crimea, Sevastopol city, part of the temporarily occupied territories in Donetsk and Luhansk regions) with a tendency to decrease. For the purposes of the NECP, the latest available demographic forecast of the Institute of Demography and Social Studies of the National Academy of Sciences of Ukraine was used, taking into account the available official statistics and assumptions used for the above-mentioned macroeconomic forecasts. For this purpose, special assumptions were made regarding life expectancy, mortality rate, fertility rate (number of children per woman), number of survivors, probability of death, number of live births, migration, and other standard demographic parameters by age and sex. The obtained results are presented in Table 4.2.

Table 4.2. Demographic forecast

	2022	2025	2030	2035	2040	2045	2050
Population, million	37,3	30,4	34,5	33,5	32,4	31,3	30,1
Urban population share, %	69,7	67,9	71,4	70,7	70,0	69,4	68,8

ii. Sectoral changes expected to impact the energy system and GHG emissions

Reconstruction of destroyed infrastructure objects (transport, energy), housing and social infrastructure, as well as the development of the defense-industrial complex (DIC) will become the main security priorities for Ukraine in the medium-term perspective. Accordingly, investments will be directed towards both construction and equipment (DIC, energy projects, etc.), which will stimulate the development of construction, production of domestic machinery products, as well as the purchase of imported investment goods.

On the demand side, the driving force of growth will be investment demand due to the implementation of projects for the development of production and infrastructure, as well as the gradual reconstruction of affected areas. Although this component will continue to occupy a leading position among other components of demand in terms of growth rates, these rates will be insufficient to restore a significant portion of the damaged production and infrastructure facilities and modernize production in the coming years.

Regarding the dynamics of the main components of GDP from the supply side in the short-term perspective, the following is forecasted.

The positive dynamics of the service sector, which is sensitive to population activity and, considering its mobility and significant level of IT utilization, is more autonomous, as well as quite flexible and flexible to consumer needs, will continue. This opens up not only domestic sales markets. Its further development will focus on expanding the range of services provided through digital platforms (including EU markets) through the improvement of existing or implementation of innovative marketing development strategies, exploring opportunities to diversify the market offering, and creating new virtual products and services.

At the same time, industrial production will be restored. In the near future, the development of effective means, methods, and technologies in the field of security and defense planning to meet the urgent needs of the Ukrainian army will remain a key task, which will stimulate further development of the machinery industry. The mining industry will be restored relatively quickly and steadily, taking into account the achievement of maximum production autonomy in order to create a strong foundation for recovery during the post-war period, which will gradually compensate for the long-term decline in potential.

There will be active recovery of enterprises in the food and chemical industries, textile production, as their activities are related to meeting urgent needs and they are representatives of mostly small and medium-sized businesses, which are more mobile and have broader opportunities to maneuver with logistics and sales of their products. The most difficult will be for large industrial enterprises, in particular metallurgical ones, some of which are destroyed. It is not so easy for such enterprises to reconfigure logistics, relocate their production capacities, and the restoration or creation of completely new modern production will require a longer period.

The development of the domestic agro-industrial complex in the forecast period will take place in the context of ensuring food security and maintaining the country's position in the global agricultural ratings as a leading exporter of agricultural products.

The need for rapid restoration of infrastructure (roads, bridges, communications), production, social and residential facilities that have suffered significant damage or have been completely destroyed during the war will require active investment in the construction sector against the backdrop of maintaining the level of defense spending, which will contribute to its further development.

Gradual activation of economic processes will support the transport sector, the activity of which in most subtypes was both stopped during the state of war and significantly affected by hostile attacks. The development of the transport sector will be facilitated by the priority in restoring transport infrastructure and building new alternative transport routes as key logistics channels for supplying products to international markets.

The growth of private consumption and production activities, establishment of logistical connections, will stimulate trade development.

Thus, taking into account all demand factors and production capabilities, GDP growth is projected at 4.6% in 2024 and the fixation of this indicator at the level of 5-5.5% until 2030-2035.

iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

Assumptions regarding global fuel prices

The forecast of import prices for Ukraine's main energy resources is based on the World Bank and International Energy Agency's forecast of prices (World Energy Outlook 2021, Announced Pledges Scenario) (Table 4.3).[331][332]

Table 4.3. Forecast of global energy resource prices

	Unit	2020	2022	2023-2030	2031-2040	2041-2050
Coal	USD/ton	61,4	250	106,7	63,3	58,3
Crude oil	USD/barrel	41,3	100	74,2	65,9	64,7
Natural gas	USD/million BTU	3,2	34	14,1	6,6	6,5

Assumptions regarding carbon price

Assumptions regarding greenhouse gas (GHG) emissions price vary depending on the scenario. Under the "with existing policies and measures" (WEM) scenario, the carbon dioxide (CO2) emissions tax rate remains at 30 UAH/ton during the war and 2 years after it (until 2027). It is expected that from approximately 2027, all taxes, including the CO2 emissions tax, will be indexed. Accordingly, the CO2 emissions tax rate will slightly increase and amount to approximately 1 euro/ton by 2050. Within the "with additional policies and measures" (WAM) scenario, the same assumptions regarding the CO2 emissions tax rate until 2027 are made (30 UAH/ton during the war and 2 years after it, and approximately 1 euro/ton from 2027). However, it is anticipated that a long-term reform of the CO2 emissions tax (currently being developed) will be implemented, which will include a review of the rate and tax base.

In addition, starting from 2025, the introduction of ETS in a test mode is also planned. However, it is expected that the framework conditions for the functioning of the ETS in Ukraine will gradually converge

[331] CMO-Pink-Sheet-December-2023.pdf (worldbank.org)

[332] World Energy Outlook 2021

with the EU ETS. The introduction of the CBAM mechanism by the EU will further incentivize Ukraine to accelerate the process of implementing a national ETS and harmonize it with the EU ETS. Therefore, it is expected that the price of CO_2 emissions (the combined impact of the CO_2 tax and the ETS) on the domestic market will constantly increase until 2050.

The conservative assumption regarding the increase in the price of CO_2 emissions for the "with additional measures" (WAM) scenario, which was used in the modeling scenarios within the NDC review, but with a delay in the price increase by 5 years (due to the impact of the war), namely: the price for CO_2 emissions will increase from 1 euro/tonne in 2027 to 16 euro/tonne by 2035 and further increase to 100 euro/tonne by 2050.

iv. Technology cost developments

The table below presents the key technical and economic parameters of selected electricity and heat production technologies that were used as assumptions in the modeling process underlying this NECP. Capital expenditures include the cost of capital, but the model also takes into account operating expenses.

Table 4.4. Brief list of prospective technologies for electricity and heat production

Technologies	*Capital cost (CAPEX), €/kW$_e$*							*Efficiency (electric), %*	*Predicted availability factor, %*	*Lifetime, years*	*Heat rate*
	2020	2025	2030	2035	2040	2045	2050				
Thermal power plants (TPP) and Combined Heat and Power Plants (CHP)											
NPP											
New large energy units	4400							33	88	60	0.03
Extension of the operating period for existing energy units	254							33	80	30	0.04
New small modular reactors (160 MW)	4400							33	90	80	0.04
High-temperature nuclear reactor with hydrogen production	7650-6885							33	94	60	0.1-0.12
Gas (natural/biomethane/synthetic methane)											
Combined cycle gas turbine	1000							60	50	35	0.15
Open cycle gas turbine	600							40	50	30	0.15
Fast start gas piston engine (maneuvering power)	1000							50	1.5	35	–
Combined cycle gas turbine + Carbon capture	2450							51	50	35	0.05
Open cycle gas turbine + Carbon capture	2050							34	50	30	0.05
Combined Cycle Power Plant	800							50	50	35	0.84
Open Cycle Power Plant	920							45	50	35	0.95
Extension of the operating period of existing power plants	280-650							19-43	50	15	1.1-3.0
Combined Cycle Power Plant + Carbon Capture	2250							45	50	35	0.84
Bioenergy											
Wood Biomass Power Plant	2800	2750	2700	2650	2600	2550	2500	24	50	30	–
Waste-to-Energy Power Plant (WTE)	2900	2850	2800	2750	2700	2650	2600	23	50	30	0.3
Biogas Power Plant	3200	3200	3200	3200	3200	3200	3200	42	50	30	–
Wood Biomass Power Plant + Carbon Capture	3650							24	50	30	–
Biogas Power Plant + Carbon Capture	5350							42	50	30	–
CCS on energy crops + Carbon capture	3750							24	50	30	–
CHP on wood biomass	3400	2850	2800	2750	2700	2650	2600	20	50	35	2.0
CHP on waste biomass	3400	2950	2850	2850	2900	2750	2700	19	50	35	1.9

CHP on energy crops	3400	3150	3100	3050	3000	2950	2900	20	50	35	2.0	
CHP on wood biomass + Carbon capture	4450							20	50	35	1.5	
CHP on energy crops + Carbon capture	4450							20	50	35	1.5	
Wind power plants (WPP)												
Onshore wind power plants	1100	1075	1050	1000	950	900	850	–	32	30	–	
Offshore wind power plants	2120	1960	1800	1700	1680	1660	1640	–	42	30	–	
Solar power plants (SPP)												
Industrial solar power plants without tracker	750	725	700	630	560	510	475	–	12.5	25	–	
Industrial solar power plants with tracker	920	850	800	720	645	590	540	–	14.5	25	–	
Roof solar power plants	900	875	850	800	750	700	600	–	13.5	25	–	
Geothermal power plants (GeoPP)												
Geothermal power plant	4300-3600							–	35-55	25	–	
Hydroelectric power plants (HPP)												
Small hydroelectric power plants	3250-3080							–	30	40	–	
Large hydroelectric power plants	3300-3100							–	33-36	60		
PSP	610							–	26	60	–	
Energy Storage Systems (ESS), Euro/kWh												
Electric batteries	1042	832	622	508	394	324	255	92	17	25	–	
Underground hydrogen storage	980	750	700	650	600	550	500	100	100	30	–	
Hydrogen tank storage, large volumes	4600	3600	3400	3200	3000	2800	2500	100	100	22	–	
Hydrogen tank storage, small volumes	2650	2075	1900	1800	1700	1600	1500	100	100	22		
Fuel cells (Hydrogen)												
CHP and TPP with fuel cells	2530	1125	1125	844				50	60	10	0.64	
Heat centers (Boiler houses)												
Gas boiler house (with the possibility of bio- or synthetic methane)	300							92	50	40	–	
Boiler on wood biomass	145	142	140	138	136			85	50	35	–	
Boiler on biomass from industrial waste	350	320	300	280	270	260	250	80	50	35	–	
Boiler on geothermal energy	1100							250	50	25	–	
Hydrogen boiler	390							64	50	35	–	
Other important technologies												
Direct Air Capture (DAC) of carbon dioxide	2.32	2.05	1.86	1.8	1.7	1.6	1.5	0.014-0.007 PJ/kt CO2	90	25	–	
Methanation	600	500	450	400	350	300	250	75-83 (H2)	95	25	–	
Direct Reduced Iron (DRI) production with hydrogen	360	355	350	345	340	333	324	17 PJ H2/mt	85	40	–	
Low-carbon production of iron ore concentrate	96							64-75	1	30	–	

Alkaline electrolyzer	650	500	450	375	300	275	250	67-75	97	25-35	–	
Proton-exchange membrane electrolyzer (PEM)	925	800	650	550	450	425	400	58-71	97	20-30	–	
Solid oxide electrolyzer cell (SOEC)	4500	3200	1900	1620	1340	1060	780	77.5-83.5	91	10-20	–	
High-capacity methane steam reforming			10.6					77	90	20	–	
Low-capacity methane steam reforming			22					69	80	20	–	
High-capacity solar methane steam reforming			9.8					120	90	20	–	
Low-capacity solar methane steam reforming			27					60	90	20	–	
Biomass gasification into hydrogen, high capacity			63.4	47.6				50	90	20	–	
Biomass gasification into low-capacity hydrogen			111	95				33	71	20	–	
Steam reforming of ethanol			234					67	90	20	–	

4.2. Dimension Decarbonisation

4.2.1. GHG emissions and removals

i. Trends in current GHG emissions and removals in the EU ETS, effort sharing and LULUCF sectors and different energy sectors

As a result of the post-Soviet economic decline, GHG emissions in Ukraine decreased from 911.4 million tons CO2-eq. (including LULUCF) in 1990 to 405 million tons CO2-eq. in 2000[333]. Although the economy started to recover after 2000 and the annual GDP growth rates were significant, GHG emissions continued to decrease (see Table 4.5). This is due to significant structural changes in Ukraine's economy, with inefficient energy-intensive sectors being partially replaced by the services and agriculture sectors. Additionally, the energy intensity of the economy also decreased as outdated assets were gradually modernized. According to the GHG Inventory for 1990-2021, total GHG emissions in Ukraine amounted to 341.5 million tons of CO2-eq. in 2021 (including the LULUCF sector). This is 62.5% lower than the levels in 1990, but 7.5% higher compared to 2020.

Table 4.5. Greenhouse gas emissions in 1990-2021, million tons of CO2 equivalent

Gas	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	Current year compared to base year, %
CO_2 (excluding LULUCF)	706.2	390.1	285.7	313.5	294.4	223.8	234.0	223.1	231.7	221.9	206.8	210.2	-70.2
CH_4	182.9	139.1	118.3	102.8	84.9	61.6	66.4	64.2	67.9	70.1	72.0	71.5	-60.9
N_2O	53.6	33.1	24.1	25.9	27.6	33.2	36.5	35.1	39.0	40.6	38.1	43.8	-18.4
HFCs*	NO	NO	15.7	285.1	743.9	801.6	921.4	1049.3	1395.8	1685.0	1751.5	1901.0	100.0
PFCs*,**	235.8	178.1	115.7	142.3	26.7	NO	NO	NO	NO	NO	NO	NO	-100.0
SF_6*	0.0	0.1	0.4	4.5	9.7	19.6	24.4	28.6	33.4	38.8	43.4	48.9	641194.7
NF_3*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-
Net CO_2 from LULUCF	-31.6	-32.4	-23.2	-9.3	-9.2	19.5	24.2	13.3	24.7	23.1	-1.1	14.0	-144.4
CO_2 (including LULUCF)	674.6	357.6	262.5	304.3	285.1	243.3	258.2	236.4	256.4	245.1	205.8	224.2	-66.8
Total (excluding LULUCF)	942.8	562.1	427.9	442.4	407.3	319.2	337.6	323.3	339.8	334.1	318.0	327.3	-65.3
Total (including LULUCF)	911.4	530.0	405.0	433.5	398.3	338.9	362.0	336.7	364.7	357.4	317.6	341.5	-62.5
Total (excluding LULUCF), including indirect CO_2	942.8	562.1	427.9	442.4	407.3	319.2	337.6	323.3	339.8	334.1	318.0	327.3	-65.3
Total (including LULUCF), including indirect CO_2	911.4	530.0	405.0	433.5	398.3	338.9	362.0	336.7	364.7	357.4	317.6	341.5	-62.5

[333] https://unfccc.int/ghg-inventories-annex-i-parties/2023

*Notes: * emissions are indicated in thousand tons of CO2 equivalent*
*** PFC emissions are absent as gas-containing refrigerants were not imported in 2011-2021*

The energy sector is the largest source of national GHG emissions, accounting for 64% of the total volume, while the contribution of the industrial processes and product use sector, and agriculture sector, is 18% and 14% respectively. As seen from Table 4.6, the LULUCF sector has evolved from a net sink to a net emitter of greenhouse gas emissions during the period of 1990-2021.

Table 4.6. Greenhouse gas emissions by sectors, million tons of CO2-equivalent

Sector	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	Current year compared to base year, %
Energy	725.3	431.4	311.3	315.1	286.4	210.8	224.8	217.8	226.3	219.2	208.0	209.7	**-71.1**
IPPU	118.2	58.2	67.5	81.0	74.7	56.4	58.1	51.9	56.5	57.6	56.0	58.4	**-50.6**
Agriculture	86.8	60.6	37.3	33.9	33.5	39.4	42.0	41.0	44.4	44.8	41.7	47.0	**-45.9**
LULUCF (removals)	-31.4	-32.1	-22.9	-8.9	-9.0	19.7	24.4	13.4	24.9	23.3	-0.4	14.2	**-145.3**
Waste	12.4	12.0	11.8	12.4	12.7	12.5	12.7	12.7	12.6	12.6	12.4	12.1	**-2.4**
Total (including LULUCF)	911.4	530.0	405.0	433.5	398.3	338.9	362.0	336.7	364.7	357.4	317.6	341.5	**-62.5**
Total (excluding LULUCF)	942.8	562.1	427.9	442.4	407.3	319.2	337.6	323.3	339.8	334.1	318.0	327.3	**-65.3**
Total (including LULUCF), including indirect CO_2	911.4	530.0	405.0	433.5	398.3	338.9	362.0	336.7	364.7	357.4	317.6	341.5	**-62.5**
Total (excluding LULUCF), including indirect CO_2	942.8	562.1	427.9	442.4	407.3	319.2	337.6	323.3	339.8	334.1	318.0	327.3	**-65.3**

Greenhouse gas emissions in agriculture

In agriculture, emissions of three greenhouse gases are considered (methane (CH4), nitrogen (I) oxide (N2O), and carbon (IV) oxide (CO2)), which result from activities in two sectors - livestock husbandry and crop farming.

Animal husbandry is characterized by two processes, which are accompanied by the emission of mainly methane and in a relatively small amount - nitrogen (I) oxide: intestinal (or enteral) fermentation of livestock (mainly cattle); handling of livestock manure and waste.

Crop production has a much more complex organization and is characterized by the emission of all three greenhouse gases in the following processes:

- N2O: application of nitrogen (mineral) fertilizers; application of organic fertilizers; application of organic fertilizers from livestock grazing; application of nitrogen (N) from crop residues; mineralization

or immobilization of nitrogen (N) associated with organic matter movement in soil; cultivation of organic soils; volatilization of nitrogen (N); leaching of nitrogen (N);

- CH4: rice cultivation;

- CO2: urea application; soil liming.

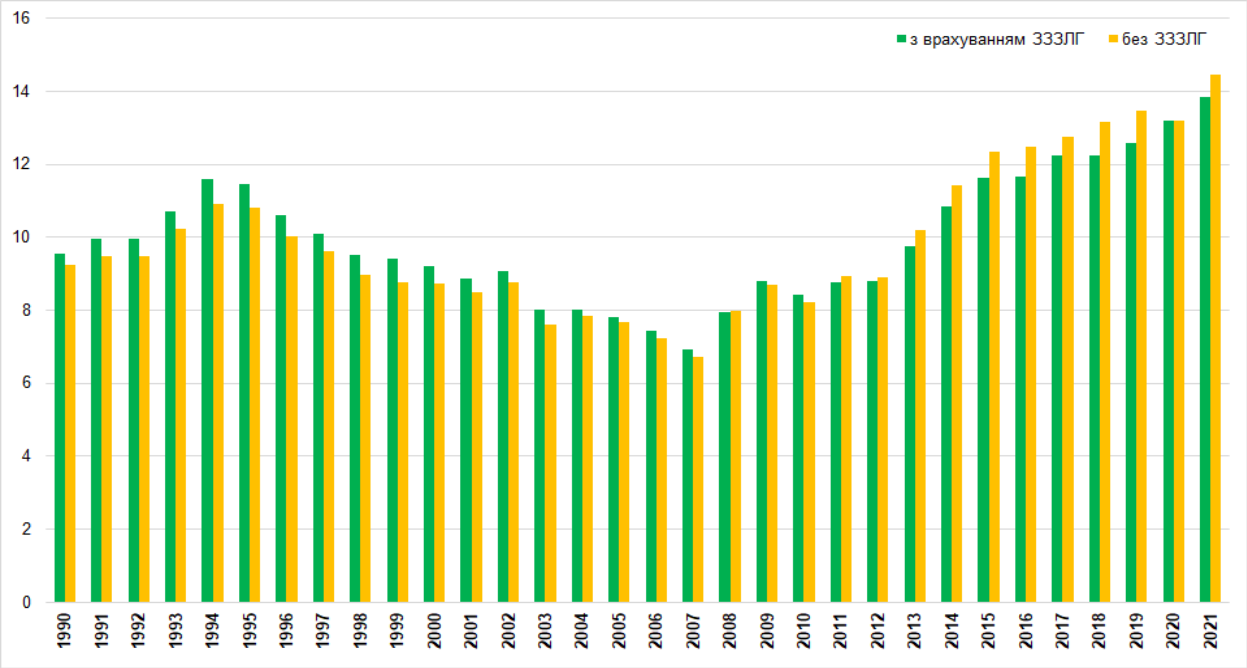
The key factors determining the dynamics of greenhouse gas emissions in livestock husbandry are the livestock number and the manure management system, which involves the collection, transportation, storage, and utilization of manure. The manure management system as a separate factor regulates the volumes of greenhouse gas emissions both by the amount of manure entering it and by the type of system in which this manure is collected, transported, stored, and used. The following types of manure management systems are mainly used in the livestock sector of Ukraine: solid storage system; liquid manure storage system; storage in open anaerobic lagoons; aerobic treatment system; composting; manure/slurry left on pastures, in pens, etc.

The field of plant cultivation in agriculture is multifaceted, so it is impossible to identify general key factors that would determine the dynamics of greenhouse gas emissions in all or most processes - only specific ones, namely:

application of nitrogen (mineral) fertilizers	- the amount of nitrogen (mineral) fertilizers applied to arable land;
application of organic fertilizers	- the amount of organic fertilizers applied to arable land;
application of organic fertilizers from livestock grazing	- the amount of residue left on the fields from livestock grazing;
application of N with crop residues	- the amount of N in plant residues (and consequently the amount of residues themselves) that remain on the fields after harvest and are plowed into the soil;
cultivation of organic soils	- area of organic soils allocated for field crops;
mineralization or immobilization of N associated with the movement of organic matter in the soil	- amount of N lost due to soil management (tillage, fertilizer application, plowing of plant residues, etc.);
erosion N	- the amount of N introduced into the soil from various sources;
leaching N	- the amount of N introduced into the soil from various sources;
rice cultivation	- the area of agricultural land allocated for rice and the amount of organic fertilizers applied;
urea application	- the amount of urea applied to arable land;
soil liming	- the amount of lime materials applied.

The agriculture sector has a significant contribution to the overall greenhouse gas emissions in Ukraine, which during 1990-2021 varied within the range of 9-14%. Despite the overall trend of reducing greenhouse gas emissions from agricultural activities, the contribution of agriculture to the total emissions is gradually increasing (Fig. 4.1).

Fig. 4.1. Contribution of agriculture to total GHG emissions in Ukraine, % share



The full-scale invasion by the Russian Federation, which began on February 24, 2022, has led to significant changes in the agricultural sector, including a reduction in livestock, changes in manure management systems, decreased use of mineral and organic fertilizers, decreased areas of land occupied by field crops (both sown and harvested areas), decreased gross crop production, and consequently, decreased yields, etc. These changes have resulted in a nearly 24% reduction in greenhouse gas emissions in 2022 compared to the previous year (Fig. 4.2).

Reducing greenhouse gas emissions has occurred in all areas of agriculture, but the most "vulnerable" categories were found to be "Rice cultivation" and "Agricultural soils" (Table 1). It should be noted separately that rice cultivation technology is a high-tech activity and is carried out in the south of Ukraine, therefore it has experienced the most extensive (both direct and indirect) impact from the hostilities during 2022.

Fig. 4.2. Total GHG emissions from agriculture in Ukraine in 1990-2022, thousand tons CO2-eq

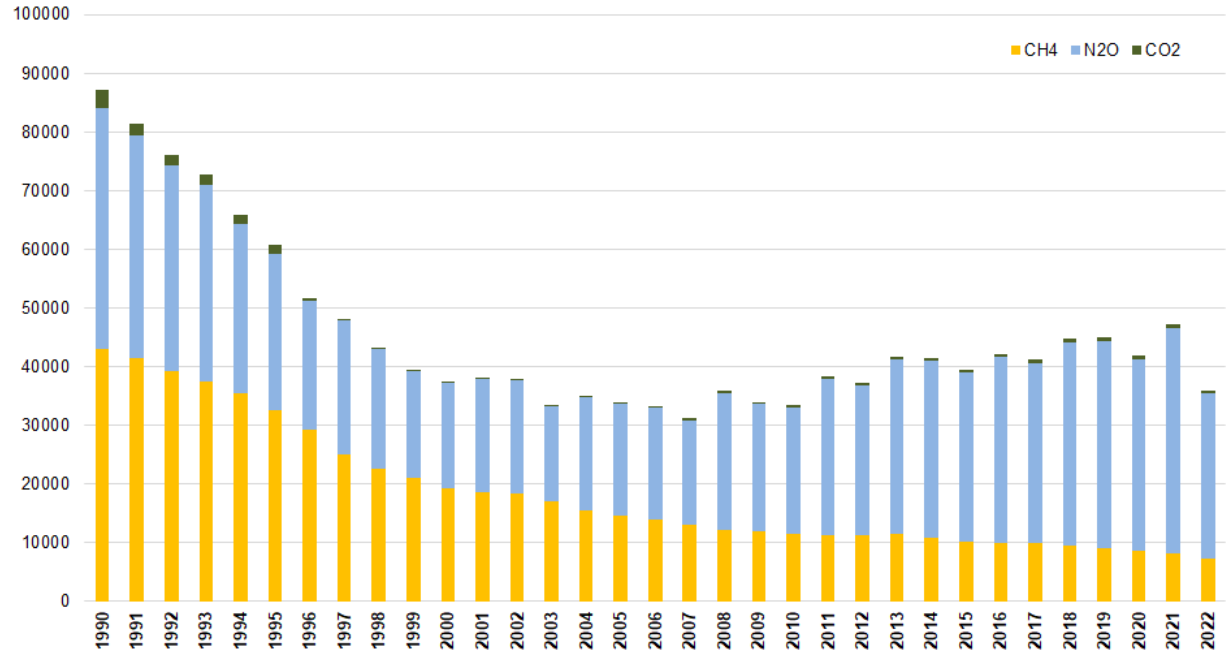


Table 4.7. Dynamics of contribution by categories of agricultural activities to greenhouse gas emissions, %

Category	1990	1995	2000	2005	2010	2015	2020	2021	2022
Intestinal Intestinalfermentation	45,1	49,7	47,6	39,5	30,0	22,8	17,7	14,9	17,5
Manure management	7,8	7,6	6,8	6,3	6,9	5,5	4,6	4,0	5,0
Rice cultivation	0,2	0,3	0,5	0,5	0,6	0,2	0,2	0,2	0,03
Agricultural soils	43,2	39,9	44,8	53,1	61,1	70,2	75,9	79,5	76,2
Soil liming	3,0	2,2	0,2	0,3	0,4	0,4	0,3	0,4	0,3
Urea injection	0,7	0,3	0,2	0,4	1,0	0,9	1,2	1,1	1,0

ii. Projections of sectoral developments with existing national and Union policies and measures until 2050 (including for the year 2030)

The table below presents the key results of modeling and forecasting GHG emissions in Ukraine under the existing policies and measures (WEM) scenario.

Table 4.7. Key modeling results of of GHG emissions in Ukraine in the WEM scenario

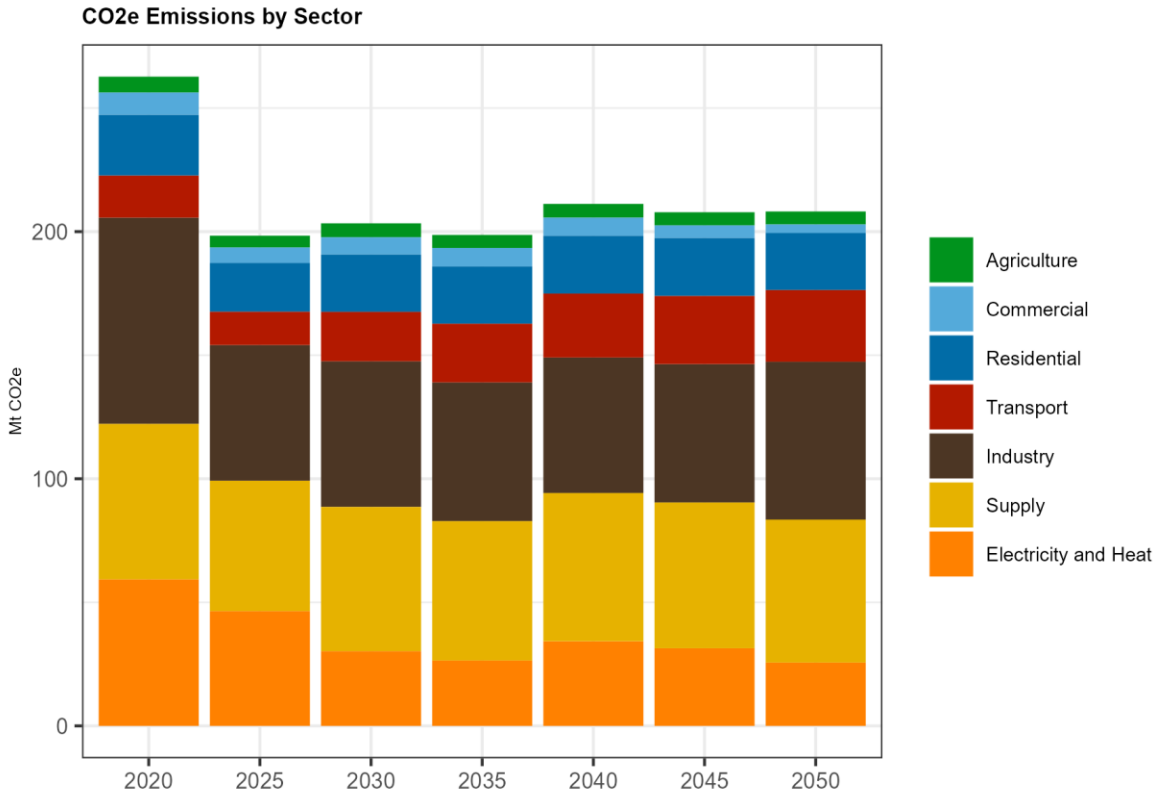
Scenario with existing policies and measures (WEM)									
	1990	2015	2020	2025	2030	2035	2040	2045	2050
Total GHG emissions, million tons CO2-eq.	**911**	**334**	**318**	**?**	**?**	**?**	**?**	**?**	**?**
Energy, industrial processes and product use sectors	***844***	***267***	***264***	***229***	***215***	***207***	***215***	***216***	***209***
Agriculture	***87***	***39***	***42***	***37***	***44***	***48***	***49***	***51***	***53***
Land use, land-use change and forestry	***-31***	***20***	***-0,4***	***?***	***?***	***?***	***?***	***?***	***?***
Waste sector	***12***	***13***	***12***	***11***	***11***	***11***	***10***	***9***	***8***
Share of GHG emissions compared to 1990 level, %	**100**	**37**	**35**	**?**	**?**	**?**	**?**	**?**	**?**
Energy, industrial processes and product use sectors	*100*	*32*	*31*	*27*	*25*	*25*	*25*	*26*	*25*
Agriculture	*100*	*45*	*48*	*43*	*51*	*55*	*56*	*59*	*61*
Land use, land-use change and forestry	*100*	*265*	*199*	*?*	*?*	*?*	*?*	*?*	*?*
Waste sector	*100*	*101*	*99*	*91*	*86*	*85*	*79*	*72*	*63*
GHG emissions per capita									
t CO2-equivalent per capita	17	7	8	?	?	?	?	?	?
Carbon intensity GDP									
t CO2-equivalent / 1,000 USD GDP (PPP)	**1,6**	**1,0**	**0,9**	**?**	**?**	**?**	**?**	**?**	**?**

Greenhouse gas emissions in the sectors of 'Energy' and 'Industrial processes and product use'

The figure below shows the forecast of GHG emissions in the sectors of 'Energy' and 'Industrial processes and product use' (according to the United Nations Intergovernmental Panel on Climate Change (IPCC)) under the scenario with existing policies and measures (WEM) until 2050, obtained using the economic-mathematical model TIMES-Ukraine, which describes all energy flows in the country.

The modeling results show that even with the rapid recovery processes of Ukraine's economy in the post-war period, without the implementation of additional measures and policies on energy efficiency, expansion of renewable energy use, other decarbonization measures, and technological modernization of the energy sector, but with adherence to the "build back better" approach, emissions in the "Energy" and "Industrial processes and product use" sectors can occur without an increase in GHG emissions.

Fig. 4.3. Greenhouse gas emissions in the sectors of "Energy" and "Industrial processes and product use" according to the WEM scenario, CO2-eq.



In the WEM scenario, GHG emissions in these sectors may decrease by almost 20% by 2030, considering the growth of Ukraine's economy compared to 2020, after which, without implementing additional measures, their stabilization may occur by 2050 at a level of approximately 25% of the GHG emissions in these sectors in 1990.

Greenhouse gas emissions in the agriculture sector

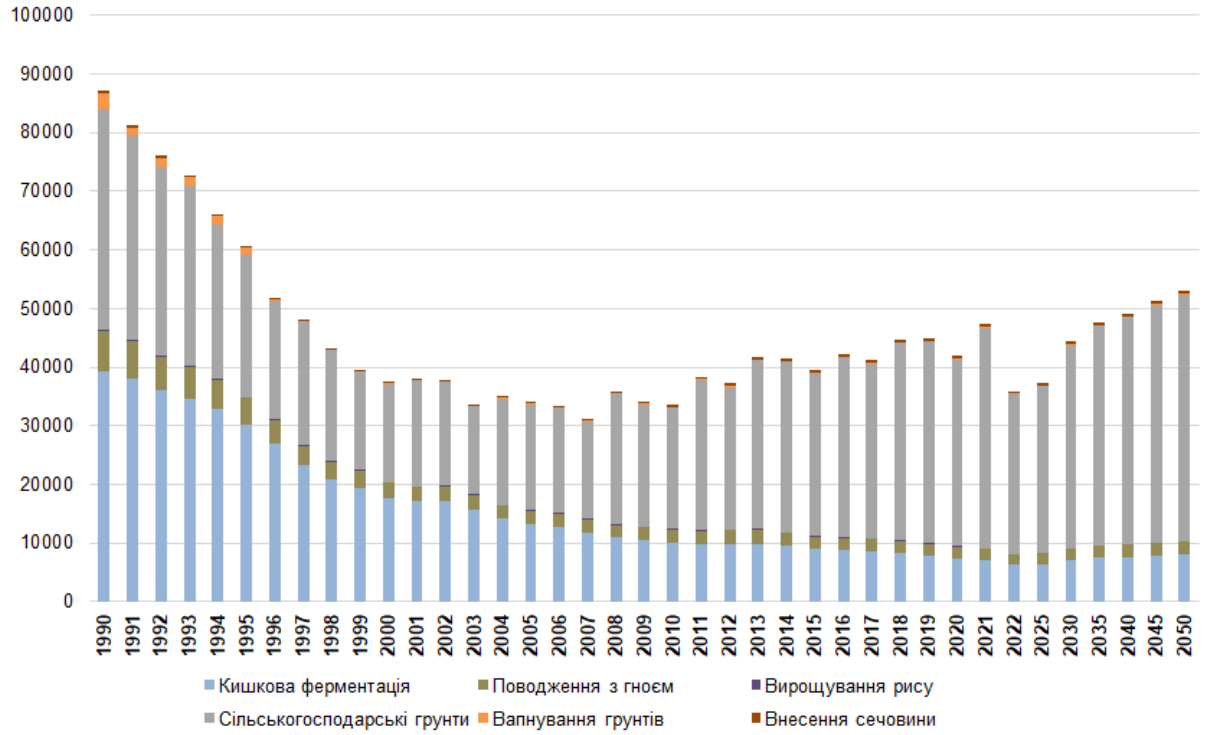
Assessment of greenhouse gas emissions for forecasting their volume is carried out in accordance with the methodological recommendations "Guiding Principles for National Greenhouse Gas Inventories", 2006 (IPCC, 2006). Key factors of agricultural activity served as drivers for the forecast.

Approved by the Ministry of Agrarian Policy and Food of Ukraine (letter No. __ dated _____) indicators of key factors as of 2030, 2040 and 2050 were developed taking into account a complex set of conditions (Appendix 2), namely: cessation of hostilities (both current active and further escalation); restoration of agricultural facilities (reconstruction of destroyed/damaged livestock farms; demining of pastures, hayfields, arable and other lands; restoration/replenishment of mechanized components of agricultural activities, etc.); restoration of population size and resettlement (migration from abroad; return to places of residence before the war/hostilities; arrangement of temporarily displaced persons in new places of residence; natural population growth, etc.); quality of demographic policy; level of domestic demand for agricultural activities; export opportunities of agricultural activities; nationwide strategy for post-war recovery and development of agriculture.

The assessment of greenhouse gas emissions in various sectors of agricultural activity according to the projected data (Fig. 3) indicates that GHG emissions under the WEM scenario will average 44,366.1 thousand. t CO2-eq, 49,178.6 thousand. t CO2-eq and 53,092.3 thousand. t CO2-eq in 2030, 2040 and 2050, respectively.

Thus, the WEM scenario, based on the current (limited) level of implementation of existing legislation, which involves a significant delay between policy formulation, adoption, and implementation, will result in a slight increase in greenhouse gas emissions. Compared to the base year of 1990, projected greenhouse gas emissions in 2030, 3040, and 2050 will be 50.9%, 56.4%, and 60.9% respectively.

Fig. 4.4. Forecast of emissions from agricultural activities in Ukraine according to the WEM scenario, thousand tons of CO2-eq



Greenhouse gas emissions in the Waste sector

The WEM scenario is based on the data of the existing waste management system in Ukraine as of 2022, using general intersectoral macroeconomic and socio-demographic forecasts. This scenario assumes that the currently effective key regulatory documents in the field of waste management, namely: the National Waste Management Strategy in Ukraine until 2030[334] and the National Waste Management Plan until 2030[335], will be partially implemented in 2030. The full implementation of the above-mentioned documents will occur gradually throughout the entire forecasting period. This scenario takes into account that the sustainable development goals in Ukraine[336] will be achieved by 2030, including reducing the share of untreated wastewater, increasing per capita consumption of food products, reducing per capita

[334] https://zakon.rada.gov.ua/laws/show/820-2017-%D1%80#Text
[335] https://zakon.rada.gov.ua/laws/show/117-2019-%D1%80#Text
[336] https://zakon.rada.gov.ua/laws/show/722/2019#Text

water consumption in GDP, etc. It also corresponds to the implementation of the provisions of Ukraine's Updated Nationally Determined Contribution[337] (hereinafter - NDC) for the period up to 2030 and takes into account the implementation of measures to implement Ukraine's climate policy within the framework of participation in the global initiative on methane emissions reduction - Global Methane Pledge[338]. Furthermore, the WEM scenario envisages a reduction in the share of landfilling of MSW to 70% by 2030 and to 30% by 2050; an increase in the share of landfill gas utilization to 15% by 2030 and 36% by 2050; the construction of new waste composting facilities with lower specific emissions of CH4 and N2O; specific emissions of N2O caused by protein consumption by the population of Ukraine will reach typical values for EU countries; methane utilization from wastewater treatment will reach 41% by 2030 and 70% by 2050; specific water consumption per unit of GDP will decrease to 0.5 by 2050 compared to 2015. The methodology for forming the WEM scenario, assessing GHG emissions and capital investments in the Waste sector is provided in Appendix 3.

Unfortunately, achieving the target of landfilling 30% of MSW by 2030 (defined as one of the main goals in the National Waste Management Strategy of Ukraine until 2030 and the National Waste Management Plan until 2030) is not a realistic goal. This is due to a number of cause-and-effect processes: the ongoing full-scale barbaric war by the Russian Federation against Ukraine in early 2022, the adoption of the new modern Ukrainian law "On Waste Management"[339] 3-4 years later than expected, unfavorable investment climate in the waste management sector in Ukraine, etc. At the same time, the implementation of the WEM scenario in terms of its execution until 2030 will ensure the necessary trend of reducing GHG emissions in the Waste sector, as laid down during the development and approval of the NDC of Ukraine.

The list of key policies in the waste management sector under the WEM scenario is provided below in table 4.8. The National Waste Management Plan until 2030 provides detailed ways to implement these policies in the field of MSW management.

Table 4.8. Key policies and measures in the 'Waste' sector according to the WEM scenario

№	Name of key policy	Quantitative indicator		
		2021/2022 (statistical information)	2030	2050
1	Promotion of the practice of reusing components of MSW	1.5%* (a, 2022)	8 %* (full implementation)	10 %*
2	Scaling up of the practice of recycling MSW	5.5%* (a, 2022)	10 %* (partial implementation)	34 %*
3	Scaling up of the practice of composting organic components of MSW	1.2%* (a, 2022)	5 %* (partial implementation)	16 %*
4	Scaling up of the practice of thermal	1.7%* (as of 2022)	7 %*	10 %*

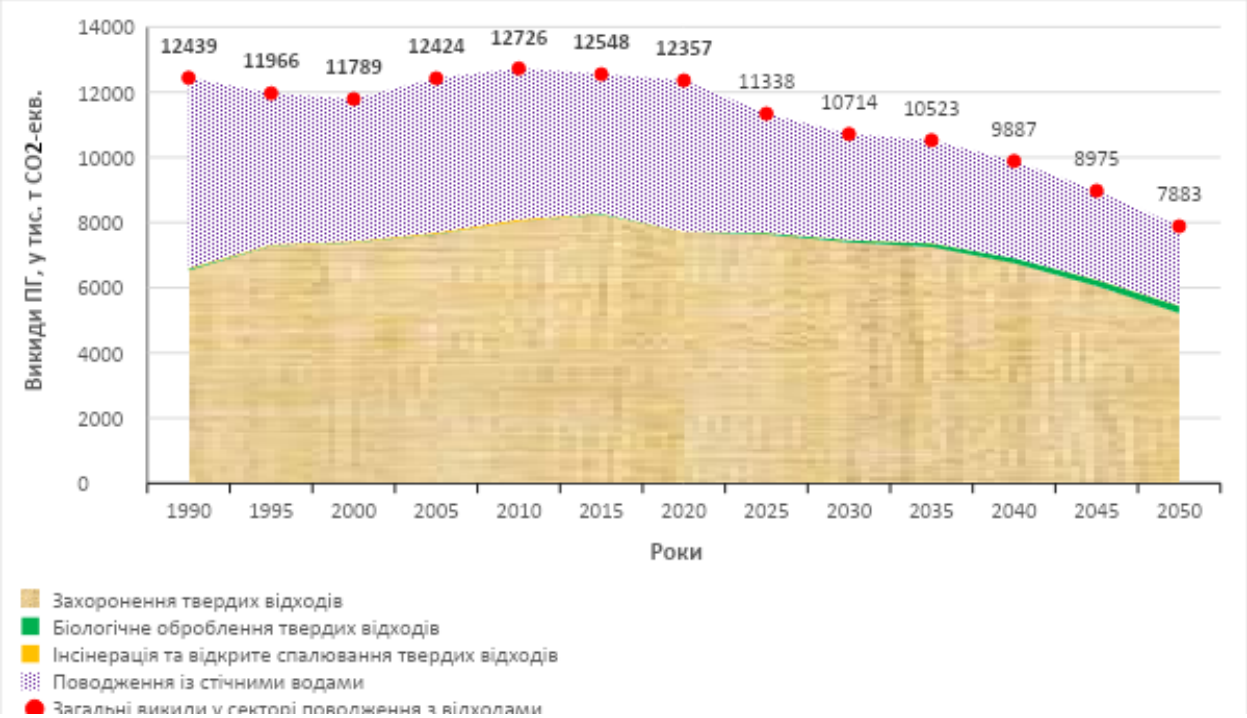
[337] https://zakon.rada.gov.ua/laws/show/868-2021-%D1%80#Text
[338] https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text
[339] https://zakon.rada.gov.ua/laws/show/2320-20#Text

	treatment of MSW (with energy recovery)		(partial implementation)	
5	Increasing the volume of utilization (recovery and flaring) of landfill gas at landfills and solid waste disposal sites	9.2%** (as of 2021)	15 %** (quantitative indicator not explicitly established by legislation)	36 %**
6	Implementation of methane utilization (recovery and flaring) practices at wastewater management facilities	0.0%** (b, 2021)	41 %** (quantitative indicator not explicitly established by legislation)	41 %**

(a, 2022) Analysis of the state of the household waste management sector in Ukraine for 2022; according to the data of the Ministry of Infrastructure;[340]
(b, 2021) National Register of anthropogenic emissions from sources and absorption of greenhouse gases, greenhouse gas emissions in Ukraine from 1990-2021; according to the data of the Ministry of Environment;[341]
* - share of total waste generated;
** - share of total methane generated.

According to the WEM scenario, GHG emissions in the waste management sector will gradually decrease and reach 10.7 million CO2-eq in 2030, which is 14% lower than the emissions level in 1990. In the future, emissions will continue to decrease and reach 7.9 million tons of CO2-eq in 2050, which is 37% lower than the level in 1990. Detailed GHG emissions in the waste management sector until 2050 are shown in Figure 4.5.

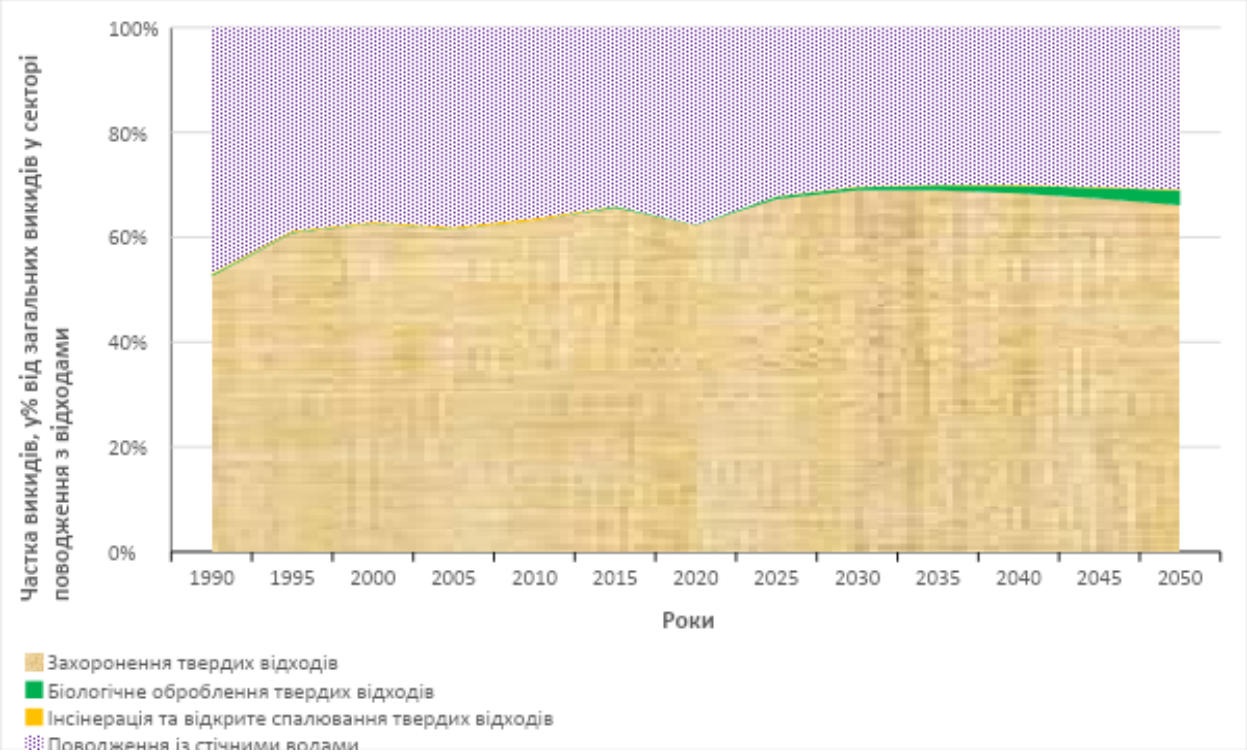
Fig. 4.5. GHG emissions in the waste management sector according to the WEM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - forecast data



[340] https://mtu.gov.ua/news/34323.html
[341] https://unfccc.int/documents/628276

According to the WEM scenario, the structure of emissions in the waste management sector does not undergo significant changes. The main source of GHG emissions in the sector will continue to be solid waste disposal sites, contributing 65% - 69%, slightly higher than the corresponding indicator in 2020, when it accounted for 62% of total sector emissions. The share of emissions associated with wastewater management will remain almost unchanged, at 30%-31% until 2050. The only source where an increase in GHG emissions is expected is the biological treatment of solid waste, with emissions projected to increase from 7.5 thousand tons of CO2-eq. (0.1% of total sector emissions) in 2020 to 69.7 thousand tons of CO2-eq. in 2030, and will reach a value of 226.5 thousand tons of CO2-eq. (2.9% of total sector emissions) in 2050. Such a significant increase in emissions from the biological treatment of solid waste will be caused by the widespread practice of composting organic components of municipal solid waste (hereinafter referred to as MSW), namely: food and garden waste. Emissions of greenhouse gases from thermal waste treatment methods will account for 0.1%-0.2% of total emissions in the waste management sector. They are the smallest source of emissions in the sector, as they include waste disposal activities without further energy recovery. The latter type of activity is included in the energy sector, where it is accounted for as the use of renewable energy sources and alternative fuels. The detailed structure of emissions by separate categories in the waste management sector until 2050 is shown in Fig. 4.6.

Fig. 4.6. Structure of GHG emissions in the waste management sector according to the WEM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - forecast data



In the WEM scenario, the main factors determining the trends in GHG emissions in the waste management sector are:

- moderate reduction of the share of landfilling of MSW by 2050;

- moderate deployment of landfill gas flaring technologies by 2030 and intensification of landfill gas recovery by 2050;
- intensive deployment of methane recovery technologies generated during centralized wastewater treatment.

The key risks on the path to reducing GHG emissions according to the WEM scenario are:

- critically slow implementation of methane recovery technologies at wastewater treatment plants;
- low efficiency of flare combustion technologies that are supposed to be implemented at low-flow landfill gas landfills.

[Modeling and forecasting of GHG emissions in the LULUCF sector is planned in the following stages of work on the NECP using appropriate modeling and calculation tools]

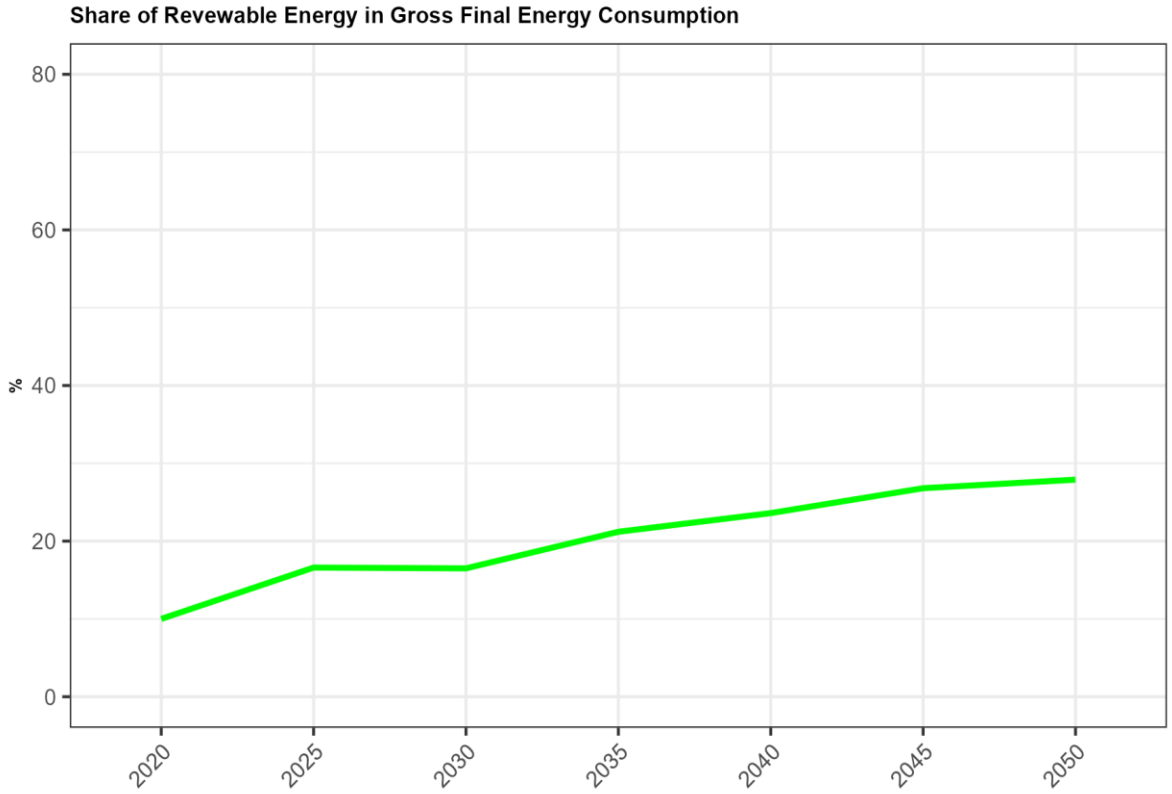
4.2.2. Renewable energy

i. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors
In 2020, the share of RES in the gross final energy consumption (GFEC) was 11%. Thus, the draft NREAP envisages its growth by almost 2.5 times by 2030.

ii. Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2050)
Considering the current and potential consequences of Russia's full-scale military aggression against Ukraine, achieving the goal of 27% RES in the gross final energy consumption seems extremely ambitious.

The modeling results for the WEM scenario show that the share of RES in the gross final energy consumption will continue to increase, but this growth will be minimal and the target indicator will not be achieved by 2030. It does not seem possible, primarily due to the low penetration of RES in industrial energy consumption, substitution of carbon-intensive energy resources, and low rates of natural gas substitution with RES in residential and commercial individual heating systems.

4.7. Share of RES in the structure of gross final energy consumption according to the WEM scenario, %



The table below provides forecast values for total primary energy supply (TPES), final energy consumption (FEC), electricity and heat production according to the WEM scenario.

Table 4.8. Key modeling results for the development of RES in Ukraine according to the WEM scenario

	2015	2020	2025	2030	2035	2040	2045	2050
Total primary energy supply (TPES)								
Total primary energy supply, mtoe	**90**	**86**	**62**	**75,8**	**78,7**	**79,8**	**79,1**	**80**
Coal, %	*31*	*32*	*28*	*19*	*16*	*19*	*17*	*16*
Gas, %	*29*	*31*	*29*	*25*	*25*	*25*	*25*	*26*
Oil, %	*12*	*11*	*13*	*14*	*16*	*16*	*16*	*16*
Nuclear energy, %	*26*	*23*	*20*	*32*	*31*	*25*	*24*	*24*
Hydropower, %	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Wind energy, %	*0,1*	*0,2*	*1*	*1*	*2*	*3*	*4*	*4*
Solar energy, %	*0,0*	*0,5*	*1*	*1*	*1*	*1*	*2*	*2*
Biofuels and waste, %	*2*	*2*	*7*	*7*	*9*	*10*	*11*	*12*
Share of RES in TPES, *%*	**3,0**	**3,1**	**10**	**10**	**13**	**14,7**	**17**	**18**
Final energy consumption (FEC)								
Total final energy consumption, mtoe	**48,2**	**45,2**	**34,8**	**42,2**	**44,2**	**46,2**	**46,5**	**48,7**
Coal, %	*8,4*	*8,1*	*6,6*	*6*	*3,7*	*4,2*	*2,6*	*5,3*
Gas, %	*32*	*29*	*27*	*26*	*25*	*25*	*26*	*25*
Oil, %	*20*	*21*	*21*	*22*	*24*	*24*	*23*	*22*
Thermal energy, %	*17*	*17*	*18*	*17*	*17*	*17*	*17*	*17*

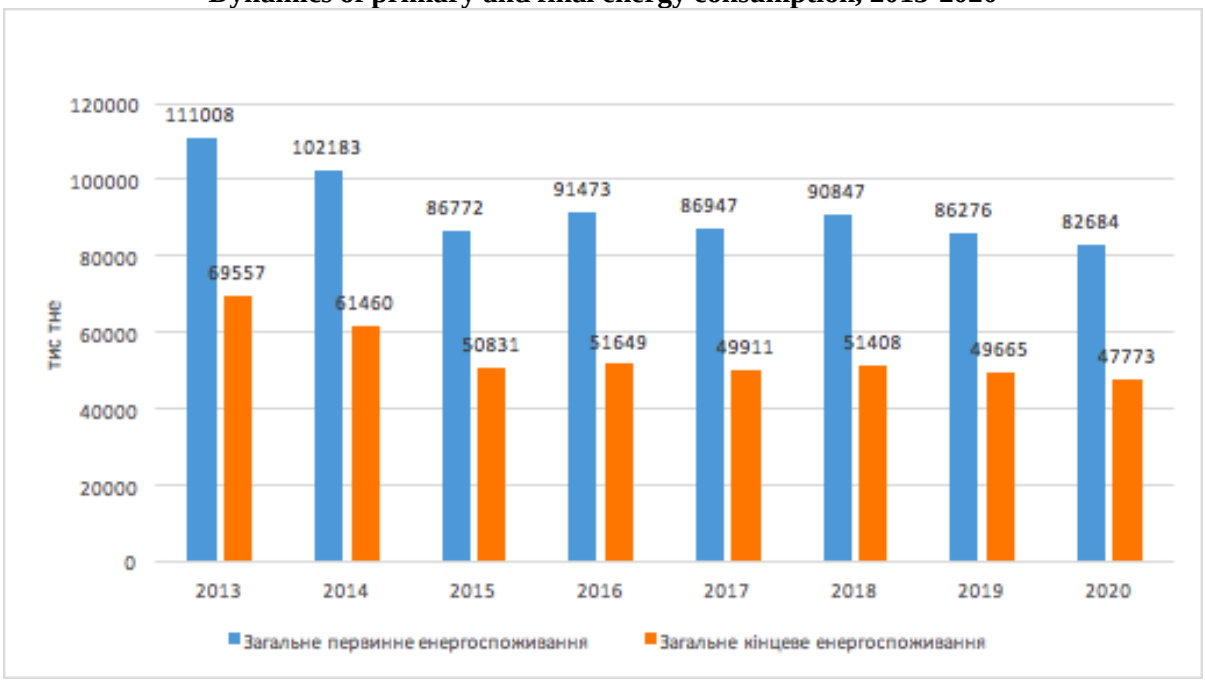
Electricity, %	*21*	*21*	*22*	*23*	*25*	*25*	*25*	*25*
RE, %	*3*	*2*	*5,8*	*6,1*	*5,7*	*5,4*	*5,6*	*5,8*
Solar energy, %	*–*	*0,01*	*0,02*	*0,03*	*0,06*	*0,09*	*0,19*	*0,31*
Share of RE in gross final energy consumption, %	**6,2**	**10,2**	**16**	**15**	**21**	**23**	**26**	**27**
Electricity production								
Electricity production, TWh	**157**	**175**	**118**	**146,2**	**161**	**170,5**	**172,7**	**173,8**
Coal, %	*33*	*33*	*29*	*13*	*11*	*18*	*17*	*13*
Gas, %	*5*	*4*	*8*	*5*	*5*	*4*	*4*	*4*
Nuclear energy, %	*56*	*52*	*41*	*63*	*58*	*46*	*43*	*44*
Biofuels and waste, %	*0*	*0*	*3*	*3*	*3*	*1*	*2*	*3*
Wind energy, %	*1*	*1*	*4*	*6*	*11*	*16*	*19*	*21*
Solar energy, %	*0*	*3*	*7*	*4*	*5*	*7*	*8*	*8*
Hydropower, %	*5*	*6*	*6*	*6*	*5*	*5*	*5*	*6*
Share of RE, %	**6,0**	**10,6**	**20**	**19**	**24**	**29**	**34**	**37**
Thermal energy production (district heating stations)								
Thermal energy production (district heating stations), mtoe	**9,5**	**9,4**	**7,4**	**8,2**	**8,7**	**8,8**	**9,3**	**9,7**
Coal, %	*15,8*	*13,7*	*13,7*	*16,8*	*16,9*	*17,7*	*17*	*14,5*
Gas, %	*61,5*	*60,1*	*58,6*	*50,6*	*44,6*	*46*	*48,2*	*47,7*
Biofuels and waste, %	*7,4*	*11,5*	*18,3*	*20,1*	*27,8*	*26,5*	*25*	*27,2*
Oil, %	*0,2*	*0,2*	*0,2*	*0,2*	*0,2*	*0,2*	*0,2*	*0,2*
Electricity, %	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Share of RE, %	**15,3**	**18,5**	**27,2**	**26,1**	**33,8**	**32,7**	**30,2**	**32,3**

4.3. Dimension Energy efficiency

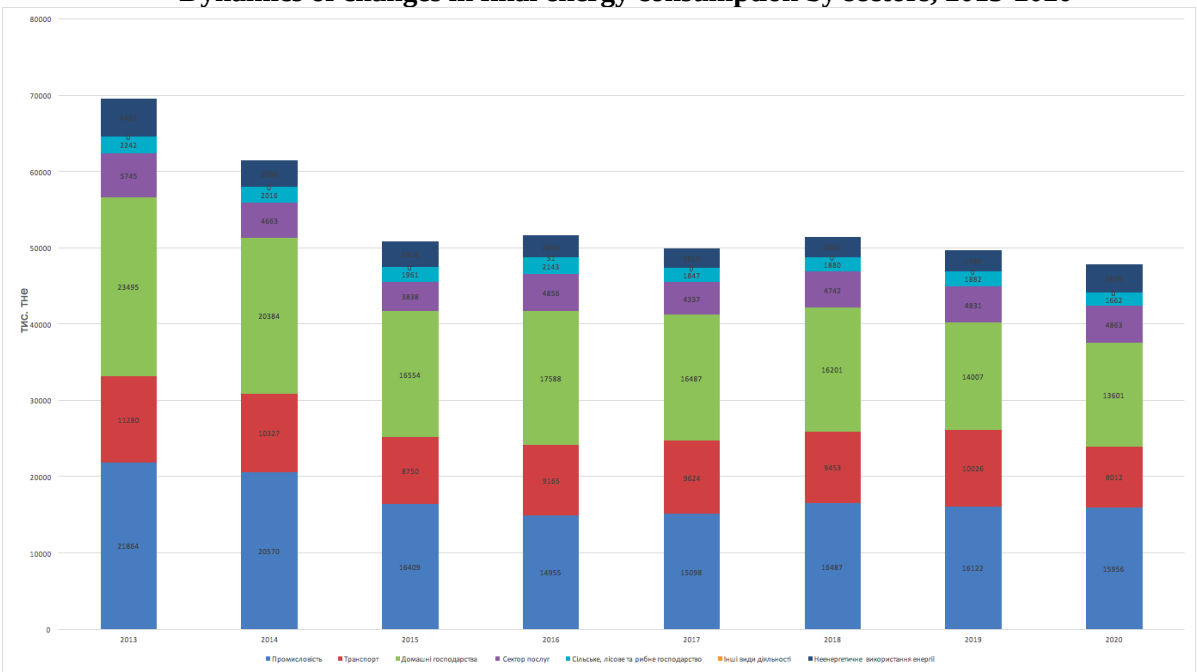
i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

As of 2020, total final consumption amounted to 47.8 million tons of oil equivalent (excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol, as well as parts of the temporarily occupied territories in Donetsk and Luhansk regions). Significant reduction in final energy consumption occurred in 2014 (by 12.4%) due to a number of factors: occupation of the Crimean Peninsula and a significant territory of industrial zones in Donetsk and Luhansk regions, economic decline, energy supply restrictions, and rising energy prices. In 2016 and 2018, there was an increase in final energy consumption due to structural factors: economic recovery and normalization of energy supply to consumers. Such growth in final energy consumption, accordingly, influenced the growth of primary energy consumption in these years. As of 2020, primary energy consumption amounted to 82.7 million tons of oil equivalent.

Dynamics of primary and final energy consumption, 2013-2020



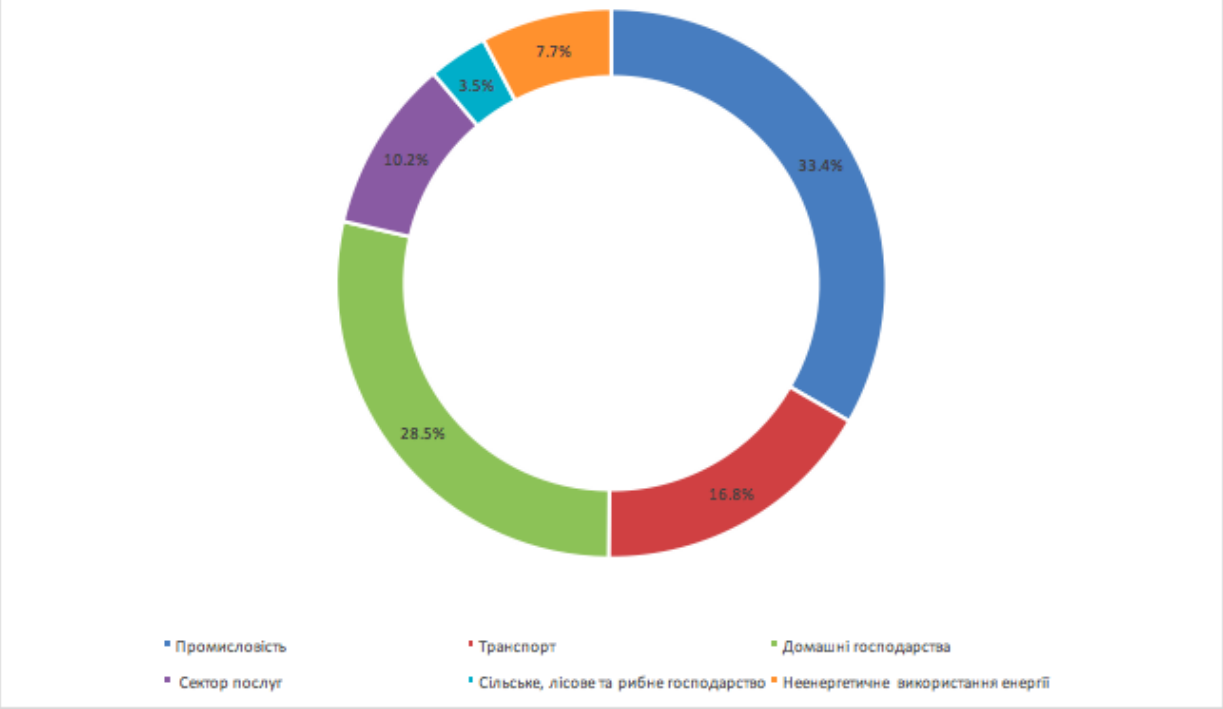
Dynamics of changes in final energy consumption by sectors, 2013-2020



**For 2014-2021 excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol, as well as parts of the temporarily occupied territories in Donetsk and Luhansk regions.*
Source: State Statistics

In 2020, the industry accounted for the largest share of final energy consumption (33.4%). The residential sector was the second largest energy consumer, accounting for 28.5%. The transport sector consumed 16.8% of the energy, the services sector - 10.2%, non-energy consumption - 7.7%, agriculture, forestry and fisheries - 3.5%.

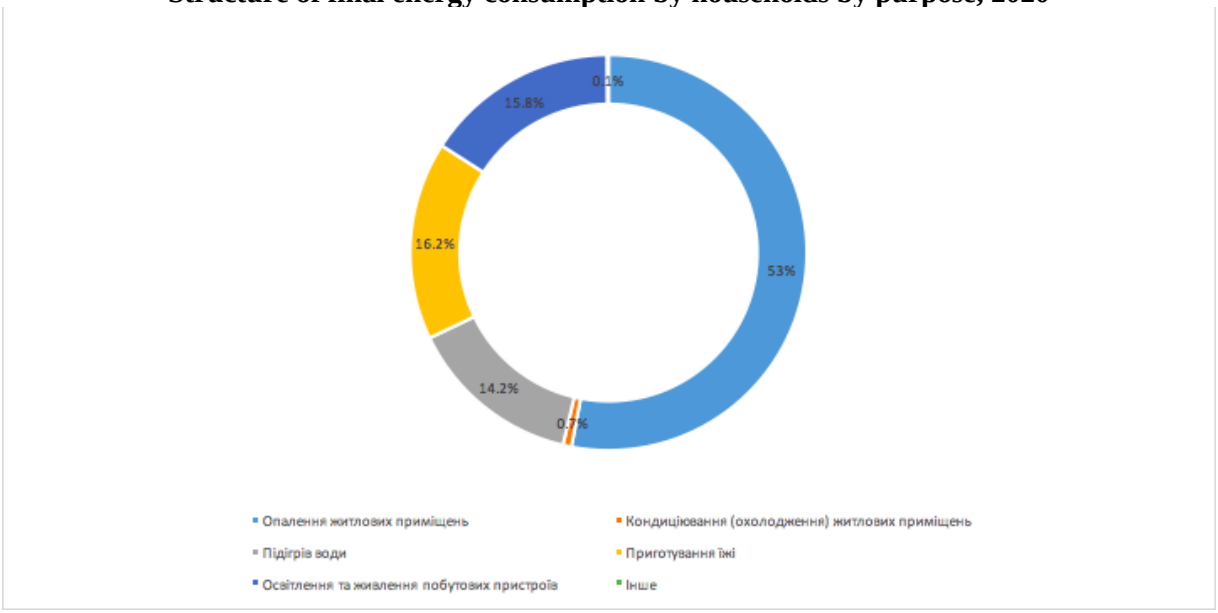
Final consumption by sectors, 2020*



Source: State Statistics

In the structure of final consumption by households, the largest share is occupied by heating (53%). Cooking uses 16.2% of energy, lighting and powering household appliances - 15.8%, water heating - 14.2%

Structure of final energy consumption by households by purpose, 2020



Source: State Statistics

Data from state statistics on final energy consumption for 2021-2022 As of the end of 2023, there is no data available. According to government statements, due to the full-scale aggressive war of the Russian Federation against Ukraine, energy consumption has decreased by 30-35% compared to 2021.

During the first year of full-scale war, the residential sector suffered the most (38% of the total damage inflicted), followed by transportation (26%), energy (8%), trade and industry (8%), and agriculture (6%)[342]. According to the World Bank's estimate, up to 1.4 million residential units (apartments) were destroyed or damaged; 135,000 individual residential houses; and up to 39,040 residential units (rooms) in dormitories. The most affected regions are Donetsk, Kharkiv, Luhansk, Kyiv, and Mykolaiv oblasts. It is estimated that more than one-third (499,056 residential units) of all damaged residential units were destroyed.

Significant damage was also inflicted on public buildings. As of February 24, 2023, at least 2,772 educational institutions were partially damaged (454 - destroyed), which together represents approximately 10% of all educational institutions (at all levels) in Ukraine. The Russian Federation continues its deliberate destruction of educational institutions in 2024. 15.9% of public healthcare facilities (1,574 institutions) have been damaged or destroyed.

The destruction in the industrial sector has a significant impact on the change in final energy consumption. According to the Kyiv School of Economics data as of September 1, 2023, the losses of industry and enterprises amount to at least 426 large and medium-sized private enterprises and state-owned companies that were damaged or destroyed as a result of the war. The metallurgy sector suffered the most: the Azovstal Metallurgical Plant and the Ilyich Iron and Steel Works in Mariupol, the second and third largest metallurgical plants in Ukraine, were destroyed.[343]

Alongside the destruction of housing and infrastructure, Ukraine has also experienced a significant population decline. According to the Institute of Demography's estimate, as of January 1, 2023, the population of Ukraine ranged from 28 million to 34 million people[344], while as of February 1, 2022, this figure was 41.1 million people (excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol)[345]. The UN records 6.2 million officially registered refugees from Ukraine as of October 2023[346].

Massive destruction, structural changes in the economy, and population reduction will have a decisive impact on the change in final energy consumption. At the same time, it is expected that the restoration of destroyed buildings, infrastructure, and industry will be carried out according to the principle of "build back better", resulting in a reduction in energy consumption.

ii. Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

As of the end of 2023, the assessment of the potential for the application of high-efficiency cogeneration and efficient centralized heating and cooling in accordance with the requirements of Directive 2012/27/EU has not been conducted.

The results of the modeling scenario with existing policies and measures (WEM) using the TIMES-Ukraine model show that cogeneration of electricity and heat by CHPs will remain above 50% throughout the modeling period (figure below), while nuclear power production may slightly increase considering the

[342] https://documents1.worldbank.org/curated/en/099062823034041908/pdf/P18017401fe8430010af21016afb4ebc8c4.pdf

[343] https://kse.ua/ua/about-the-school/news/zagalna-suma-pryamih-zbitkiv-zavdana-infrastrukturi-ukrayini-cherez-viynu-syagaye-151-2-mlrd-otsinka-stanom-na-1-veresnya-2023-roku/

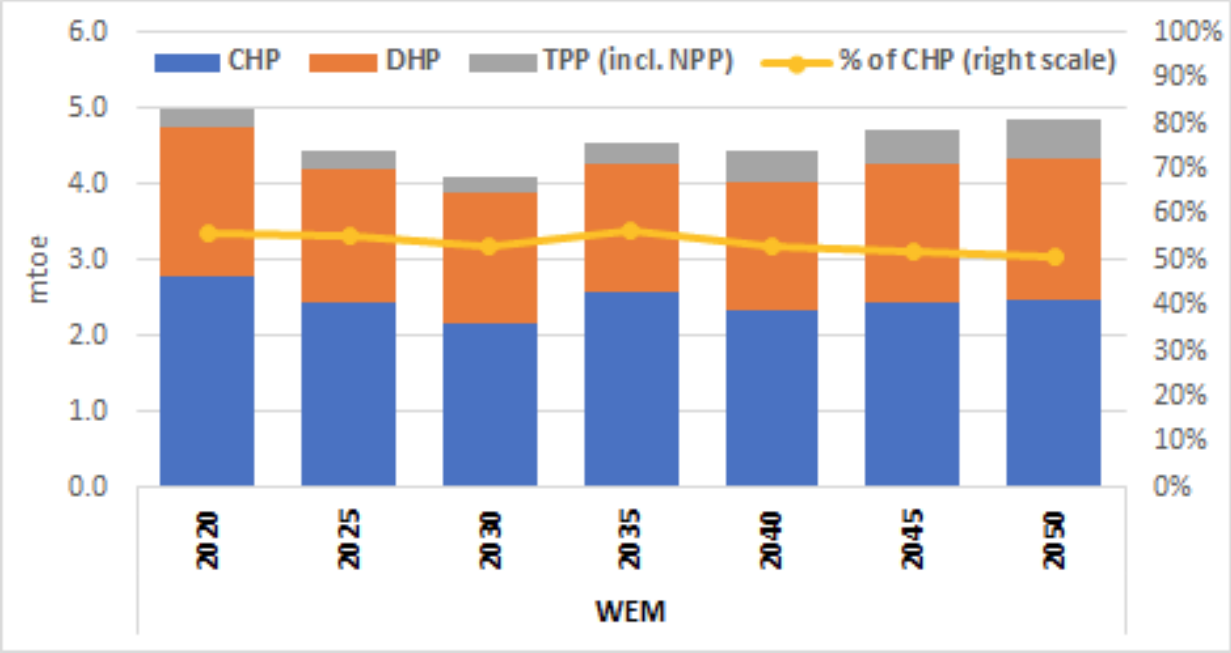
[344] https://voxukraine.org/fejk-za-chas-vijny-naselennya-ukrayiny-skorotylosya-do-20-miljoniv

[345] https://www.ukrstat.gov.ua/

[346] https://data.unhcr.org/en/situations/ukraine

development of nuclear energy, which is also a form of cogeneration, essentially, but with a small share of heat.

Production of thermal energy in the WEM scenario, million tons of oil equivalent

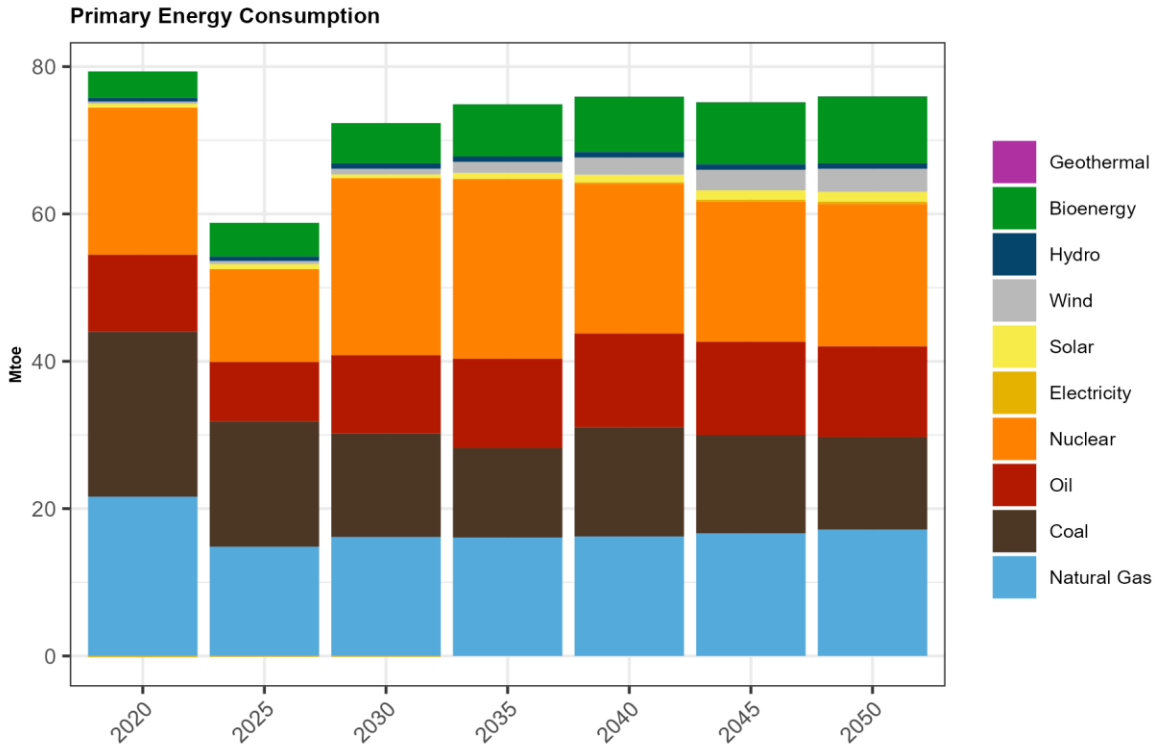


iii. Projections considering existing energy efficiency policies, measures and programmes as described in point 1.2.(ii) for primary and final energy consumption for each sector until 2050 (including for the year 2030)

The modeling results for the WEM scenario confirm, and this is logical even without modeling, that the post-war recovery of the economy and reintegration of temporarily occupied territories of Ukraine will contribute to a significant increase in demand for energy resources - especially in the first 5-10 years.

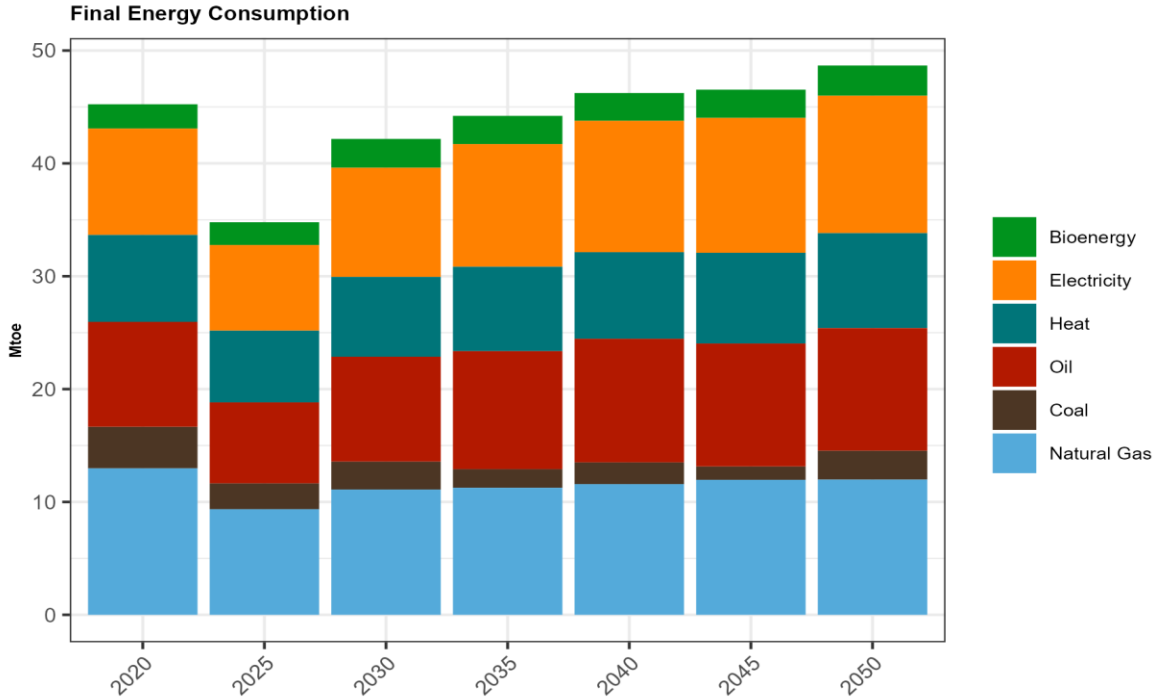
At the same time, existing measures and policies in the field of energy efficiency and renewable energy will only provide stabilization of primary energy consumption (PEC) after post-war recovery. Nevertheless, PEC growth will increase slightly in the WEM scenario, and this growth will be primarily driven by increased consumption of RES and nuclear energy (see figure below).

Primary energy consumption in the WEM scenario, mtoe



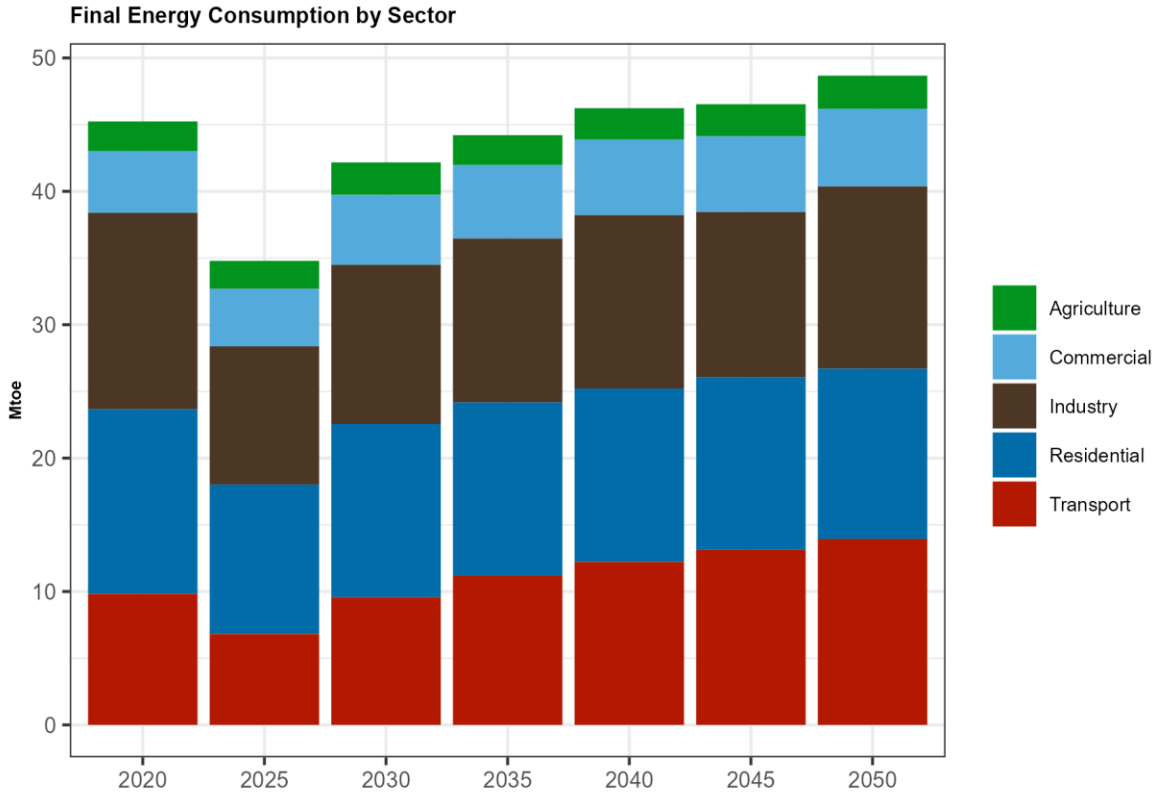
The dynamics of final energy consumption (FEC) is similar to the dynamics of primary energy consumption (PEC), however, in the WEM scenario, the growth rates of FEC are slightly higher than the growth rates of PEC due to increased electricity consumption, indicating an increase in the efficiency of the energy transformation sector.

Final energy consumption by energy type in the WEM scenario, mtoe



After a drastic decrease in energy consumption in 2022 as a result of Russia's full-scale war against Ukraine, there will be an increase in energy demand in all sectors of the economy until 2030, caused by the recovery of the economy and the reintegration of temporarily occupied territories, which will continue even after 2030.

Final energy consumption by sectors in the WEM scenario, mtoe



The results of modeling the final energy consumption by sectors and types of fuel in Ukraine are presented in the table below.

Table 4.9. Final energy consumption by sectors and types of fuel, million tons of oil equivalent

	2015	2020	2025	2030	2035	2040	2045	2050
Final energy consumption in the services sector								
Final energy consumption in the services sector, mtoe	**3,8**	**4,8**	**4,4**	**5,4**	**5,7**	**5,8**	**5,8**	**5,9**
Coal	*3,4*	*4,7*	*3,3*	*2,9*	*2,3*	*1,5*	*0,9*	*0,3*
Gas	*9*	*14,6*	*11,4*	*14,8*	*13,7*	*12*	*10,4*	*6,4*
Oil	*5,4*	*4,9*	*2,8*	*2,5*	*2,7*	*0,7*	*0,3*	*0*
Heat energy	*38,4*	*44,9*	*48,4*	*35*	*34,7*	*35,3*	*40,4*	*46,1*
Electricity	*39*	*28,6*	*28,9*	*27,4*	*27,2*	*27,3*	*28,2*	*28,1*
RE	*3,7*	*2,2*	*5,2*	*17,4*	*19,4*	*23,2*	*19,8*	*19,2*
Solar energy	*0*	*0*	*0,1*	*0,1*	*0,3*	*0,4*	*1,2*	*1,5*
Final energy consumption in industry								

Final energy consumption in industry, mtoe	**15,7**	**14,7**	**10,3**	**11,9**	**12,3**	**13**	**12,4**	**13,7**
Coal	*23*	*22,5*	*20,6*	*18,2*	*11,2*	*13*	*7,9*	*17,5*
Gas	*25,2*	*25,3*	*22,5*	*19*	*17,9*	*14,8*	*14*	*11*
Oil	*2,8*	*2,6*	*2,8*	*1,7*	*1,5*	*1,3*	*1,1*	*0,9*
Heat energy	*16,6*	*16,2*	*16,6*	*18,1*	*19,5*	*19,3*	*20,4*	*19,1*
Electricity	*27,4*	*27,1*	*29,6*	*33,8*	*39,2*	*41*	*44,6*	*40,8*
RE	*0,5*	*0,5*	*1*	*1,9*	*2,5*	*2,7*	*3,1*	*3,2*
Final energy consumption in residential sector								
Final energy consumption in residential sector, mtoe	**16,6**	**13,8**	**11,2**	**13**	**13**	**13**	**13**	**12,8**
Coal	*2*	*1*	*0*	*1*	*1*	*1*	*1*	*1,1*
Gas	*55,5*	*48,8*	*51,3*	*52,9*	*54,8*	*56,9*	*59,7*	*62,9*
Oil	*0,1*	*0,2*	*0*	*0*	*0*	*0,8*	*0,7*	*0*
Heat energy	*17,5*	*14*	*12,7*	*13,4*	*13,2*	*12,9*	*12,7*	*12,5*
Electricity	*18,5*	*21,9*	*21,1*	*22,1*	*22,6*	*22,5*	*22,2*	*22,1*
RE	*6,6*	*14,1*	*15*	*10,7*	*8,3*	*5,9*	*3,6*	*1,5*
Solar energy	*0*	*0*	*0*	*0,1*	*0,1*	*0,1*	*0,2*	*0,5*
Final energy consumption in transport sector								
Final energy consumption in transport sector, mtoe	**10**	**9,8**	**6,8**	**9,6**	**11,1**	**12,2**	**13,1**	**14**
Coal	*0,05*	*0,1*	*0,1*	*0,1*	*0,1*	*0,1*	*0,1*	*0,1*
Gas	*14,7*	*16,5*	*8,7*	*10,1*	*8,7*	*11,3*	*12,9*	*13,4*
Oil	*75,7*	*75,7*	*82,4*	*79,5*	*79,6*	*76,2*	*70,8*	*67,3*
Electricity	*8,9*	*7,2*	*8,1*	*9,5*	*10,8*	*11,6*	*11,1*	*11,4*
RE	*0*	*0*	*0*	*0,2*	*0,3*	*0,3*	*4,5*	*7,2*
Final energy consumption in agriculture								
Final energy consumption in agriculture, mtoe	**2,3**	**2,3**	**2,2**	**2,5**	**2,3**	**2,4**	**2,5**	**2,5**
Coal	*0,6*	*0,6*	*0,6*	*0,6*	*0,6*	*0,6*	*0,6*	*0,6*
Gas	*8,5*	*8,5*	*8,4*	*8,5*	*8,4*	*8,3*	*8,1*	*7,9*
Oil	*60,5*	*60,5*	*60,8*	*60,7*	*60,9*	*59,3*	*57,5*	*55,1*
Heat energy	*14,2*	*14,2*	*14,2*	*14,2*	*14,2*	*14,3*	*14,4*	*14,5*
Electricity	*15*	*15*	*14,7*	*14,9*	*14,8*	*14,8*	*14,8*	*14,9*
RE	*1,2*	*1,2*	*1,1*	*1,2*	*1,1*	*2,8*	*4,6*	*7,2*

iv. Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU

Minimum requirements for the energy efficiency of buildings are established based on data calculated for reference buildings, taking into account the requirements for thermal characteristics of enclosing structures and the energy efficiency of engineering systems (including equipment) of buildings, according to the economically feasible level, taking into account the cost of discounted total expenses for implementing measures to improve the energy efficiency level relative to the calculated service life of each reference building, and are differentiated depending on the functional purpose, height of buildings, and type of construction works (new construction, reconstruction, major repairs).

- For new construction, reconstruction that leads to a change in the functional purpose of the building, the minimum requirement for the energy efficiency of the building is class 'C'.
- For reconstruction, major repairs of buildings as a whole or their separate parts, the minimum requirement is to fulfill the condition:

$$\textbf{ER use} \leq 1.2 \times \textbf{ER p}, \quad (1)$$

where: $\textbf{ER}_{\textbf{use}}$ - is the overall specific energy consumption for heating and cooling, kW·h/m², (kW·h/m³), calculated according to the Methodology for determining the energy efficiency of buildings;

$\textbf{ER}_{\textbf{p}}$ - the maximum value of specific energy consumption for heating and cooling of residential and public buildings, kW×h/ m^{-2}, (кW×h/ m^{-3}), as shown in Table 5 below.

- During reconstruction, major repairs, and designated parts of the building (individual enclosing structures as a whole) as defined by the project documentation, the minimum requirement is to meet the following condition:

$$R_{\Sigma\ пр} \geq R_{q\ min}, \quad (2)$$

where: $R_{\Sigma\ пр}$ - the thermal resistance of the enclosing structure, m-2 × K/W, which is determined in accordance with DBN V.2.6-31:2016 "Thermal insulation of buildings" (hereinafter - DBN V.2.6-31);

$\textbf{R}_{\textbf{q min}}$ - the minimum permissible value of the thermal resistance, m-2 × K/W, which is determined in accordance with DBN V.2.6-31.

Table 5. Maximum values of specific energy consumption for heating and cooling of residential and public buildings

No. of payment	Type of building (reference buildings)	Maximum value of specific energy consumption of buildings for heating and cooling, ER r, kW × h/m-2 [kW × h/m-3], for the temperature zone of Ukraine	
		I	**II**
1	**Residential buildings (number of floors):**		
	from 1 to 3	120	110
	from 4 to 9	85	75
	from 10 to 16	75	70
	17 and more	70	65
2	**Public buildings (number of floors):**		
	from 1 to 3	[38Λ_{bci} + 15]	[34Λ_{bci} + 13]
	from 4 to 9	[30]	[25]
	10 and more	[25]	[20]
3	**Separate types of public buildings:**		
3.1	Hotel buildings	57Λ_{bci} + 60	50Λ_{bci} + 55
3.2	Educational institution buildings	[55Λ_{bci} + 24]	[52Λ_{bci} + 23]
3.3	Preschool institution buildings	[32]	[28]
3.4	Healthcare institution buildings	[30]	[26]
3.5	Commercial buildings	[33Λ_{bci} + 17]	[26Λ_{bci} + 15]
Note: Λ bci - building compactness coefficient, m-1, is determined according to DBN V.2.6-31:2016 "Thermal insulation of buildings".			

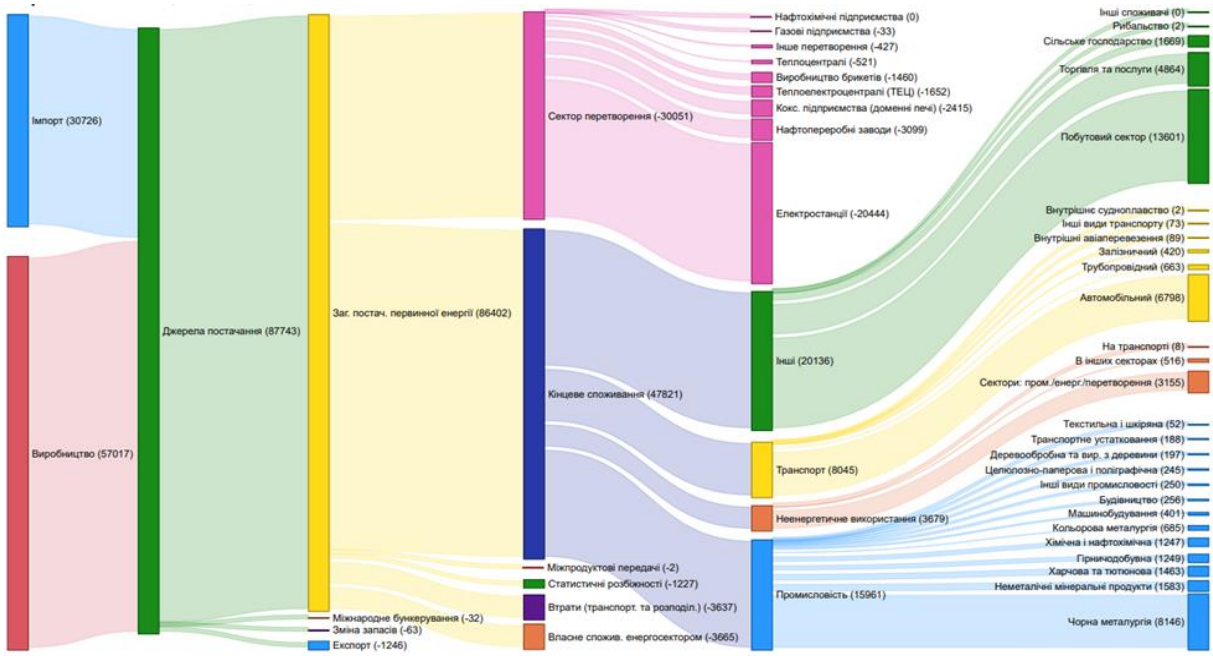
4.4. Dimension Energy security

i. Current energy mix, domestic energy resources, import dependency, including relevant risks

Over the past years, the total primary energy supply in Ukraine has been at 86-93 million tonnes of oil equivalent, which is almost a third less than in 2010. The gradual decline corresponds, on the one hand, to the dynamics of economic development/decline, and on the other hand, to the increase in energy conversion and consumption efficiency.

At the same time, import indicators were quite stable. As of 2020, imports amounted to 30.7 million tons of oil equivalent, or about 35% of total primary energy supply. The share of domestic production in TPES was 65% in 2020 and did not exceed 70% in the previous 5 years.

Energy flows, thousand tons of oil equivalent, 2020

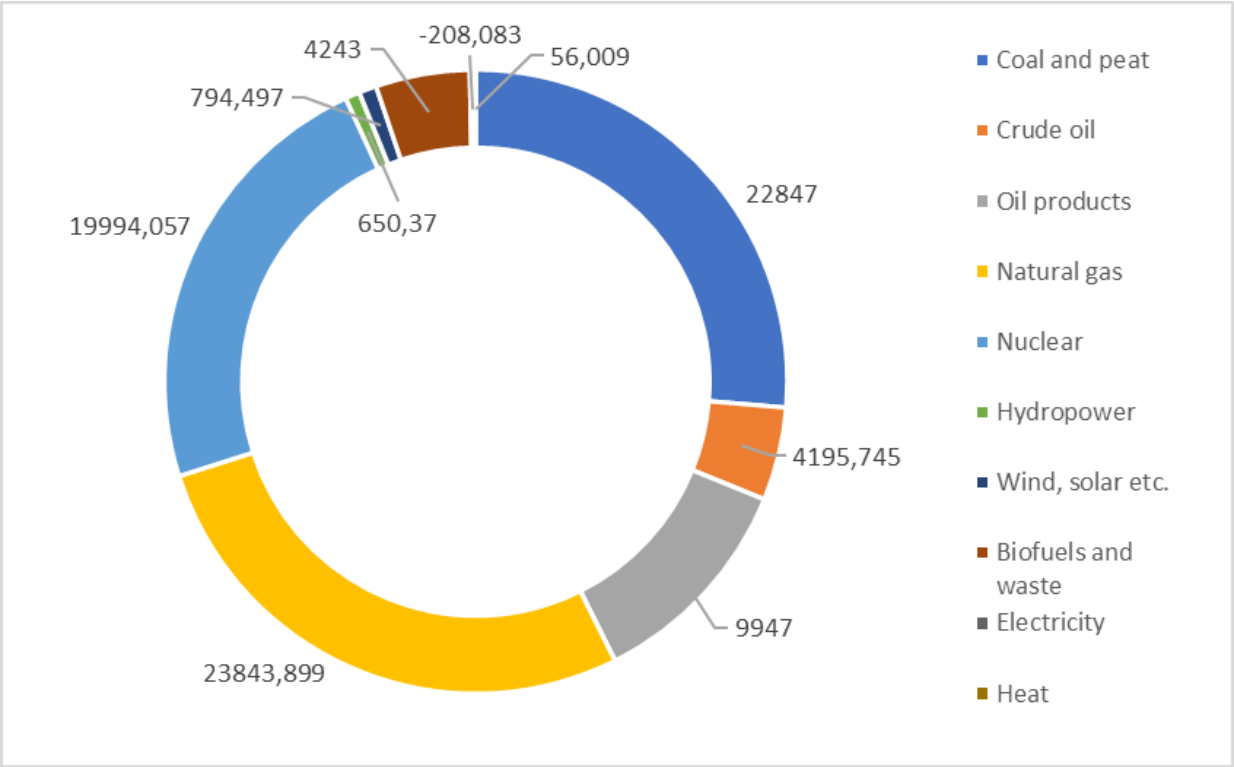


Source: State Statistics Service of Ukraine[347]

According to the 2020 Energy Balance, Ukraine's current energy mix includes four main energy sources, which account for almost 90% in TPES: coal (26.5%), natural gas (27.6%), nuclear energy (23.2%), and petroleum products (11.5%). The share of renewable energy sources, including hydropower, is 6.6%.

[347] https://www.ukrstat.gov.ua/operativ/operativ2020/energ/drpeb/graf_u.zip

Energy Balance (TPES) of Ukraine for 2020



Source: State Statistics Service of Ukraine[348]

Despite the decline in net imports in absolute terms in the 1990s and 2000s, which stabilized in the last 5 years, the dynamics of ensuring the economy's own resources for individual energy sources looks different.

There has been a significant decline in the self-sufficiency of coal and peat - from 98.5% in 2013 to 55.8% in 2020. This is largely due to the loss of control over mining enterprises in the occupied territories, as well as further decline in production indicators of state-owned mines. According to the State Customs Service, Ukraine reduced the import of hard coal and anthracite by 4.2 times (to 14,932.904 thousand tons) in 2022 compared to 2021 - to 4,630.144 thousand tons.[349]

A similar trend was observed in crude oil supply, which accounted for 59% in 2020. But even this relatively satisfactory indicator only takes into account the demand of Ukrainian refineries, and if we consider the motor fuel market, according to the 2017 Energy Balance (product) (the latest complete production data), imports accounted for almost 64% of domestic gasoline supply, 87% of diesel supply, and 75% of liquefied petroleum gas supply. According to the State Customs Service, Ukraine imported 7,300,073 thousand tons of petroleum products in 2022, which is 17% less than in 2021 (8,790,515 thousand tons)[350].

On the other hand, the situation regarding natural gas has significantly improved. Self-sufficiency has increased from 40.6% in 2013 to 66.5% in 2020. The main factors were stabilization of production, despite the loss of resources in the occupied territories (including the Black Sea offshore), low investment in new drilling, and significant reduction in consumption in both industrial and residential sectors.

[348] https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

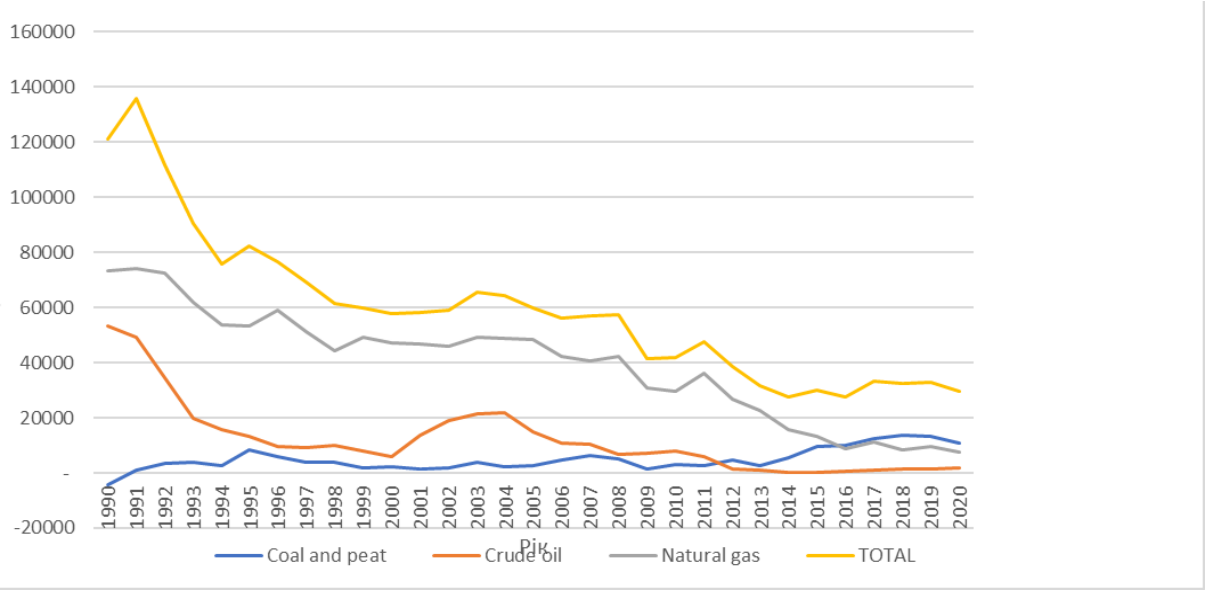
[349] https://ua-energy.org/uk/posts/ukraina-u-sichni-skorotyla-import-naftoproduktiv-ta-vuhillia

[350] https://ua-energy.org/uk/posts/ukraina-u-sichni-skorotyla-import-naftoproduktiv-ta-vuhillia

According to industry data, total gas consumption decreased by 31% to 19.8 billion cubic meters in 2022. while production amounted to 18.5 billion cubic meters.

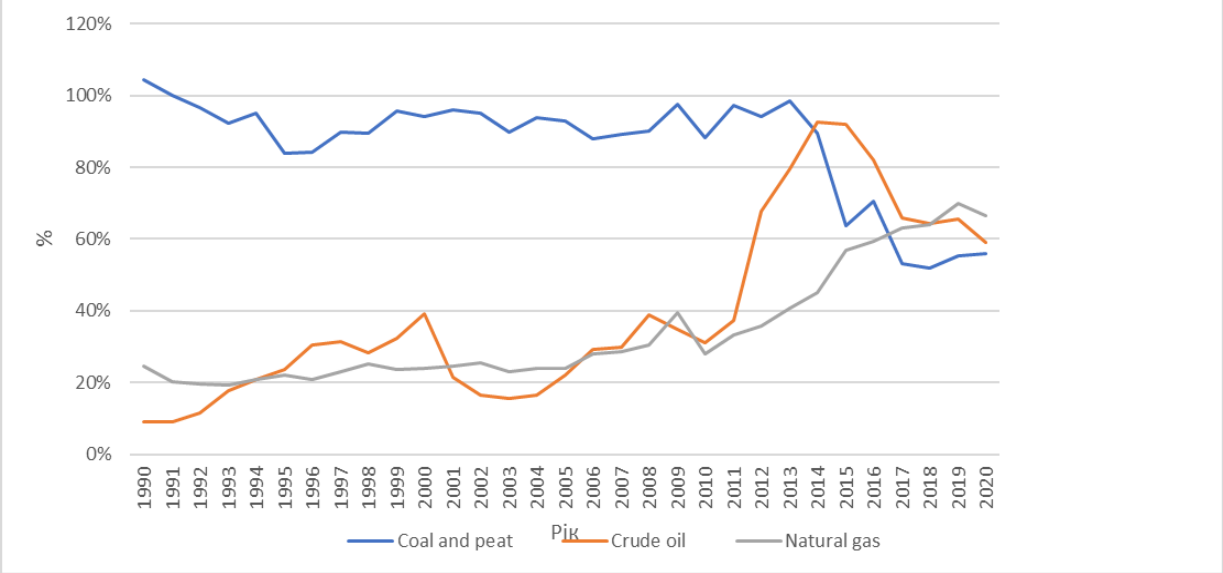
In terms of nuclear fuel, Energoatom has decided to stop importing Russian products in favor of Westinghouse, and plans to provide 50% of its own production by 2025.

Net energy imports, thousand toe



Source: State Statistics Service of Ukraine[351]

Self-sufficiency of Ukraine's economy, %



Source: State Statistics Service of Ukraine[352]

[351] https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

[352] https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

4.5. Dimension Internal energy market

4.5.1. Electricity interconnectivity

i. Current interconnection level and main interconnectors

Ukraine has direct electrical connections with ENTSO-E countries and Moldova. Until February 24, 2022, due to technical peculiarities of Ukraine's power system, there were two separate trading zones: 'Island of Burshtyn TPP' (synchronized with ENTSO-E) and the Integrated Power System of Ukraine' (synchronized with Russia and Belarus). To conduct stability testing of the power system in preparation for integration with ENTSO-E systems, starting from February 24, Ukraine's IPS was disconnected from the systems of Russia and Belarus, while the internal systems (trading zones) were synchronized. Since March 16, 2022, the unified trading zone of Ukraine's IPS operates synchronously with the power systems of continental Europe ENTSO-E.

Ukrenergo can transmit electricity through interconnectors to Hungary (up to 650 MW), Slovakia (up to 400 MW), Romania (up to 400 MW), Poland (up to 1,210 MW), as well as to Moldova (based on the cross-border transmission capacity of the power system of Ukraine, the electricity flow between the power systems of Ukraine and Moldova can reach up to 400 MW, but during peak load hours it is limited to 260 MW, and during repair works on adjacent 330 kV power lines - to zero).

In 2023, Ukraine transitioned to the unified European rules for access to interconnectors for electricity exporters and importers. Market participants obtain access to interconnectors through explicit auctions conducted by the auction office of the TSO (Ukrenergo)[353] in collaboration with the TSOs of neighboring countries. In the future (until the market coupling with neighboring EU countries), most coordinated auctions for the allocation of access to Ukraine's interconnectors will take place on the pan-European auction platform Joint Allocation Office (JAO). In particular, on September 12, 2023, the NEURC adopted a resolution 'On the approval of rules for the allocation of cross-border transmission capacity at Ukraine-Poland, Ukraine-Slovakia, and Ukraine-Hungary directions'.[354]

Until the emergency synchronization of the IPS of Ukraine with the ENTSO-E systems on March 16, 2022, the annual volume of electricity transmission was up to 7 TWh (5 TWh through the "Burshtyn Island" interconnectors and up to 2 TWh through the Dobrotvir TPP - Zamosc 220 kV transmission line). According to Ukrenergo estimates, the additional transmission volume, in case of restoration of the Khmelnytska NPP - Rzeszów and Pivdennoukrainska NPP - Issaccea interconnectors, may reach up to 16 TWh per year. Thus, the annual volume of electricity transmission from Ukraine to ENTSO-E countries may reach up to 30 TWh.

Table 4.10. Cross-border power transmission lines of the IPS of Ukraine (as of 2021)

Country	Number of power transmission lines by voltage (kV), units						
	750 kV	400 kV	330 kV	220 kV	110 kV	35 kV	6-10 kV
Poland	1			1			
Slovakia		1				1	
Hungary	1	1		2			
Romania	1	1					
Moldova			7		12	1	1

[353] https://eap-office.ua.energy/pages/dashboard

[354] https://zakon.rada.gov.ua/rada/show/v1683874-23#Text

Total connections with ENTSO-E countries	3	3	7	3	12	2	1

After synchronization with the IPS of Ukraine, ENTSO-E on June 7, 2022, decided to gradually increase the allowed capacity for electricity imports/exports. Commercial exchanges of electricity with EU countries started at a minimum level on June 30, 2022 (the allowed export capacity was 100 MW). Subsequently, from July 2022 to November 2023, there was a gradual increase in the allowed capacity for electricity exports and imports. In March 2023, ENTSO-E increased the allowed capacity for electricity imports from EU countries to Ukraine and Moldova to 700 MW, in April - to 850 MW, in May - to 1 050 MW,[355] in June - to 1 200 MW.[356]

In November 2023, the Regional Group ENTSO-E "Continental Europe" confirmed the full implementation by Ukrenergo of all technical measures of the Catalog of Measures,[357] which is an integral part of the Agreement on the terms of future integration of the power systems of Ukraine and continental Europe, announced the completion of the project of full synchronization of the power systems of Ukraine and ENTSO-E, and decided to increase the volumes of allowed transmission capacity of interconnectors for electricity imports to Ukraine and Moldova up to 1700 MW.[358] This decision is based on the results of research on the security and stability of synchronous operation of the Ukrainian and European systems.

Further gradual increase in the permitted technical capacity for importing electricity from EU countries to Ukraine/Moldova is expected in accordance with ENTSO-E decisions. The technical capacity for exports from Ukraine/Moldova to Europe is 400 MW.[359]

In March 2023, a new agreement on emergency support for the power systems of Ukraine entered into force, allowing Ukrenergo to request emergency support, and neighboring countries' power systems to offer emergency support in cases of failure of generating or transmission capacities or situations of sudden imbalance between electricity demand and supply.[360]

ii. Projections of interconnector expansion requirements (including for the year 2030)

ESU2050 determines the needs for further development of the transmission capacity of Ukraine's interconnectors with ENTSO-E countries. In particular, by 2032, an increase in the transmission capacity of interconnectors to 6 GW is planned, and by 2050 - to 10 GW to ensure more intensive cross-border trade in electricity and services.

[355] https://www.entsoe.eu/news/2023/04/19/further-increase-in-the-trade-capacity-with-the-ukraine-moldova-power-system/

[356] https://www.entsoe.eu/news/2023/06/21/press-release-further-increase-in-the-trade-capacity-with-the-ukraine-moldova-power-system/

[357] Technical conditions (Catalog of Measures) were fixed in the Agreement on the terms of future integration of the energy systems of Ukraine and continental Europe, signed in 2017. The catalog contains more than 200 technical measures in 9 directions. The catalog of measures is an integral part of the Framework Agreement on the synchronous area of continental Europe (SAFA), which is joined by NPC "Ukrenergo".

[358] https://www.entsoe.eu/news/2023/11/28/continental-european-tsos-announce-completion-of-synchronisation-project-with-ukrenergo-and-significant-increase-in-export-capacity-from-continental-europe-to-ukraine/

[359] https://ua.energy/zagalni-novyny/entso-e-zbilshyla-obsyagy-propusknoyi-spromozhnosti-mizhderzhavnyh-interkonektoriv-dlya-importu-elektroenergiyi-v-ukrayinu-ta-moldovu-do-1200-mvt/

[360] https://www.entsoe.eu/news/2023/03/29/press-release-entso-e-announces-further-support-to-ukraine-through-a-new-agreement-on-emergency-energy-assistance-and-increased-electricity-trading-capacity/#:~:text=This%20new%20energy%20agreement%20establishes,generation%20and%20demand%20in%20Ukraine

The TSO within the framework of the basic document, which assesses the prospects for the development of the power industry - the Generation Capacity Adequacy Assessment Report to cover the projected demand for electricity and ensure the necessary reserve in 2022, determines the dynamics of the development of the maximum capacity of Ukraine's interconnectors for the period up to 2050 (table 4.11).[361]

Table 4.11. Maximum potential for development of interconnectors for electricity exports/imports

Years	2024	2030	2035	2040	2050
Cross-border transmission capacity, GW	3,6	4,8	4,9	6,2	8,0

[NB: Forecasts for the expansion of interconnectors (including for 2030) will be determined based on TSO modeling - taking into account the total installed generation capacity, RES capacities, and peak load forecasts in the power system]

4.5.2. Energy transmission infrastructure

i. Key characteristics of the existing transmission infrastructure for electricity and gas

Electricity infrastructure

The IPS of Ukraine is a combination of power plants, electrical networks, and other objects of the power industry that are united by a common mode of production, transmission, and distribution of electricity under centralized management by TSO. The IPS of Ukraine is the basis of the country's power industry, which provides centralized supply of electricity to domestic consumers, interacts with the energy systems of neighboring countries, and ensures the exports and imports of electricity. It combines generating capacities, distribution networks of Ukrainian regions, connected to each other by system-forming power transmission lines with a voltage of 220-750 kV (electricity transmission system).

The IPS of Ukraine is one of the largest power systems in Europe; it consists of 6 regional power systems and 32 distribution systems. The operational and technological management, balance maintenance in the IPS of Ukraine, and the organization of synchronous operation with the ENTSO-E systems are carried out by the TSO.

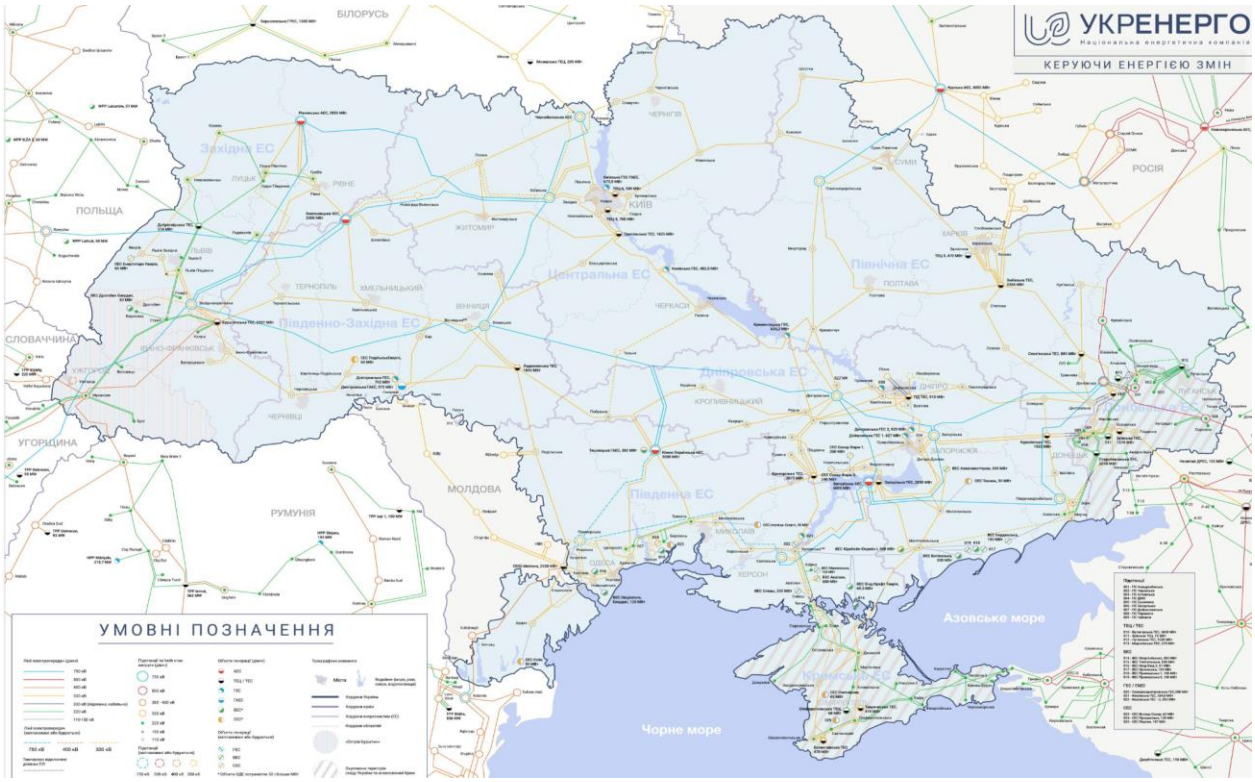
System-forming networks with voltages of 220-750 kV include main and cross-border power lines. They ensure electricity transmission from power plants to distribution networks, as well as export-import connections with neighboring countries. Power transformation is provided by autotransformers and transformers with voltages of 750/500 kV, 750/330 kV, 500/220 kV, 330/220 kV, 400/330 kV, 330/110(150) kV, 220/110(150) kV, 150/110 kV. As of January 1, 2021, the power system includes 21,861.6 km of overhead lines (OHL) along the route and 23,559.1 km of OHL along the chains.

According to the 2022-2031 Transmission System Development Plan, as of the beginning of 2021, there were 141 substations with a voltage of 110-750 kV and a transformer capacity of 83,178.1 MVA on the balance sheet of the TSO. Of these, there are 33 substations with a voltage of 220 kV, 88 substations with a voltage of 330 kV, 2 substations with a voltage of 400 kV, 3 substations with a voltage of 500 kV, 9 substations with a voltage of 750 kV, and 6 substations with a voltage of 110 kV (station nodes of solar power plants). The electricity distribution system had over 1 million km of overhead and cable power lines with a voltage of 0.4-150 kV and approximately 200,000 transformer substations with a voltage of

[361] https://zakon.rada.gov.ua/rada/show/v0664874-23#Text

6-150 kV. The electricity distribution system had over 1 million km of overhead and cable power lines with a voltage of 0.4-150 kV and approximately 200,000 transformer substations with a voltage of 6-150 kV.

Ukraine's power system map (as of the beginning of 2021)



The main equipment installed in the transmission system, which operates continuously and determines the reliability and economic efficiency of operation, was mainly manufactured in the 1950-1970s. In terms of key technical characteristics (weight and dimensions, reliability and economic indicators, etc.), it lags behind modern equipment and requires increasing repair volumes. This condition significantly affects the increase in electrical energy losses in the transmission system and limits the possibility of preventing technological disruptions - damage to electrical equipment or its malfunction, which leads to disruptions in the normal and reliable operation of energy facilities of power objects and the Ukrainian power system as a whole.

Technological losses of electricity in transmission and cross-border lines account for about 2%. Among the objective reasons for the high losses in the power system of Ukraine, the following should be mentioned:

- Transmission of electricity over long distances, especially in distribution networks;
- Unsatisfactory technical condition of networks due to the operation of worn-out equipment.

The main equipment with long operating terms is operated at the TSO substations (Table 4.12).

Table 4.12. Operating terms of the main equipment (as of 01.01.2021)

Equipment name	Capacity, MW	Number of units	Including in operation, units			
			up to 25 years	from 25 to 30 years	from 30 to 40 years	40 years and more
Autotransformers (220-750 kV)	78 450	359	76	49	156	78
Power transformers (35-220 kV)	4 722	106	24	12	26	44
Shunt reactors (35-750 kV)	8 230	109	88	4	14	3
Switches (35-750 kV)	-	3 326	1 134	260	777	1 115

According to the data provided in table 4.13, there are 20,792 km of OHL in operation for more than 30 years (88.0% of the total length of all lines), of which 16,344 km have been in operation for more than 40 years (69.4% of the total length of all lines). These data indicate a trend of further aging and insufficient rates of reconstruction of power lines, which leads to complications in their operation.

Table 4.13. Terms of operation of overhead transmission lines by voltage (as of 01.01.2021)

Voltage	Total, km		Including in operation (by chains), km			
	along the route	by chains	up to 25 years	from 25 to 30 years	from 30 to 40 years	40 years and more
800 kV	98,5	98,5	-	-	-	98,5
750 kV	4 403,2	4 403,2	692,6	-	1 905,4	1 805,2
500 kV	375,3	375,3	38,7	-	159,5	177,1
400 kV	339,0	339,0	-	-	-	339,0
330 kV	13 013,3	13 617,1	1 236,3	460,7	2062,3	9 857,9
220 kV	3 044,3	4 025,7	228,4	-	265,5	3 531,8
110 kV	458,3	568,9	66,4	5,4	42,4	454,7
35 kV	129,7	131,3	36,1	2,5	12,5	80,2
Total	21 861,6	23 559,1	2 298,6	468,5	4 447,7	16 344,3

Due to changes in climate conditions in the last decade, a significant number of power transmission lines built in the 1970s-1980s are vulnerable to increased climate loads. This is particularly evident in the autumn-winter period in the southern and northern regions of Ukraine (Southern, Dnipro, and Northern power systems). Due to increased loads and the effects of storm winds, icing, vibration, and wire galloping, the number of damages to power lines and their wear has significantly increased. As a result, there is a need for comprehensive technical modernization and reconstruction of power lines in these regions and overall, as the design service life (40 years) of most of them has already expired.

The urgent need for the reconstruction of the 220 kV power lines of the IPS of Ukraine remains, as the service life of most of them has already exceeded 50 years. The annual plans include repair work on the foundations of metal supports, reinforced concrete supports, replacement of lightning protection cables,

porcelain insulation, and other work aimed at ensuring the reliability of the power lines. However, due to the accelerated aging of the power lines and the impact of increased loads, these works require increasing material and labor costs every year.

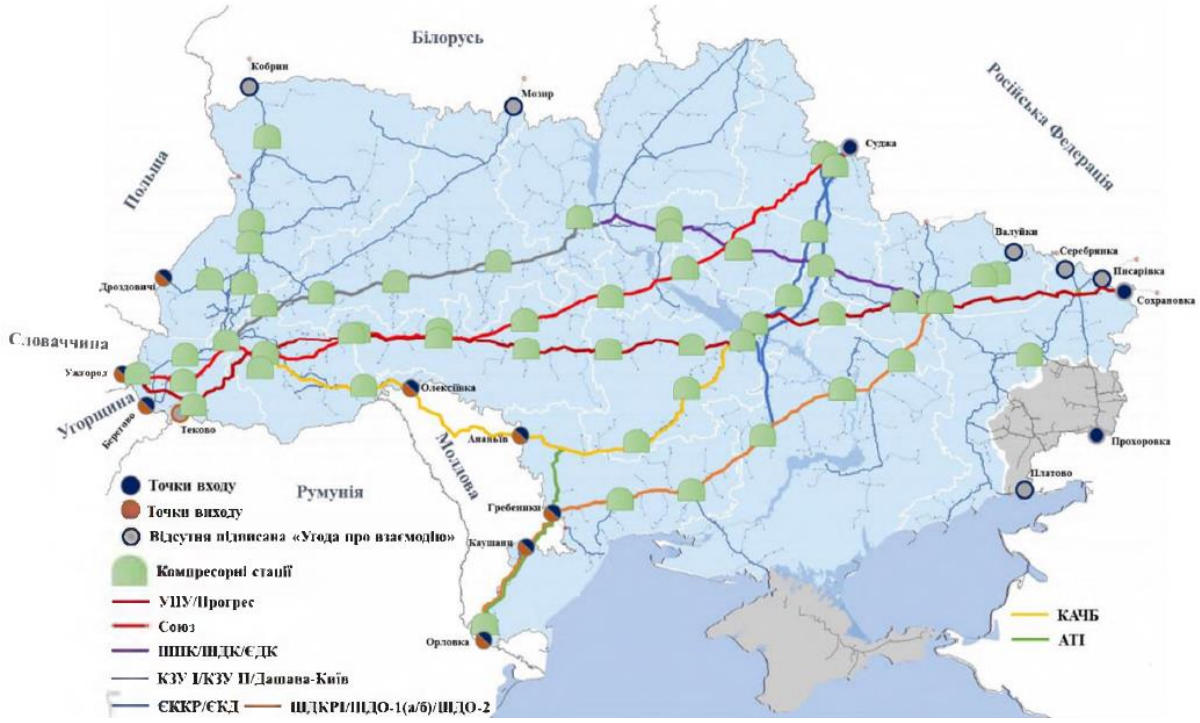
The analysis of financing and implementation of overhaul, technical re-equipment and reconstruction of power lines indicates that the volumes of restoration do not reduce the existing disproportion between aging and restoration and do not cover the actual wear and tear of power lines. Today, this is one of the main problems in the operation of overhead power lines. In general, the aging of structures and equipment occurs much faster than their replacement during reconstruction and capital repair.

Gas infrastructure

According to the ESU2050, the Ukrainian GTS had the following technical characteristics as of the beginning of 2022:

- 33079 km of main gas pipelines,
- 1389 gas distribution stations,
- 57 compressor stations.

Main gas pipelines of the Ukrainian GTS



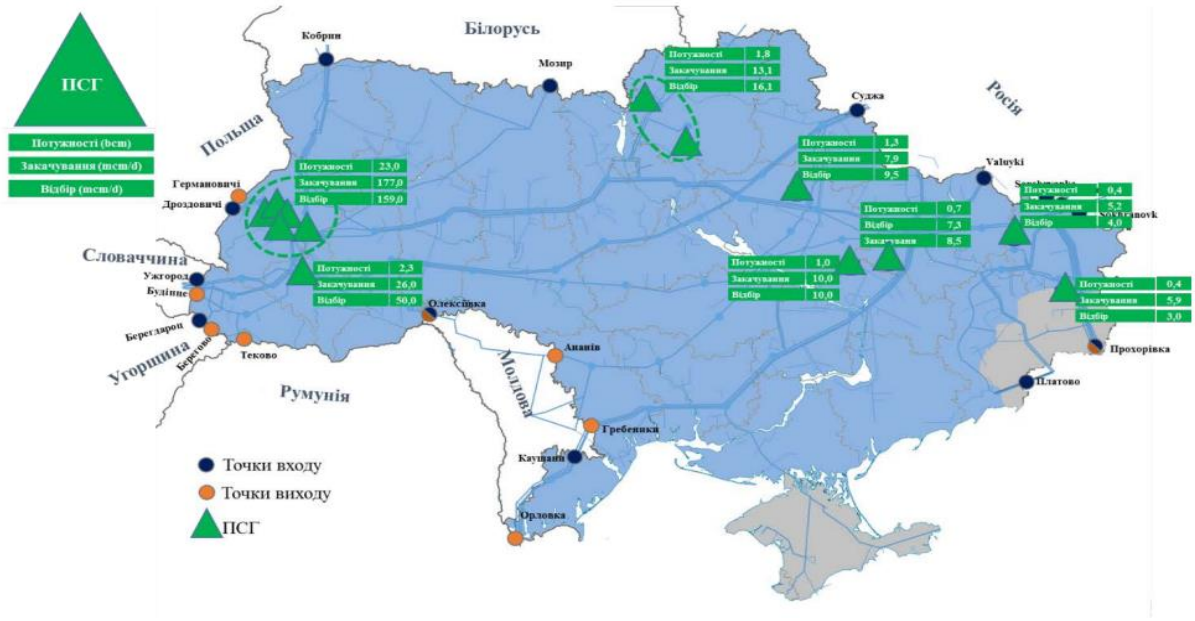
Source: LLC "Operator of GTS of Ukraine"

At the same time, the entry capacity of the GTS was 281 billion m3, and the exit capacity stood at 146 billion m3. On the European side, the GTS has interconnection with the operators of Moldova, Romania, Poland, Hungary, and Slovakia. Overall, the capacity on the interconnections is sufficient to meet current needs, and considering the cessation of gas transit from the territory of russia and belarus, it may become excessive.

The management of PJSC "Ukrtransgaz" covers 12 underground natural gas storage facilities, two of which are created on the basis of aquifers, and the rest are based on depleted gas fields, with a total active

capacity of 30.95 billion cubic meters as of the beginning of 2022. There is another gas storage facility located in the Crimean Peninsula (operated by PJSC "Chornomornaftogaz").

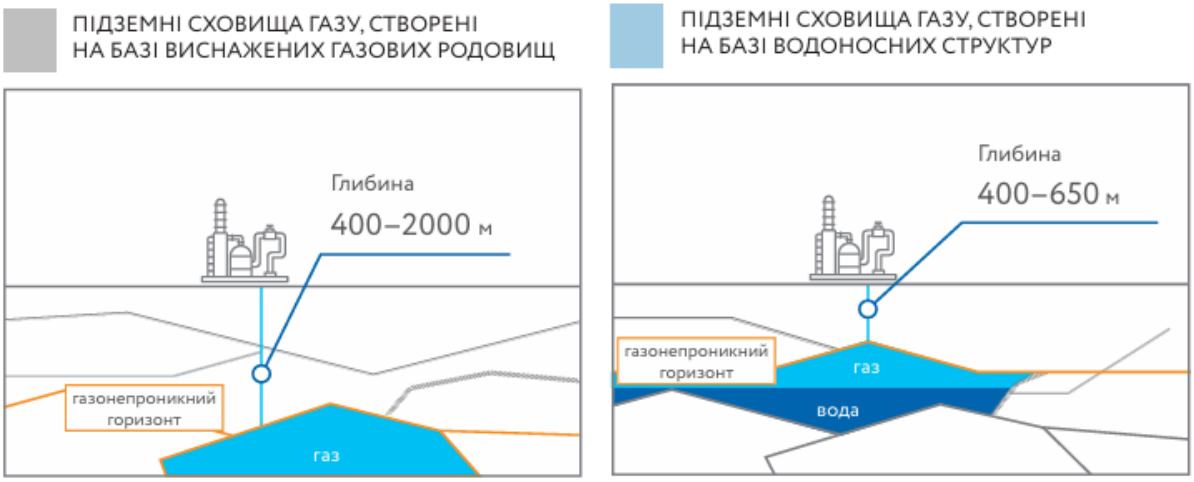
Main characteristics of PJSC "Ukrtransgaz" UGS



Source: PJSC "Ukrtransgaz"[362]

According to the geological structure, the UGS under the management of PJSC "Ukrtransgaz" have the following characteristics:

Geological structure of UGS "Ukrtransgaz"



Source: PJSC "Ukrtransgaz"

ii. Projections of network expansion requirements at least until 2040 (including for the year 2030)

Electricity infrastructure

[362] Source - PSG Development Plan for the period 2021-2030.

[Planned for the next stages of work on NECP, depending on the final results of modeling]

Gas infrastructure

[Planned for the next stages of work on NECP, depending on the final results of modeling]

4.5.3. Electricity and gas markets, energy prices

i. Current situation of electricity and gas markets, including energy prices

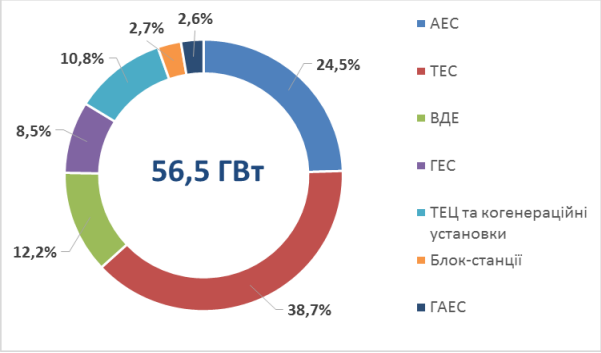
Electricity market

a) Sector characteristics before and during the war

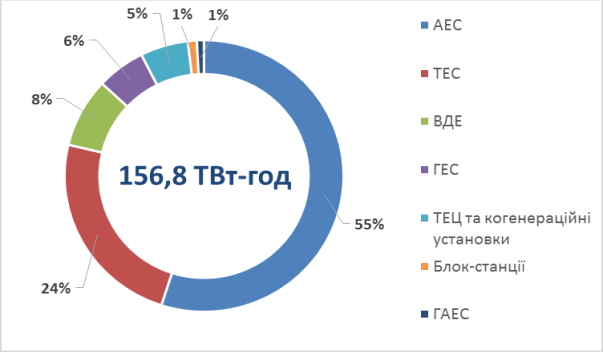
Prior to the start of full-scale war with Russia (24.02.2022), Ukraine had excess generating capacity. According to ENTSO-E, as of 01.01.2022, nominal capacity was approximately 54.8 GW.[363] The TSO estimated installed capacity at around 56.5 GW. The total generating capacity exceeded the maximum demand (load) observed in the winter period in the IPS of Ukraine during 2016-2022, which was about 21-22 GW.[364] This excess capacity provided significant production potential for electricity exports, particularly to EU countries, which was mainly limited by the capacity of interconnectors.

In 2021, coal generation predominated in the installed capacity mix, however, nuclear energy traditionally dominated in electricity mix.

Installed capacity mix (2021)



Electricity mix (2021)



The war with Russia had a significant impact on the electricity sector. On the one hand, Ukraine was able to demonstrate a high level of energy system resilience by operating for three weeks in isolated mode and joining ENTSO-E, and in June 2022 - starting commercial electricity exports to the EU.

On the other hand, mass rocket and drone attacks on energy infrastructure have caused significant destruction and damage to generation and power grids. A large part of power plants came under occupation - in particular, Zaporizhia NPP (6,000 MW), Luhansk, Zaporizhia, and Vuhlehirska TPP (about 7,700 MW). Kakhovka HPP (343 MW) was blown up and completely destroyed. There are thermal power plants (with a total capacity of about 490 MW), a significant part of wind (WPP) and solar (SPP) power plants, as well as coal mines, in the territories not controlled by Ukraine. Due to the loss of a

[363] http://bit.ly/3ZCPf9S (ENTSO-E)

[364] https://www.iea.org/data-and-statistics/data-tools/ukraine-real-time-electricity-data-explorer

significant part of capacity and transmission capabilities in the energy system, Ukraine suspended the export of electricity to EU countries from October 11, 2022, to April 2023.[365]

Due to massive migration abroad and a decrease in production and business activity, the demand for electricity in the energy system has decreased by approximately 30-35%. Nevertheless, due to the capture and destruction of energy facilities, the generation capacity is insufficient to meet domestic demand.

To stabilize the operation of the energy system throughout Ukraine, large-scale planned and emergency power outages have been implemented. In addition, the government has started working on the creation of special financial and economic mechanisms to cover the domestic electricity deficit, which, taking into account the significant price difference between electricity in Eastern European countries and Ukraine, will make imports from EU countries economically viable.

b) Specifics of the electricity market design and operation

The electricity market of Ukraine, similar to European markets, consists of six main segments:

- bilateral contracts market (BCM),
- day-ahead market (DAM),
- intraday market (IDM),
- balancing market (BM),
- ancillary services market (ASM),
- retail market.

The functioning of the markets is determined by the respective rules approved by the Regulator. The majority of electricity is sold through the Wholesale Electricity Market - in 2022, the total sales volume amounted to approximately 135.5 TWh.[366] Approximately 18.2 TWh (-49.1% compared to 2021) were sold through the Retail Electricity Market, and 2.7 TWh (-46.7% compared to 2021) were sold through the wholesale electricity market.[367]

In accordance with the Law of Ukraine "On the Electricity Market", in order to ensure transparency and equal conditions for electricity producers of state, municipal and private ownership on the market, temporarily, until April 1, 2023, producers (except producers of electricity from RES) sell electricity under bilateral contracts exclusively through electronic auctions, the procedure for conducting which is approved by the Cabinet of Ministers of Ukraine. In fact, trading on the wholesale electricity market takes place through the electronic platform of Ukrainian Energy Exchange LLC (UEEX),[368] as UEEX has obtained the priority right to organize and conduct auctions for the sale of electricity under bilateral contracts based on the results of the competitive selection of organizers of electronic auctions.[369]

In this regard, the leading price-setting segment can be considered the day-ahead market (DAM), the quotations of which are mainly used to determine the selling prices on the bilateral contract electricity market (usually at a discount of 5-10% from DAM). It is worth noting that the prices of DAM and intraday market (IDM), as well as the balancing market, are regulated through price caps. The current values of price caps for DAM and IDM are (as of November 30, 2023):

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[365] https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_11_24_UA_sectoral_evaluation_and_damage_assessment_Version_IV.pdf

[366] https://www.nerc.gov.ua/monitoring-rinku-elektrichnoyi-energiyi/operativnij-monitoring-rinku-elektrichnoyi-energiyi/informaciya-shchodo-zdijsnennya-kupivli-prodazhu-elektrichnoyi-energiyi-za-dvostoronnimi-dogovorami/torgivlya-za-dvostoronnimi-dogovorami-vcilomu

[367] https://www.oree.com.ua/index.php/web/10538

[368] https://www.ueex.com.ua/auctions/electricenergy/

[369] http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art_id=245396800&cat_id=35109

- maximum prices from 00:00 to 07:00 and from 23:00 to 24:00 - 3,000 UAH/MWh; from 07:00 to 08:00 and from 11:00 to 17:00 - 5,600 UAH/MWh; from 08:00 to 11:00 - 6,900 UAH/MWh; from 17:00 to 23:00 - 7,500 UAH/MWh;
- minimum price - 10 UAH/MWh;

on the balancing market:

- maximum price - 125% of the DAM price determined by the market operator for each settlement period of the corresponding supply day;
- minimum price - 0.01 UAH/MWh.[370]

Price caps on DAM and IDM by time periods of the day (from November 30, 2023)

According to the Market Operator, which administers DAM and IDM, during the twenty-month period from March 2022 (the start of synchronized operation of the Ukrainian power system and ENTSO-E) to October 2023, maximum prices had a significant impact on DAM, as in 36% of the calculation periods, hourly prices on DAM were at or close (with a difference of less than 1%) to the established upper limit of the maximum price for the corresponding calculation period for this market segment.[371]

Comparison of price dynamics on the Ukrainian and neighboring EU countries DAM (Poland, Hungary, Slovakia, and Romania) demonstrates low correlation, mainly due to insufficient capacity of interconnectors, lack of integration of spot markets in Ukraine with EU markets, and price regulation on the Ukrainian DAM by the Regulator through the price caps. During 2020-2023[372] the difference between daily Base price indices on the Ukrainian DAM in the majority of periods (days) is higher than 2 euros/MWh (compared to Poland - in 98% of periods, Romania - 95.6%, Slovakia - 94.9%, Hungary - 95.8%). The average difference in daily indices Base on the Ukrainian DAM compared to the markets of

[370] https://www.nerc.gov.ua/news/nkrekp-vstanovila-granichni-cini-na-elektrichnu-energiyu

[371] https://www.oree.com.ua/index.php/control/results_mo/DAM

[372] The period from January to September 2023, which was considered in the analysis of electricity prices at the DAM, includes January-September 2023.

Poland was 98.0 euros/MWh, Romania - 269.8 euros/MWh, Slovakia - 268.7 euros/MWh, Hungary - 285.4 euros/MWh.[373]

According to the Market Operator, as of the end of the first half of 2022, there were 523 market participants with active status in the DAM and IDM. Among them: 37 are electricity producers, 31 are distribution system operators, 459 are suppliers, 27 are traders, 5 are large consumers, the TSO and the guaranteed buyer.[374] By the end of September 2023, the number of market participants with active status in the DAM and IDM increased to 566 (+8.2%).[375] During the period of martial law, suppliers and traders are prohibited from selling electricity in these market segments. Thus, the main sellers are generating companies and the guaranteed buyer, which sells electricity generated from RES.

Bilateral electricity trading is conducted through the UEEX auction platform[376] or in the over-the-counter segment. In addition, state-owned generating companies are required to sell the entire volume of electricity sold under bilateral contracts through the UEEX in accordance with the approved Auction Procedure. Prices are not regulated and are determined based on the auctions results.[377]

A significant amount of electricity is effectively "withdrawn" from the competitive market, as it is sold through regulated procedures within the framework of the PSO mechanism determined by the government. Its main goal is to maintain affordable electricity prices for households, which are among the lowest in Europe.[378]

b) Specifics of cross-border trade and its regulation

The electricity exports from Ukraine is based on explicit auctions[379] for the allocation of access of potential exporters (producers, traders, suppliers) to cross-border transmission capacity (TC).[380] The available TC with Poland, Romania, Hungary, Slovakia, and Moldova is determined by Ukrenergo based on the technical capabilities of the interconnectors and in coordination with ENTSO-E.[381] One of the activities of Ukrenergo is to provide market participants with access to the TC of Ukraine's interconnectors. Access is provided through joint coordinated auctions for the distribution of TC of interconnectors.

Since May 2017, an electronic platform for conducting auctions for the allocation of cross-border electricity transmission capacities has been implemented, which contains all the information regarding the auctions. As the network operator, Ukrenergo conducts annual, monthly, and daily auctions for the allocation of access to export and import of electricity, on a competitive basis, the available transmission capacities are distributed among the auction participants. Export and import auctions are transparent, and the schedule of their conduct and results are regularly published on the operator's online platform.[382]

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[373] https://map.ua-energy.org/uk/resources/5bee4464-ba9f-4117-a4ca-f71584bd5f54/

[374] https://www.oree.com.ua/index.php/web/10431

[375] https://www.oree.com.ua/index.php/main/register

[376] https://www.ueex.com.ua/auctions-calendar/elektrichna-energiya/

[377] https://zakon.rada.gov.ua/laws/show/499-2019-%D0%BF#Text

[378] https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text

[379] Explicit auction only involves the allocation of access to cross-border transmission capacity, but not the actual commercial volume of electricity that will be transferred through the interconnector according to contracts or trading results.

[380] The capacity of interconnectors of Ukraine's power system - the technical possibility of supplying electricity through an interconnectors in a certain direction, taking into account the plans for technical maintenance and repairs of the power equipment of the Ukraine's power system and neighboring systems.

[381] https://eap-office.ua.energy/pages/bandwidth/public-ntc

[382] https://eap-office.ua.energy/pages/dashboard

Companies participating in auctions must conclude a contract with Ukrenergo for participation in the distribution of transmission capacity for the corresponding year.[383] As of January 12, 2023, the list of registered Ukrenergo companies for potential participation in distribution auctions included 242 participants.[384] However, there are significantly fewer active participants. Thus, during July-September 2022, 12-13 companies (primarily traders and producers) participated in daily auctions for the export of electricity to Romania, Slovakia, and Poland, ensuring intense competition and high prices for access to the transmission system. As a result of access distribution, companies purchased electricity on the wholesale market (primarily through bilateral agreements or bilateral contracts) and carried out exports based on bilateral contracts with counterparts from EU countries and Moldova.

Taking into account the significant price spread between the electricity markets of Ukraine and EU countries and the relatively high profitability of exports, on July 7, 2022, the Cabinet of Ministers of Ukraine adopted Resolution No. 775 "On imposing special obligations on participants in the electricity market engaged in electricity export operations to ensure public interests in the functioning of the electricity market during the state of war. By this resolution, the government introduced the PSO mechanism for export operations with the aim of "ensuring the security of supply and uninterrupted functioning of the electricity market. According to it, exporters must return 80% of the profit obtained from electricity exports to the SOE Guaranteed Buyer. Moreover, the term of the export PSO is set until the day of termination or cancellation of the state of war in Ukraine.[385]

According to the resolution of the Cabinet of Ministers No. 775, electricity exporters are obliged to: 1) conclude contracts with the guaranteed buyer for ensuring security within five working days from the date this Regulation comes into force; 2) provide the guaranteed buyer with daily information necessary for calculating the actual cost of the service for ensuring security of electricity supply; 3) timely and in full pay the guaranteed buyer the cost of the service for ensuring security of electricity supply in accordance with the terms of the contracts for ensuring security. Overall, this legislative innovation significantly limited the profitability of export operations and the commercial interest of export companies.

Changes have also been made to the Law of Ukraine "On the Electricity Market", which introduced a new income distribution scheme for Ukrenergo from distribution auctions of interstate power grids. Before these changes were adopted, all income received by Ukrenergo from auctions for access to interconnectors had to be directed exclusively towards the technical development of these grids.[386] Taking into account the changes to the Law, from August 1, 2022, to January 1, 2023, the TSO (Ukrenergo) was required to transfer 50% of the income from auctions to cover the debt accumulated in the electricity balancing market to balancing service providers and other market participants responsible for balancing, and 50% to the guaranteed buyer for further allocation of the respective funds to Energoatom and renewable energy producers to cover debts. In addition, thermal power plants and combined heat and power plants providing balancing services were required to use the funds received from Ukrenergo exclusively for fuel procurement (primarily coal, natural gas, or fuel oil) or for conducting equipment maintenance to ensure proper operation of generating capacities during the heating season of 2022-2023.[387]

Since October 11, 2022, the conduct of export auctions and commercial export of electricity has been suspended due to a significant deficit in Ukraine's energy system caused by deliberate and systematic attacks by the Russian Federation on Ukraine's energy infrastructure (generating capacities and power grids). The auctions were resumed by the TSO in 2023.

[383] https://ua.energy/wp-content/uploads/2022/12/Nakaz_616_-na-2023-rik.pdf

[384] https://ua.energy/wp-content/uploads/2023/01/Reyestr-uchasnykiv-vid-12.01.23.xlsx

[385] https://zakon.rada.gov.ua/laws/show/775-2022-%D0%BF#Text

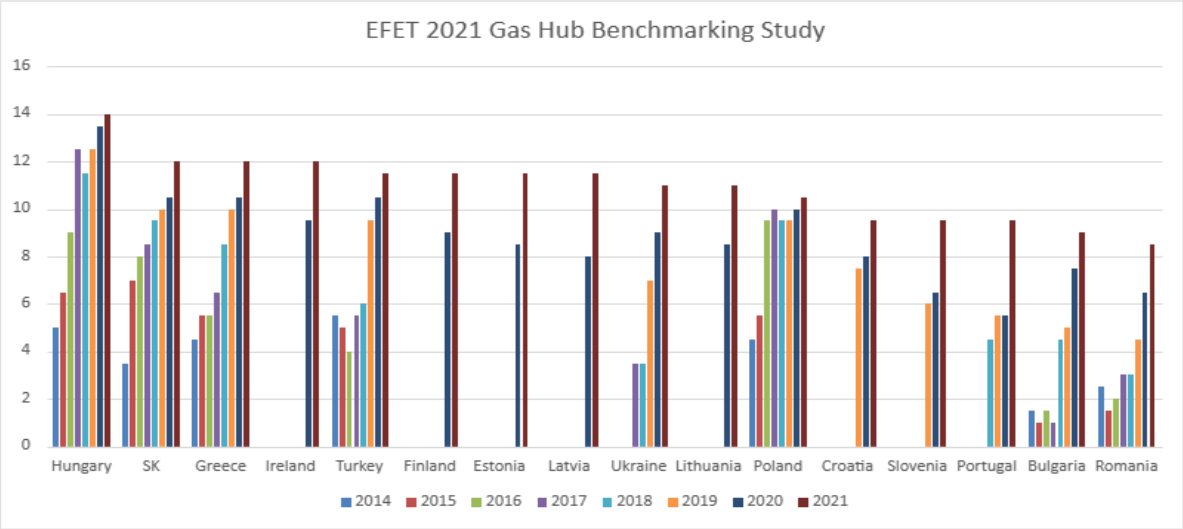
[386] https://zakon.rada.gov.ua/laws/show/2479-IX#Text

[387] https://www.gpee.com.ua/news_item/1086

Natural gas market

Due to the full-scale invasion by russia since February 2022, as well as the measures taken to counter its destructive consequences, the development of the gas market and competition in it has significantly slowed down.

At the same time, in previous years starting from 2014, Ukraine's gas market has significantly developed and become part of the European energy market. In particular, according to a comparison of European gas hubs conducted by EFET (European Federation of Energy Traders) in 2021, the Ukrainian gas hub had a high level of development and stable growth dynamics.[388]



Source: EFET

ACER also assessed the situation in the gas market of Ukraine in a similar way. The monitoring report on wholesale gas markets in 2020 states that in 2020, the volume of trading on the Ukrainian Energy Exchange increased to 2 billion cubic meters (from 0.3 billion cubic meters in 2019), and the number of trading participants doubled. Most of the trades were for month-ahead products, but day-ahead trades were also planned. Most of the liquidity was created by Naftogaz Group, which was able to increase trading volumes on this platform after reducing the special obligations imposed on it.[389]

Since February 2022, natural gas consumption has significantly decreased, particularly in the industrial sector, and the export of natural gas has been prohibited, creating negative incentives for private companies to develop extraction. In addition, a significant portion of consumers receive gas at fixed prices.

In particular, there is a legislative moratorium on price increases above the level that was in effect as of February 24, 2022, which applies to residential consumers, associations of co-owners of multi-apartment buildings, housing construction cooperatives, and other authorized co-owners according to the law, who, through self-provision, maintain autonomous heating systems of multi-apartment buildings owned by co-owners on the basis of joint shared ownership in a multi-apartment building, enter into gas supply contracts for the operation of gas boilers (roof, attached, and/or those located on the adjacent territory) to meet the needs of co-owners of multi-apartment buildings (excluding non-residential premises), heat energy producers - if they use natural gas for heat energy production for the population and have entered

[388] https://www.efet.org/home/documents?id=19

[389] ACER Market Monitoring Report 2020 – Gas Wholesale Market Volume, 14/7/2021.

into a contract with a natural gas market entity, which, in accordance with the first part of Article 11 of the Law of Ukraine "On the Natural Gas Market," has special obligations.

For residential consumers, this price is 7,960 UAH/thousand m3 (including VAT). In the context of natural gas supply to residential consumers, the Regulation on the imposition of special obligations on natural gas market entities to ensure public interests in the functioning of the natural gas market is operational as approved by the Cabinet of Ministers' resolution dated March 6, 2022, applies. No. 222 (hereinafter referred to as Regulation PSO No. 222). By this Regulation, LLC "Gas Supply Company "Naftogaz Trading" is obliged to provide natural gas sales to natural gas suppliers to residential consumers at the price of such supplier's base offer, excluding a trade markup of 0.6 UAH/m3 (including VAT).[390]

In addition, by Order of the NERC No. 222:

- LLC "Gas Supply Company "Naftogaz of Ukraine" is obliged to provide natural gas sales to GDS operators in the amount of normative losses (Volume I), excess losses (Volume III), and production-technological costs, losses caused by military actions and incurred in connection with prevention/resolution of humanitarian crisis situations (Volume II) at separate prices for each of these volumes: Volume I - 7,420 UAH/thousand m3 (including VAT); Volume III - 0.01 UAH/thousand m3 (including VAT); Volume II - according to the formula;

- LLC "Gas Supply Company "Naftogaz Trading" is obliged to provide natural gas supply for combined heat and power plants that generate electricity in a cogeneration cycle - 16,500 UAH/thousand cubic meters (including VAT); for thermal power plants and combined heat and power plants that generate electricity in a condensation cycle - 10,950 UAH/thousand cubic meters (including VAT).

In the context of natural gas supply to heat energy producers, including associations of co-owners of multi-apartment buildings, residential-construction (residential, servicing) cooperatives, managers of multi-apartment buildings, until 15.04.2024 the Regulation on the imposition of special obligations on natural gas market entities to ensure public interests in the functioning of the natural gas market regarding the peculiarities of natural gas supply to heat energy producers and budgetary institutions applies as approved by the Cabinet of Ministers' resolution of 19.07.2022 No. 812 (as amended) (hereinafter - Regulation PSO No. 812). According to it, the supply to such consumers is carried out by LLC "Gas Supply Company "Naftogaz Trading" within three volumes supplied at different prices:[391]

- Volume I (fixed) - for the needs of thermal energy production for the provision of heat supply services and hot water supply to the population and/or supply of thermal energy as a commodity for these needs at a price of 7,420 UAH/thousand m3 (including VAT), also the price includes a tariff for natural gas transportation services and a coefficient that is applied in case of ordering capacity for the next day;

- Volume III (fixed) - for the production of thermal energy for the provision of heat supply services and hot water supply to budgetary institutions/organizations, religious organizations, enterprises, institutions and organizations under the management of the State Administration, and/or supply of thermal energy as a commodity for these needs at a price of 16,390 UAH/thousand m3 (including VAT), also the price includes a tariff for natural gas transportation services and a coefficient that is applied in case of ordering capacity for the next day;

- Volume II - gas for needs other than those covered by volumes I (fixed) and III (fixed), at a price determined monthly by the 25th day of the month preceding the month of natural gas supply, taking

[390] https://zakon.rada.gov.ua/laws/show/222-2022-%D0%BF#n31

[391] https://zakon.rada.gov.ua/laws/show/812-2022-%D0%BF#n34

into account the weighted average price of the resource for the previous month based on electronic trading on the Ukrainian Energy Exchange for all contracts, payment terms and bases (in the gas transmission system, gas storage facilities), and for all standardized products in the "Natural Gas" direction, for the period from the 1st to the 20th (inclusive) day of the month for all trading days of the month, taking into account the value-added tax. The price of gas within Volume II for December 2023 is 15,050.17 UAH/thousand m3 without VAT, and the price also includes the tariff for natural gas transportation services and a coefficient applied when ordering capacity for the next day.

According to PSO Regulation No. 812:

- LLC "Gas Supply Company "Naftogaz Trading" is obliged to supply natural gas to budgetary institutions, state-owned healthcare institutions, and municipal healthcare institutions at a price of 16,390 UAH/thousand m3 or 7,420 UAH/thousand m3 (in case of heat production for the population) including VAT (excluding the tariff for natural gas transportation services at the exit point and the coefficient applied when ordering capacity for the next day); taking into account VAT (excluding the tariff for natural gas transportation services at the exit point and the coefficient applied when ordering capacity for the next day);

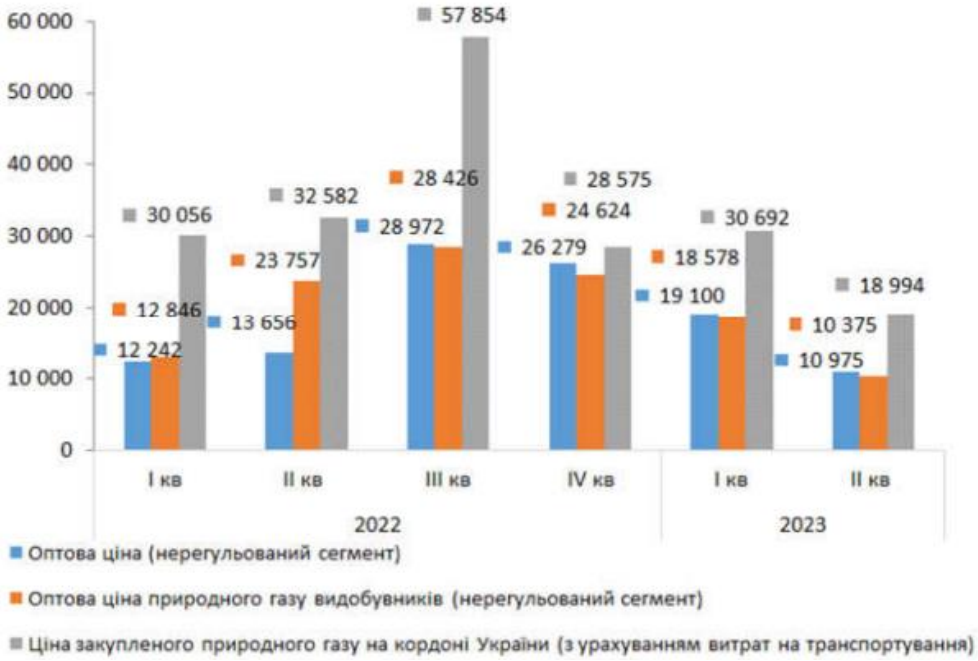
- LLC "Gas Supply Company "Naftogaz of Ukraine" is obliged to provide natural gas supply to dormitories and/or other residential buildings where household consumers permanently or temporarily reside, at a price of 7,420 UAH per thousand cubic meters including VAT (excluding the tariff for natural gas transportation services at the exit point and the coefficient applied when ordering capacity for the next day). m3 including VAT (excluding the tariff for natural gas transportation services at the exit point and the coefficient applied when ordering capacity for the next day).

NJSC "Naftogaz of Ukraine" provides resources to LLC "Gas Supply Company "Naftogaz Trading" and LLC "Gas Supply Company "Naftogaz of Ukraine" to fulfill obligations under the PSO, purchasing resources from JSC "Ukrgasvydobuvannya" and, if necessary, importing natural gas.

Considering the scope of the PSO provisions and other factors, only small volumes are traded on the open market, as evidenced by information from available trading platforms such as the "Ukrainian Energy Exchange". According to the SEEGAS initiative, in 2022, the trading volume on this main gas exchange amounted to 167.45 million m3.[392] According to the NEURC, there is a significant difference between gas prices at the border (taking into account transportation costs) and gas prices sold on the domestic market by producers.[393]

[392] https://www.energy-community.org/regionalinitiatives/SEEGAS.html#pouqvh-accordion

[393] https://www.nerc.gov.ua/storage/app/sites/1/Docs/Sfery_Gaz/Monitoring_rynku_gaz/2023/monitoryng_gaz_II-2023_.pdf



Source: NEURC

According to NEURC data, a total of 180 and 168 natural gas suppliers (respectively) were engaged in the supply of natural gas in the first and second quarters of 2023, with 13 companies also supplying natural gas to residential consumers. In both quarters, 97% of the volume of natural gas supply to the population was carried out by LLC "Gas Supply Company "Naftogaz of Ukraine".

In terms of protecting vulnerable consumers and combating energy poverty, according to the data of the NES, a significant portion of household budgets is allocated to communal services. Expenditures on communal services in 2019 accounted for more than 13% of the total household expenditure, which is a significant component of the household budget. In Ukraine, the average level of energy poverty ranges from 11% (according to the State Statistics Service of Ukraine) to 13-18% (according to the Energy Community). According to the Self-Assessment of Household Accessibility to Individual Goods and Services in 2021, 15.4% of households did not have enough funds to timely and fully pay for housing bills and necessary maintenance services or gas for cooking, and 17.2% did not have enough funds to maintain a sufficiently warm temperature in their homes during the heating season.

Energy use in transportation

The use of energy in transportation requires a separate review (separate from the review of electricity and natural gas markets), considering the variety of transportation modes and types of energy products used in different vehicles. This review is also necessary to provide context for the development of related infrastructure, both fossil fuels (including oil and petroleum products) and charging infrastructure for electric vehicles.

EU statistics[394] define the division of transport into freight and passenger. Within freight transport, the following are distinguished:

- land transport (road transport, railway transport, pipeline transport);

[394] Eurostat, Key figures on European transport, 2022 edition, Key figures on European transport – 2022 edition (europa.eu)

- water transport (maritime transport, inland water transport);
- aviation.

Within passenger transport, the following are distinguished:

- land transport (road transport, railway transport); in this case, road passenger transport is carried out by passenger cars, motorcycles and mopeds, as well as buses;
- water transport (maritime transport, inland water transport);
- aviation.

Since the beginning of 2022, due to the full-scale invasion and other criminal actions of the aggressor on the territory of Ukraine, the circulation of maritime, inland waterway and aviation transport has significantly decreased.

JSC "Ukrzaliznytsia" is the unified operator of railway transport. The main types of energy products used by JSC "Ukrzaliznytsia" for train traction are diesel fuel and electricity.[395]

In Ukraine, the following types of energy products are used for road transport purposes:

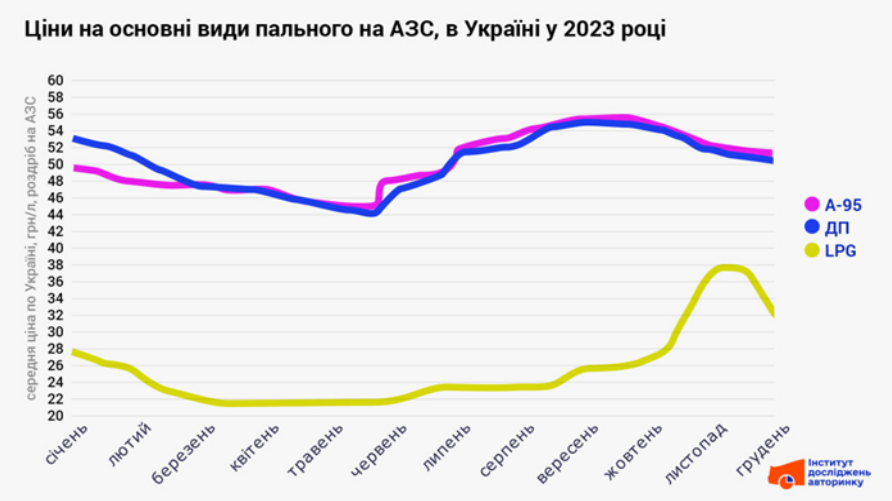
- Gasoline;
- Diesel fuel;
- Liquefied petroleum gas (LPG);
- Compressed natural gas (CNG);
- Electricity.

Liquefied natural gas (LNG) is currently not used for transport purposes.

Partially gasoline, diesel fuel, as well as autogas (LPG, CNG) are produced in Ukraine; however, the majority of the required volumes are imported. According to "Naftorynok", in 2023 the number of importers of petroleum products was 652, compared to 657 in 2022. During 2023, petroleum products were imported by 24% more than in 2022, and the main importers were companies of the OKKO, WOG, and UPG groups, which together provided almost 30% of the imported petroleum products.[396] At the same time, since February 24, 2022, the number of issued licenses (based on the applicant's location) for wholesale trade in fuel without sales outlets has increased by 589 units compared to 2019-2021. - the beginning of 2022, to 1862.[397] In addition, from February 2022 to November 2023, 104 new gas stations started operating in Ukraine: 45 in 2022 and 59 in 2023.[398]

According to the data from the Institute of Automotive Market Research, the prices of petroleum products at Ukrainian gas stations during 2023 were as follows:

[395] https://www.uz.gov.ua/press_center/up_to_date_topic/page-3/618680/
[396] https://www.nefterynok.info/novosti/upg-okko-ta-wog-mportuvali-tretinu-dizpalnogo-u-2023-r
[397] https://www.nefterynok.info/novosti/klkst-vidanih-optovih-lcenzy-zrosla-na-46-u-2022-2023-rr
[398] https://www.nefterynok.info/novosti/z-pochatku-povnomasshtabnogo-vtorgnennya-zapracyuvali-104-novih-azs



As of September 2023, the total fleet of electric vehicles registered in Ukraine consists of 72,435 units: 70,316 passenger cars, 2,114 commercial vehicles, and 5 buses[399]. The number of publicly accessible charging stations for electric vehicles is approximately 3,200[400].

The dynamics of increasing the number of electric vehicles

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Electricity market

[399] https://eauto.org.ua/news/393-rekordna-kilkist-vzhivanih-elektromobiliv-z-za-kordonu-ta-import-novih-z-kitayu-shcho-kupuvali-u-veresni

[400] https://eauto.org.ua/news/375-ukrajinoyu-jizdit-na-20-tisyach-bilshe-elektromobiliv-nizh-u-polshchi

Among the key factors that will determine the situation in the electricity market of Ukraine and the potential for foreign trade after the cancellation or cessation of martial law, the following should be highlighted:

1) the scale of damage and destruction of generation and network facilities, which will determine the level, structure, flexibility of electricity supply, as well as the level of prices in the domestic market;

2) the degree of regulation of maximum prices (price caps) and other types of regulation in wholesale market segments;

3) the policy of bringing electricity prices for households to market-based levels, along with the gradual minimization of the Public Service Obligation (PSO) and increasing electricity supply in the competitive market;

4) deepening integration with EU markets (increasing cross-border capacity and integration format), in particular, by merging day-ahead markets and intraday markets (market coupling) with Eastern European countries (Poland, Romania, Slovakia, Hungary, and Moldova).

Taking into account factors of significant inflation, a gradual increase in the level of maximum prices (price caps) for electricity can be expected in wholesale market segments (DAM, IDM, and balancing market). The revision of price caps will result in a corresponding increase in wholesale electricity prices, including in the DAM segment, which is based on reference price quotations of the DAM. in the DAM segment, which is based on reference price quotations of the DAM.

Prices for households will remain at the current level until the end of the heating season 2023/2024. Their revision towards an increase during the state of war in Ukraine is unlikely but possible, provided a slight gradual increase over time (at least 2-3 years). The Cabinet of Ministers of Ukraine will adopt a Roadmap for the gradual liberalization of the gas and electricity market, outlining the necessary steps and corresponding timelines to be implemented after the end of the state of war. The Roadmap will be based on a technical analysis to understand the financial condition of the sector.

As part of deepening European market integration, Market Operator joined the NEMO Committee (NEMO Committee) as an observer for the work of the unified day-ahead coupling (SDAC) and Single Intraday Coupling (SIDC) European electricity spot market.[401] Observer status allows for technical preparation to integrate Ukraine's spot markets with European countries. To integrate spot markets, it is necessary to regulate a number of tax issues related to external trade in electricity at the legislative level, including value-added tax, excise tax, and import duties. Ukraine's full participation in the unified spot market of Eastern European countries will expand opportunities for international electricity trade, which will be limited by the available capacity of interstate networks, and the directions, time periods, and volume of trade will be determined based on the market conditions in the unified electricity spot markets.

[Completion is planned in the next stages of work on the NECP]

Natural gas market

Existing policies and measures in general do not allow achieving all the goals set for the "Internal Energy Market - Gas" dimension.

Firstly, restrictions on the export of both natural gas and biomethane significantly limit domestic production and distort prices in the domestic market. In the context of biomethane, this ban reduces the pressure from the sector to address other problems faced by biomethane producers (such as access to

[401] https://www.oree.com.ua/index.php/newsctr/n/17286

networks): in the case of export opening, these problems have become more urgent and their resolution has accelerated.

Secondly, the presence of price constraints (within the framework of the PSO provisions) for a large circle of consumers also does not encourage increased production, including through the development of new technologies and the search for synergies. In addition, such constraints, against the backdrop of reduced consumption due to the war, lead to weakened competition through a decrease in import volumes and importers, who usually compete with sellers of domestically produced gas.

Thirdly, without implementing additional measures, the conditions for operating in the domestic gas market are difficult and burdensome for new players. This concerns the uncertainty regarding the fate of assets and property of gas distribution system operators, insufficient level of their unbundling from supply and production interests, as well as the lack of guarantees for adequate financing, which significantly affects the functioning of the retail market. Dependent on this are also the issues of balancing rules and the absence of a comprehensive gas commercial metering system (against the background of insufficient consumer metering equipment), which, under current policies and measures, do not allow suppliers to independently manage their gas supply risks, especially for residential consumers. At the same time, the quality of market operation should be reflected in an increase in competitive offers that residential consumers have the opportunity to receive.

Existing policies and measures for the development of infrastructure in general are adequate to ensure sufficient connectivity of gas networks between Ukraine and the EU (in terms of planning and identifying market demand, creating new products). However, they are not sufficient for the proper adaptation of these networks to the requirements of the future energy market (in terms of optimization, integrated planning, transition to the use of new substances, balancing the interests of infrastructure operators and various gas producers, etc.).

In addition, existing policies and measures create positive incentives for the development of natural gas extraction, however, according to market participants, they may be insufficient to achieve the planned production volumes, let alone obtain additional gas volumes for export.

Energy use in transportation

[Completion is planned in the next stages of work on the NECP]

4.6. Dimension Research, Innovation and Competitiveness

i. Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at the Union or global level)

International innovation ratings are one of the qualitative sources of information about the level of innovation in the country. This applies, in particular, to innovations in the field of energy and climate technologies.

European Innovation Scorecard

[402]According to the European Innovation Scorecard (EIS) 2023, Ukraine belongs to the group of 'New Innovators' (Emerging Innovators) together with Bulgaria, Latvia, Poland, Romania, Slovakia, and Croatia, and demonstrates an efficiency index in innovative areas at 31% of the European Union average. EIS identifies the strengths of the Ukrainian economy as the export of intellectual services, environmentally friendly technologies, employment in the service sector, venture investments, and innovations without a significant R&D component. On the other hand, EIS considers product innovations,

[402] "European innovation scoreboard 2023." 06 Jul. 2023, https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/european-innovation-scoreboard-2023_en.

design, sales of innovative products, involvement in international scientific publications, and R&D expenditures in budget-funded sectors as relatively weak points of the Ukrainian economy.

Global Innovation Index

[403]According to the Global Innovation Index 2023, which is compiled annually by the World Intellectual Property Organization (WIPO), Ukraine ranked 55th among all analyzed countries and entered the top three most innovative countries in the group with below-average incomes, along with India and Vietnam. According to the authors of the Global Innovation Index, in Ukraine, the results of the work of innovative sectors exceed the investment volume in them (Output rank - 47 / Input rank - 78), which classifies Ukraine as an innovation outperformer.

Clean Energy Demonstration Projects Database (MEP)

Some relevant international rankings and databases do not contain data on Ukraine or innovative energy and climate projects being implemented in Ukraine. For example, one of the most well-known databases of innovative energy projects, the Clean Energy Demonstration Database of the International Energy Agency, does not mention any clean energy demonstration projects in Ukraine. At the same time, this database contains information about demonstration projects implemented in countries that are at the same level of innovation as Ukraine (according to the Global Innovation Index 2023), such as Vietnam and India.

The absence of innovative energy projects from Ukraine in this specific database may be due to the fact that our country became an associated member of the EEA quite recently (in 2021), as well as the fact that demonstration projects in the field of clean energy in Ukraine are financed and implemented mostly by private companies without government involvement.

Funding for research and innovation under international agreements

A significant part of research and innovation activities in Ukraine in areas related to the National Energy and Climate Plan is carried out within the framework of relevant agreements between Ukraine and the EU. The legal basis for this interaction and for bilateral cooperation and dialogue in the field of research and innovation is the Agreement on Scientific and Technological Cooperation between Ukraine and the European Union, extended in 2022. Under the Agreement, Ukraine has become a participant in the Horizon Europe and Euratom Research and Training Programme initiatives. Ukrainian players in the research and innovation sector can participate in them on equal terms with representatives of EU member states.[404]

The Horizon Europe initiative has a total budget of 95.5 billion euros for research grants for the years 2021-2027. A significant portion of the funding through Horizon Europe is directed towards research in the field of addressing climate and energy issues, including:

1. Horizon Europe Cluster 5: Climate, Energy and Mobility: This cluster is dedicated to combating climate change, developing sustainable energy solutions, and promoting mobility, encompassing various programs and funding opportunities for sectors such as clean energy, renewable energy, energy efficiency, climate adaptation, and more.
2. European Green Deal Call : As part of Horizon Europe , the European Green Deal Call is a program that funds projects that contribute to achieving the goals of the European Green Deal towards climate neutrality by 2050.
3. Mission Area on Climate-Neutral and Smart Cities : Horizon Europe also includes separate lines of action aimed at addressing societal challenges, including the achievement of climate

[403] "Global Innovation Index 2023: Innovation in the face of uncertainty - WIPO." https://www.wipo.int/global_innovation_index/en/2023/.

[404] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2022.095.01.0001.01.ENG&toc=OJ%3AL%3A2022%3A095%3ATOC

neutrality goals and "smart" cities. The objective of this line of action is to support research and innovative projects that contribute to the sustainable development of European cities.

In October 2023, a structural unit called "Horizon Europe Office in Ukraine" started operating in Ukraine based on the National Research Fund of Ukraine.[405] Also, as part of the aforementioned agreement, Ukraine gained access to research and innovation programs covering energy and climate topics:

- EIC4Ukraine[406] - a program of financial and advisory support for Ukrainian deep-tech startups with a total budget of 20 million euros.
- EU Mission for Climate Neutral and Smart Cities: a program with a budget of 5 million euros aimed at supporting partnerships with Ukrainian cities to support their efforts in reconstruction with consideration of the principles of climate neutrality
- Technologies for extraction and processing of critical raw materials (IA) - an initiative to support the construction of sustainable supply chains for critical materials, strengthening the EU's partnerships with countries rich in relevant minerals to ensure the security of industrial sectors and environmentally friendly transformation of extractive industries in partner countries.
- Excellence Hubs Initiative[407] - a mentoring program for the development of innovative components, to which Ukrainian participants are invited.

Several energy-related research projects have already been implemented within the Horizon Europe program:

- BIOMETHAVERSE[408]: two Ukrainian organizations, "Eco Energy" and the Bioenergy Association of Ukraine, are participating in this strategic project with a budget of 12 million euros, aimed at the development of biomethane and green hydrogen production technologies in Europe according to the Strategic Energy Technology Plan (SET plan).
- TWISMA project[409] aims to increase the level of scientific research and innovative capacity of the Institute for Scintillation Materials (Kharkiv) and its institutional partners within the Twinning programs, in order to develop innovative calorimeters based on advanced scintillation materials for use in the field of high-energy physics.

Other ratings and data sources

According to the World Bank, the share of gross value added in high- and medium-high-tech sectors in the total gross value added of the manufacturing industry in 2015 was 63% in Switzerland, 50.5% in the Czech Republic, 61.4% in Germany, 42.8% in Israel, 63.7% in South Korea, and 30.4% in Ukraine. According to the State Statistics Service, in Ukraine this share was 25.7% in 2016 (7.6% and 18.1% in high- and medium-high-tech sectors, respectively). If we compare the gross domestic product per capita in 2016 at current prices of the mentioned countries with the GDP per capita of Ukraine, according to the National Science Foundation of the USA, this ratio will be from 8.5 times to 36 times.

According to the World Economic Forum's Global Competitiveness Report 2020, Ukraine ranked 94th out of 142 surveyed countries[410]. According to the Innovation Index presented by Bloomberg in 2020, Ukraine ranked 56th out of 60 surveyed countries.[411]

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[405] Started his work Office program 'Horizon Europe ' in Ukraine based NFDU https:// nrfu .org. ua /news/ started - his - work - office - program - horizon - europe -in ukraine - based - nfdu /

[406] https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3533

[407] https://rea.ec.europa.eu/funding-and-grants/horizon-europe-widening-participation-and-spreading-excellence/excellence-hubs_en

[408] https://cordis.europa.eu/project/id/101084200

[409] https://cordis.europa.eu/project/id/101078960

[410] "Global Competitiveness Report 2020 | World Economic Forum." 16 Dec. 2020, https://www.weforum.org/publications/the-global-competitiveness-report-2020/competitiveness-rankings/

[411] https://www.bloomberg.com/news/articles/2020-01-18/germany-breaks-korea-s-six-year-streak-as-most-innovative-nation

2020 Bloomberg Innovation Index

2020 Rank	2019 Rank	YoY Change	Economy	Total Score	R&D Intensity	Manufacturing Value-added	Productivity	High-tech Density	Tertiary Efficiency	Researcher Concentration	Patent Activity
1	2	+1	Germany	**88.21**	8	4	18	3	26	11	3
2	1	-1	S. Korea	**88.16**	2	3	29	4	16	5	11
3	6	+3	Singapore	**87.01**	12	2	4	17	1	13	5
4	4	0	Switzerland	**85.67**	3	6	14	10	17	3	19
5	7	+2	Sweden	**85.50**	4	16	19	7	13	7	18
6	5	-1	Israel	**85.03**	1	31	15	5	32	2	7
7	3	-4	Finland	**84.00**	10	15	9	14	24	9	10
8	11	+3	Denmark	**83.22**	7	24	6	8	31	1	24
9	8	-1	U.S.	**83.17**	9	27	12	1	47	29	1
10	10	0	France	**82.75**	13	39	16	2	20	17	8
11	12	+1	Austria	**82.40**	6	11	13	19	12	8	16
12	9	-3	Japan	**82.31**	5	5	35	9	30	16	12
13	15	+2	Netherlands	**81.28**	17	28	17	6	36	12	14
14	13	-1	Belgium	**79.93**	11	25	11	13	49	14	13
15	16	+1	China	**78.80**	15	14	47	11	5	39	2
16	14	-2	Ireland	**78.65**	34	1	1	12	39	20	34
17	17	0	Norway	**76.93**	16	51	5	20	10	10	22
18	18	0	U.K.	**76.03**	21	44	27	15	6	19	21
19	21	+2	Italy	**75.76**	24	23	21	16	33	25	20
20	19	-1	Australia	**74.13**	18	55	8	21	15	31	6
21	31	+10	Slovenia	**73.93**	19	8	20	40	14	15	26
22	20	-2	Canada	**73.11**	22	35	26	26	35	21	9
23	23	0	Iceland	**71.56**	14	36	3	-	3	4	27
24	25	+1	Czech Rep.	**70.00**	20	7	25	42	38	18	31
25	22	-3	Poland	**69.98**	35	17	39	22	19	38	29
26	27	+1	Russia	**68.63**	33	37	43	30	25	23	25
27	26	-1	Malaysia	**68.28**	23	9	46	25	41	40	38
28	32	+4	Hungary	**68.24**	25	13	40	18	54	30	48
29	24	-5	New Zealand	**68.08**	30	42	33	28	46	22	23
30	35	+5	Greece	**66.30**	32	50	43	27	9	28	40
31	28	-3	Luxembourg	**65.41**	29	45	10	48	59	6	4
32	29	-3	Romania	**65.25**	56	19	32	23	27	47	30
33	30	-3	Spain	**65.11**	31	30	34	44	18	26	35
34	34	0	Portugal	**65.08**	26	34	42	43	4	24	47
35	33	-2	Turkey	**63.84**	37	20	49	38	28	44	17
36	36	0	Estonia	**62.79**	27	29	22	-	23	27	41
37	42	+5	Latvia	**62.03**	54	47	24	24	21	42	45
38	37	-1	Lithuania	**61.97**	38	21	28	-	2	33	53
39	38	-1	Hong Kong	**61.70**	43	59	7	31	37	32	15
40	40	0	Thailand	**60.36**	44	18	51	33	29	48	33
41	39	-2	Slovakia	**59.36**	39	10	38	51	53	35	46
42	41	-1	Bulgaria	**56.59**	45	33	48	47	44	37	50
43	44	+1	Croatia	**55.00**	40	40	37	49	42	41	56
44	46	+2	U.A.E.	**54.31**	36	32	30	50	50	57	49
45	50	+5	Argentina	**53.78**	52	43	50	45	11	45	55
46	45	-1	Brazil	**53.65**	28	56	54	32	51	50	43
47	43	-4	Malta	**53.48**	50	46	23	36	45	36	60
48	48	0	Cyprus	**51.56**	49	58	36	34	56	46	51
49	NR	-	Algeria	**51.24**	51	12	55	55	7	54	59
50	51	+1	S. Africa	**51.15**	41	53	53	39	57	58	28
51	58	+7	Chile	**49.58**	58	49	41	56	22	53	39
52	52	0	Tunisia	**49.56**	48	48	56	41	52	43	54
53	56	+3	Saudi Arabia	**49.54**	42	22	45	52	43	-	37
54	54	0	India	**49.33**	46	54	59	29	55	59	32
55	57	+2	Qatar	**48.81**	55	26	31	-	58	52	58
56	53	-3	Ukraine	**48.24**	57	57	57	35	48	49	36
57	60	+3	Vietnam	**47.64**	53	52	60	37	40	55	42
58	NR	-	Egypt	**46.29**	47	38	58	46	60	51	52
59	NR	-	Kazakhstan	**46.10**	60	41	52	53	8	56	44
60	NR	-	Macao	**46.09**	59	60	2	54	34	34	57

Sources: Bloomberg, International Labor Organization, International Monetary Fund, World Bank, Organisation for Economic Cooperation and Development, World Intellectual Property Organization, United Nations Educational, Scientific and Cultural Organization

Notes: 1. R&D intensity: Research and development expenditure, as % GDP 2. Manufacturing value-added: MVA, as % GDP and per capita ($PPP) 3. Productivity: GDP and GNI per employed person age 15+ and 3Y improvement 4. High-tech density: Number of domestically domiciled high-tech public companies -- such as aerospace and defense, biotechnology, hardware, software, semiconductors, Internet software and services, and renewable energy companies -- as % domestic publicly listed companies and as a share of world's total public high-tech companies 5. Tertiary efficiency: Total enrollment in tertiary education, regardless of age, as % the post-secondary cohort; gross graduation ratio of first-degree earners, share of labor force with advanced level of education; annual new science and engineering graduates as % total tertiary graduates and as % the labor force 6. Researcher concentration: Professionals, including postgraduate PhD students, engaged in R&D per population 7. Patent activity: Annual patent filings, patent grants and patent-in-force, per population and/or GDP; 3Y avg growth of filings abroad and filings growth, per world total growth

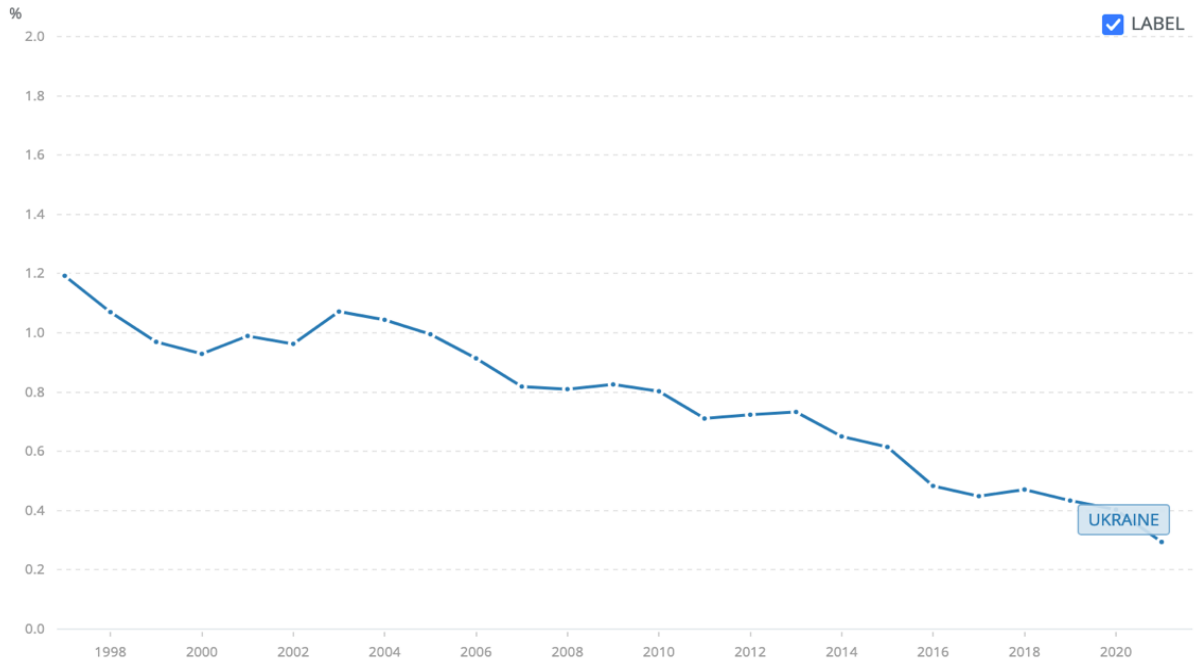
All metrics are equally weighted. Metrics consisting of multiple factors were rescaled for countries void of some but not all data points. Most recent data available used. Of the more than 200 economies evaluated, 105 had data available for at least six of the seven factors and were ranked; The top 60 and the metric ranks among them are displayed.

Bloomberg

ii. Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

Ukraine demonstrates relatively low levels of expenditure on research and innovation compared to other Eastern European countries. Yes, according to the World Bank, as of 2021, R&D expenditure in Ukraine amounted to only 0.29% of GDP.[412]

Ukraine's R&D expenditure as a percentage of GDP



Expenditure on research in the low-carbon technology and innovation sector in Ukraine is carried out by both public and private entities.

State institutions finance research and innovation primarily through specialized research institutions and grant funding from the National Research Fund. Among the key research institutions:

1. State

- Institute of Renewable Energy of the National Academy of Sciences of Ukraine
- Institute of Technical Thermophysics of the National Academy of Sciences of Ukraine
- Institute of Bioenergy Crops and Sugar Beets (National Academy of Agrarian Sciences)
- Institute of Electrodynamics of the National Academy of Sciences of Ukraine
- Department of Hydrogen Energy of the A.M. Pidhornyi Institute of Machine Building Problems of the National Academy of Sciences of Ukraine
- Center for Hydrogen Technologies of the Gas Institute of the National Academy of Sciences of Ukraine

[412] https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?contextual=region&end=2021&locations=UA&start=1997&view=chart

- Ivano-Frankivsk National Technical University of Oil and Gas

2. Private

- LLC "Scientific and Technical Center "Biomass" (approximately 15 researchers)
- MHP "Eco Energy" (approximately 20 researchers)

3. Separate university departments

- Educational and Scientific Institute of Energy, Automation and Energy Efficiency (NUBiP)
- Department of Renewable Energy Sources at NTU KPI
- Direction of RES Engineering at IFNTUOG

It is worth mentioning that there is a bachelor's degree program in the field of Electrical Engineering called "Renewable Energy Sources and Hydropower"[413]. This program is taught at the following universities[414]:

- NUVGP (Rivne)
- Vinnytsia National Technical University
- NTU "KhPI"
- KNUBA
- Lviv National University of Natural Resources and Environmental Sciences
- ZNU (Zaporizhia)

Assessing specific volumes of investments **by private companies** in research and innovation in the field of low-carbon technologies in Ukraine is complicated due to the non-disclosure of a significant amount of investments made by private companies. The latter can be divided into several groups with different business models and sources of capital.

Startups

These participants in the low-carbon innovation market in Ukraine focus on working in global markets, largely ignoring the Ukrainian market as too small in scale for their developments. The main source of funding for Ukrainian climate startups is:

- Angel/venture capital
- Own capital (bootstrapping)
- Grant funding

Clearly assessing investments in low-carbon technologies of Ukrainian startups is a challenging task due to the confidentiality of these investments and the contribution of companies and their founders, which is often not expressed in financial terms.

Corporate innovations

The corporate sector in Ukraine relies more on technologies that are much closer to the commercialization stage than those developed by startups or already commercially available globally, but are still very new to the Ukrainian market. The largest corporate innovators in Ukraine include:

[413] https://osvita.ua/consultations/spec-bach/64447/

[414] https://osvita.ua/consultations/vartist-navchannya/90604/

- DTEK - invests in energy storage technologies, smart grids, electromobility, has its own research centers and innovation program. DTEK became the first company to implement a 1 MW energy storage system at the currently occupied Zaporizhia TPP;
- MHP - invests in biomass processing technologies, hydrogen technologies, energy storage, electromobility, has its own research centers;
- KNESS - invests in research and development of smart grid technologies and energy storage systems. It was the first to obtain a license for commercial use of energy storage systems;
- RGC (now the main assets under the management of the Naftogaz group) conducted research on the possibility of transporting renewable gases (hydrogen and biomethane) through the distribution network built for natural gas;
- HALS Agro, VitAgro - invest in biomass processing technologies into renewable gas (biomethane), interested in Biomethane2grid projects;
- Aventston
- Atmosfera

It should be noted that a significant number of Ukrainian companies have started investing in the use of low-carbon technologies, primarily in the energy sector. The drivers of such investments are listed below:

- The need for businesses to ensure their own energy security and reduce costs. After the shelling of the energy infrastructure by Russian forces, many businesses faced a sharp problem of providing themselves with energy. Therefore, Ukrainian entrepreneurs started installing electricity generation and storage facilities "behind the meter";
- Efforts by exporters to minimize the financial impact of CBAM implementation on them. Ukrainian companies exporting their goods to EU countries calculate the financial consequences of CBAM implementation and invest in low-carbon production chains.

Number of patents in green economy subsectors in Ukraine[415]

	CPC (Спільна патентна класифікація)	Кількість патентів (ранній пріоритет => 2010)
Вітрова енергетика	**Y02E10/70-766**	**270**
Сонячна енергетика	**Y02E10/40-47**	**153**
Гідроенергетика	**Y02E10/20-28**	**112**
Фотовольтаїка	Y02E10/50-58	52
Паливо з відходів	Y02E50/30-346	50
Сільське господарство	Y02P60	42
Ядерна енергетика	Y02E30	32
Морська енергетика	Y02E10/30-38	30
Переробка біоорганічної фракції	y02w30/40-47	13
Біопаливо	Y02E50/10-18	12
Воднева енергетика	Y02E70 Y02E60/30+	5
Гібридні сонячні технології	Y02E10/60	5
Надпровідникові електричні елементи	*Y02E40/60-69*	*0*
Геотермальна енергетика	*Y02E10/10-18*	*0*

[415] I. Y. YEGOROV, PhD .econ . science, professor , corr. member of NAS of Ukraine V. Y. GRIGA, PhD .econ . science, senior researcher Y. O. RYZHKOVA, n. s ."PATENT ACTIVITY IN THE GREEN ECONOMY: CURRENT STATE AND PROBLEMS" SCIENCE, TECHNOLOGY, INNOVATION • 2021, No 3 http:// nti . ukrintei . ua /wp-content/uploads/2022/11/%D0%84%D0%B3%D0%BE%D1%80%D0%BE%D0%B2_3-2021-1.pdf .

iii. Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

The cost of electricity for Ukrainian consumers is determined according to the categories to which certain consumers belong. Tariffs for electricity for individuals are subsidized through the PSO mechanism (implemented through state enterprises) by increased tariffs for consumers belonging to legal entities.

Key components of tariffs for Ukrainian consumers:

- Cost of electricity on the centralized electricity market (floating)
- Tariff for electricity transmission through high-voltage networks of "Ukrenergo" (set at 0.582 UAH per kWh);
- Tariff for electricity distribution through low-voltage networks of DSO (approved by the National Commission for State Regulation of Energy and Public Utilities at 1.753 UAH per kWh);
- Tariff for supplier services (contractual - for legal entities, fixed for residential consumers);
- Taxes (VAT, excise).

[Completion is planned in the next stages of work on the NECP]

iv. Description of energy subsidies, including for fossil fuels

In Ukraine, there are several types of direct and indirect subsidies in regulated state energy markets (gas, electricity, centralized heating). The system of energy subsidies in Ukraine is primarily aimed at protecting vulnerable households, which can be characterized as energy poor. However, the main beneficiaries of this system are wealthy citizens. This is a result of the fact that the system of energy subsidies in these markets consists of several levels:

1. Different tariffs for households and legal entities. There are preferential prices/tariffs for households (residential consumers) and market prices for legal entities in the gas, centralized heating, and electricity markets. Separate preferential prices/tariffs also exist for religious organizations;
2. Targeted subsidies for vulnerable consumers allow providing financial assistance to households whose utility expenses exceed the government-set percentage of their monthly income.

The typical mechanisms that allow setting prices/tariffs for residential consumers (households) at a level lower than economically justified are as follows:

- Cross-subsidization through tariffs of non-residential consumers within the mechanism of imposing special obligations (PSO) on certain market participants to ensure public interests - for example, in the electricity market;
- Compensation through refinancing of state-owned companies involved in the PSO from the state budget (for example, in the gas market);
- Support for heat producers from local budgets.

Terminological remarks

It should be noted that there are several interpretations of subsidies in the regulatory framework of Ukraine. A number of different terms are used in legislation on budget policy and state support. These terms can be compared with the components of broader definitions used by international organizations. A direct and rather narrow definition of subsidies is provided in the Instructions for the Application of

Economic Classification of Budget Expenditures, approved by the order of the Ministry of Finance of Ukraine No. 333 dated March 12, 2012. According to the instructions, subsidies are defined as 'all non-repayable current payments to enterprises that do not involve compensation in the form of specifically stipulated payments or goods and services in exchange for payments made, as well as expenses related to the reimbursement of losses of state-owned enterprises'.[416]

The budget legislation of Ukraine includes a number of subsidies, grants, and other transfers that are not considered subsidies according to national legislation, but are actually subsidies according to international definitions. In addition, the term " subsidy " does not apply to tax benefits, but the government of Ukraine considers certain cases of tax benefits as revenue foregone, and the Ministry of Finance assesses these losses for the budget.

Since May 16, 2008, Ukraine has been a member of the World Trade Organization (WTO), so the definition of "subsidy" provided in the Agreement on Subsidies and Countervailing Measures (SCM Agreement) automatically applies to state regulation in Ukraine.[417]

> *1.1 For the purposes of this Agreement, a subsidy is considered to be:*
>
> *a) 1) a financial contribution provided on the territory of a WTO member by the government or any governmental body (referred to as the government in this Agreement), when:*
>
> *i) the government practices direct transfer of funds (such as subsidies, loans, or capital injections), potential direct transfer of funds or obligations (such as loan guarantees);*
>
> *ii) the government foregoes or does not collect its own revenues (such as fiscal incentives like tax credits)[1];*
>
> *iii) the government provides goods and services, except for general infrastructure, or purchases goods or services;*
>
> *iv) the government makes payments to the financing mechanism or instructs or orders a private institution to perform one or more functions mentioned above in points "i" and "iii", which would normally be performed by the government, and the practice of their application by such institution does not differ significantly from the practice that the government would usually follow;*
>
> *or*
>
> *a) 2) support of income or prices in any form within the meaning of Article XVI of GATT 1994; as well as*
>
> *b) benefit provided in this way.*
>
> *1.2 Subsidy, as defined in paragraph 1, falls under the provisions of Part II, or Part III, or V only if such subsidy is targeted in accordance with the provisions of Article 2.*

Subsidies in the gas market

Subsidies for the natural gas market are received by all households (residential consumers) regardless of their income level through special commercial offers that are lower than the economically justified level (cost of extraction or purchase of natural gas on the market and the necessary services for its delivery to the consumer). These tariffs are ensured through the PSO mechanism (Cabinet of Ministers resolutions No. 812 of July 19, 2022, No. 222 of March 6, 2022), entrusted to NJSC "Naftogaz of Ukraine" and

[416] Instructions on the application of economic expenditure classification in the budget https://zakon.rada.gov.ua/go/z0456-12

[417] Agreement on subsidies and compensatory measures https://zakon.rada.gov.ua/go/981_015.

group enterprises (including through LLC "Gas Supply Company "Naftogaz Trading"). For more information on the level of prices and other consumers covered by the PSO, see section 4.5.3.i.[418][419]

The specified regulations define mechanisms for ensuring subsidized prices for gas used by households (residential consumers):

- directly (in the form of gas physically delivered to households);
- through CHP plants that generate heat and hot water for residential consumers.

According to the Law "On the Natural Gas Market," a market participant who has special obligations is entitled to compensation for economically justified expenses (excluding income received during the PSO) taking into account the permissible level of profit. The calculation of such compensation is carried out in accordance with the procedure approved by the Cabinet of Ministers' resolution of December 3, 2020, No. 1194.[420]

Centralized heating sector

Centralized supply of thermal energy is also characterized by subsidized tariffs for heating and hot water supply for residential consumers. This subsidy is implemented through a combination of subsidized gas prices for CHP plants and support for CHP plants from local budgets.

This system has formed as a result of the combination of two factors:

- Implementation of the PSO mechanism in the gas market, which ensured regulated prices for gas supplied by Naftogaz Trading to district heating enterprises for various needs;
- Transfer of powers for calculation and approval of tariffs for heating and hot water supply from the NEURC to local self-government authorities.

Tariffs for heating and hot water supply for the population in different cities differ significantly due to the economic parameters of CHP enterprises and the level of their budget support from local budgets.

Thus, in the field of centralized heating, there is a dual system of subsidization - at the state and local levels. Tariffs for heating, approved by local councils, often do not meet the requirements of the Law "On Heat Supply", which requires tariffs to be no lower than the cost price. At the same time, during the period of martial law in Ukraine and 6 months after its completion, Law No. 2479-IX of July 29, 2022 prohibits the increase of tariffs for all categories of consumers for natural gas distribution services, heat energy (its production, transportation and supply), heat energy supply services, and hot water supply. The increase of tariffs for all categories of consumers for natural gas distribution services, heat energy (its production, transportation and supply), heat energy supply services, and hot water supply is prohibited during the period of martial law in Ukraine and 6 months after its completion, according to Law No. 2479-IX of July 29, 2022.[421]

It should be noted separately that subsidizing the gas tariff negatively affects the production of heat from renewable energy sources, in particular - from biomass. According to the legislation, there is a simplified

[418]Resolution No. 812 of July 19, 2022On the approval of the Regulation on imposing special obligations on natural gas market entities to ensure public interests in the functioning of the natural gas market regarding the peculiarities of natural gas supply to heat energy producers and budgetary institutions" https://zakon.rada.gov.ua/laws/show/812-2022-п#Text

[419]" On the approval of the Regulation on the imposition of special obligations on natural gas market participants to ensure public interests in the functioning of the natural gas market https://zakon.rada.gov.ua/go/222-2022-%D0%BF

[420] https://zakon.rada.gov.ua/laws/show/1194-2020-%D0%BF#n10

[421] https://zakon.rada.gov.ua/laws/show/2479-20#Text

mechanism for approving tariffs for heat produced from biomass, at a level of 90% of the cost of heat produced from gas. Since the state subsidizes the price of natural gas within the framework of the Public Service Obligation, the production of thermal energy from biomass for the needs of the population is not economically viable, and this leads to the following consequences:

- Investors refuse to finance projects that involve the use of biomass for heat supply to the population. Instead, they invest in projects that provide heat to legal entities.
- CHP plants that use biomass for heat generation are either shutting down or their operation is subsidized from local budgets.

Subsidies in the electricity market

The key regulatory acts that determine the mechanisms of subsidizing in the electricity market are Resolution of the Cabinet of Ministers of Ukraine No. 483 "On Approval of the Regulation on Imposing Special Obligations on Market Participants of the Electricity Market to Ensure Public Interests in the Functioning of the Electricity Market"[422] and the Law of Ukraine "On the Electricity Market"[423]. See also PM_IME_WEM_12 Regulation of retail prices for households.

Among the mechanisms of price subsidization implemented through the PSO mechanism and/or involving the redistribution of funds in the market:

- Price subsidization for households;
- Subsidization of electricity production from RES through the fee-in tariff.

The State Enterprise "Guaranteed Buyer", established in June 2019 in accordance with the Cabinet of Ministers' resolution of April 17, 2019, is responsible for conducting calculations under the "green" tariff and ensuring the functioning of the PSO mechanism. No. 324 to perform the functions of a guaranteed buyer of electricity from renewable sources.

In order to provide electricity to the population at prices lower than market prices, Energoatom and Ukrhydroenergo compensate for the losses incurred by universal service providers (USPs) when supplying electricity to the population. Considering the significant costs of state-owned generating companies (Energoatom estimated costs for PSO implementation at UAH 128 billion in 2023[424], Ukrhydroenergo - UAH 23.67 billion[425]), this cannibalizes development and investment programs, such as accumulating resources for future decommissioning of nuclear power units.

Transformation of subsidies in the energy sector

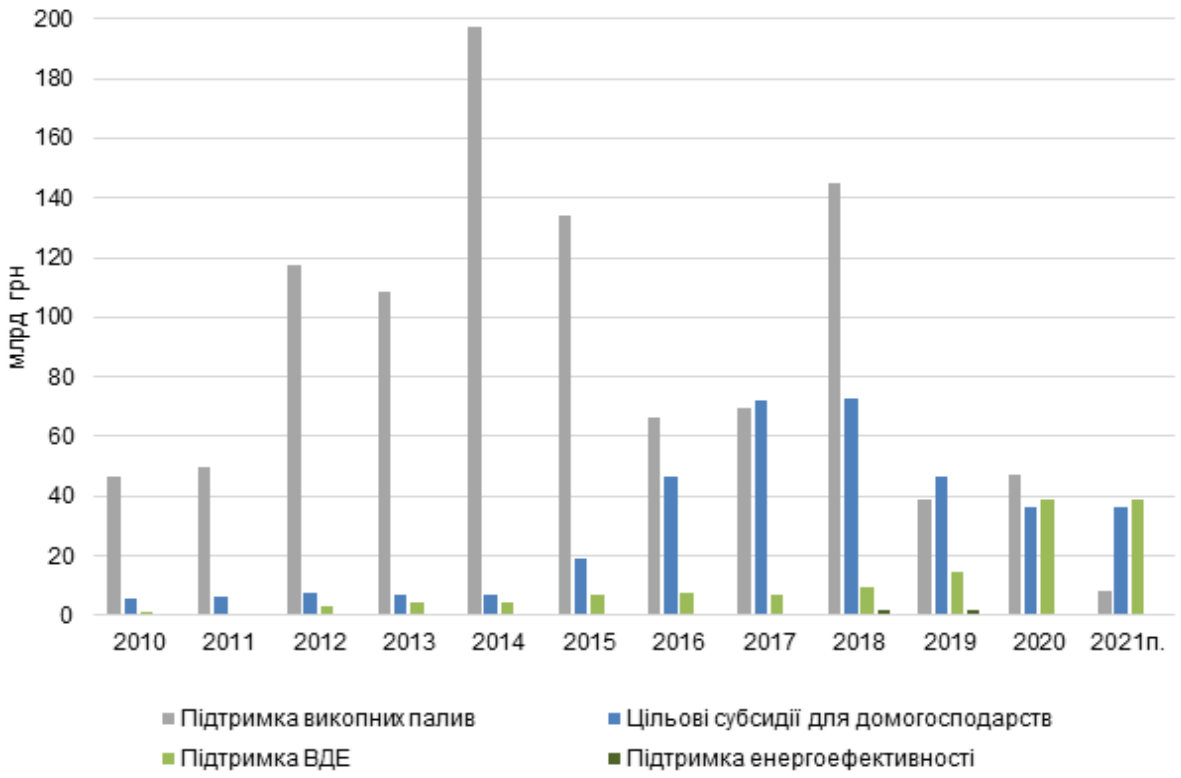
Since the publication of the first comprehensive analysis of subsidies for fossil fuels in Ukraine (OECD, 2018), the landscape of energy subsidies has changed significantly. The graph below illustrates the development of state support for the production and consumption of fossil fuels, targeted subsidies to households, support for renewable energy sources, and energy efficiency.

[422]"Resolution of June 5, 2019No. 483 "On the approval of the Regulation on the imposition of special obligations on participants in the electricity market to ensure public interests in the functioning of the electricity market" https://zakon.rada.gov.ua/go/483-2019-%D0%BF

[423]Law of Ukraine "On the electricity market" https://zakon.rada.gov.ua/go/2019-19.

[424] https://www.energoatom.com.ua/o-1201241.html

[425] https://uhe.gov.ua/media_tsentr/novyny/ihor-syrota-ukrhidroenerho-povnistyu-vykonalo-zobovyazannya-z-pso-za-2023-rik



The majority of the energy used for household consumption also falls into the category of 'fossil fuels'. However, targeted subsidies for households are shown as a separate group, as this type of support is more effective and is considered an acceptable form of social assistance for low-income households.

During the period 2014-2021 There has been a clear trend of phasing out 'general' subsidies for fossil fuels, while the amount of targeted subsidies and benefits for households has been increased to provide support for the poor during the increase in utility tariffs. State support for fossil fuels reached its peak at 197 billion UAH in 2014, although the level in 2018 was also very high (almost 145 billion UAH), mainly due to cross-subsidies in the electricity sector and the need for domestic gas to be sold at regulated, lower-than-market prices under the PSO regime.[426]

In 2017 and 2019, the volume of targeted subsidies for households slightly increased the value of 'general' subsidies for fossil fuels. However, it should be noted that subsidy estimates for certain years should not be compared to each other, as in certain years, municipal service providers and Naftogaz received compensation for providing services at prices below market prices for several years. For example, in 2020, Naftogaz received compensation for the difference between the price of imported natural gas and its sale for heat production for households during the period of 2015-2019.

As the production of electricity from renewable energy sources is rapidly increasing, the amount of support for RES has increased more than 11 times from 2012 to 39 billion UAH in 2020. At the same time, state support for energy efficiency remains minimal compared to subsidies in other sectors. In 2018 and 2019, about 1.9 billion and 1.8 billion UAH were allocated from the budget, respectively, to support the Energy Efficiency Fund and the energy efficiency program 'warm loans'. In the following years, funding for these programs sharply decreased, partly due to the COVID-19 pandemic.

[426] Prepared based on previous estimates of subsidies for fossil fuels in Eastern Partnership countries, published in the OECD report (2018), data from the Ministry of Finance of Ukraine (2020, 2018, 2017, 2014, 2013, 2010), NEURC (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), State Treasury Service of Ukraine (2021).

Table 4.14. State support for production and consumption of fossil fuels in Ukraine, million UAH[427]

Program	Support mechanism	Indicator [428]	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Restructuring of coal and peat industries	direct transfer	PSE	1 059	1 597	1 078	1 178	355	206	107	244	n.a.[429]	3 269	5 039	3 125
Phase-out of unprofitable coal and peat extraction enterprises	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	281	128	265	1 032
Rescue measures at coal mining enterprises	direct transfer	PSE	275	378.6	414	430	288	234	263	288	290	289	290	340
Prevention and elimination of emergencies in coal mines	direct transfer	PSE	n.a.	1.1	n.a.	0.4	n.a.	n.a.	n.a.	10	82	n.a.	n.a.	n.a.
Elimination of emergency situation on the main gas pipeline 'Luhansk - Lysychansk - Rubizhne'	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	35	n.a.	n.a.	n.a.	n.a.
Elimination of emergency situation at the Vuhlehirska Thermal Power Plant	direct transfer	PSE	n.a.	n.a.	n.a.	111	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Partial compensation of costs for the production of finished coal products	direct transfer	PSE	5 807	6 710	10 172	13 302	8 705	1 212	1 373	2 122	1 072	n.a.	n.a.	n.a.
Improvement of safety measures at coal mining enterprises	direct transfer	PSE	70	134	260	197	3	n.a.	n.a.	99	n.a.	n.a.	n.a.	n.a.
Construction and technical re-equipment of coal and peat extraction enterprises	direct transfer	PSE	337	1 719	1 293	343	54	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Replenishment of circulating capital or increase of statutory funds of coal mines to repay wage arrears	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	200	500	n.a.	n.a.	n.a.	n.a.	n.a.
Repayment of debt for electricity by state coal mining enterprises	direct transfer	PSE	140	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	445	n.a.	n.a.
State support for the construction of mine No. 10 "Novovolynska"	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	146	50	70	35	62	n.a.	n.a.
Measures to support domestic coal production and reform the coal industry	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 671	n.a.	n.a.	n.a.
State support for PJSC "Main Gas Pipelines of Ukraine"	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.13	20	n.a.	n.a.	n.a.
Compensation by NJSC "Naftogaz of Ukraine" for the difference between the purchase prices of imported natural gas and its sale for heat production for households	direct transfer	CSE	3 424	n.a.	3 900	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Allocation of funds from the budget to "Smilakomunteploenergo" to prevent an emergency situation in the city of Smila due to the company's financial inability to pay for natural gas	direct transfer	CSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	15	n.a.	n.a.
Subsidy from the state budget to local budgets to compensate for the difference between actual expenses for communal services and established tariffs	direct transfer	CSE	n.a.	2 857	14 443	2 052	12423	4 685	n.a.	1 798	978	n.a.	n.a.	n.a.
Subsidy from the state budget to local budgets for providing benefits and housing subsidies for payment of communal services to low-income households	direct transfer	CSE	5 131	6 069	6 718	6 046	6 173	17 995	44 120	69 740	69 977	21 561	n.a.	n.a.
Subsidy from the state budget to local budgets for providing benefits and housing subsidies for the purchase of solid and liquid household fuel and liquefied gas for households with low incomes	direct transfer	CSE	496	557	738	733	715	1 121	2 280	2 633	2 694	1 820	n.a.	n.a.

[427] Prepared based on previous estimates of subsidies for fossil fuels in Eastern Partnership countries, published in the OECD report (2018), data from the Ministry of Finance of Ukraine (2020, 2018, 2017, 2014, 2013, 2010), NEURC (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), State Treasury Service of Ukraine (2021).

[428] RES - support for energy producers, ESC - support for energy consumers

[429] n.a.: not applicable, -: no data available, p. - preliminary data

Direct payments of benefits and housing subsidies to households to partially cover utility services, solid and liquid fuels, and expenses for liquefied gas	direct transfer	CSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	23 267	36 357	35 208
Repayment of wage arrears to employees of PJSC "Mine "Nadiya"	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	51	n.a.
Compensation to NJSC "Naftogaz of Ukraine" for supplying imported gas to consumers of the Public Service Obligation	direct transfer	CSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	32 205	n.a.
Ensuring the acquisition of LLC "Operator of the Gas Transmission System of Ukraine" by JSC "Main Gas Pipelines of Ukraine" from PJSC "Ukrtransgaz"	direct transfer	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	3 851	n.a.
Compensation to consumers using electric heating for the increase in electricity prices	direct transfer	CSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 400
Total direct transfers			**16 739.1**	**20 023.3**	**39 016.7**	**24 393.3**	**28 716.0**	**25 799.0**	**48 692.6**	**77 039.6**	**77 100.7**	**50 856.3**	**78 057.9**	**41 105.2**
Deduction of corporate income tax for energy companies' expenses planned within investment programs	Tax exemption	PSE	n.a.	263	975	761	957	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Tax credit from corporate income tax for the amount of excise tax levied on heavy distillates (gasoline) used in vehicles	Tax exemption	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	735	639	n.a.	n.a.
Deduction of corporate income tax for expenses related to exploration and organization of oil and gas fields	Tax exemption	PSE	-	23	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Temporary VAT exemption for operations with natural gas supplied to the customs territory of Ukraine by NJSC Naftogaz of Ukraine	Tax exemption	PSE	n.a.	575	1 464	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Temporary VAT exemption for the supply of coal and/or its enrichment products on the customs territory of Ukraine	Tax exemption	PSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2 116	2 609	3 042	2 808	1 333	1 431
Exemption from excise tax for operations with the sale of natural gas on specialized auctions for household needs	Tax exemption	CSE	n.a.	13	69	78	78	14	14	109	65	57	n.a.	n.a.
Reduction of the excise tax rate for operations with the sale of aviation gasoline and fuel for jet engines produced in Ukraine, as well as imported	Tax exemption	CSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5 191	2 235	2 398
Total tax benefits			**-**	**873.9**	**2 507.5**	**838.8**	**1 035.6**	**14.1**	**2 129.8**	**2 717.5**	**3 841.4**	**8 694.7**	**3 568.4**	**3 828.9**
Requirements for domestic gas producers (more than 50% state-owned) regarding the sale of gas for household needs at regulated tariffs	indirect transfer	CSE	-	-	43 168	44 493	36 679	53 893	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Requirements for domestic gas producers to sell gas at regulated prices under the PSO regime	indirect transfer	CSE	n.a.	n.a.	n.a.	n.a.	n.a.	-	16404.7	25529.1	91092.72	n.a.	1683.45	n.a.
Cross-subsidization in the electricity sector	indirect transfer	CSE	23 326	28 048	34 467	37 557	40 825	43 848	45 466	36 595	45 344	26 053	n.a.	n.a.
Total indirect transfers		CSE	**23 326.4**	**28 048.1**	**77 634.6**	**82 050.1**	**77 503.3**	**97 741.0**	**61 870.7**	**62 124.1**	**136 436.7**	**26 052.5**	**1 683.5**	n.a.
Increase in the authorized capital of NJSC "Naftogaz" through the issuance of government bonds to cover its deficit	transfer of risk to the government	CSE	12 400	7 500	6 000	8 000	96 610	29 700	n.a	n.a	n.a	n.a	n.a	n.a
Total transfer of government risk			12 400	7 500	6 000	8 000	96 610	29 700	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total support mechanisms			**2 465.5**	**56 445.4**	**125 158.8**	**115 282.3**	**203 864.5**	**153 254.2**	**112 693.1**	**141 881.2**	**217 378.8**	**85 603.5**	**83 309.7**	**44 934.0**

Table 4.15. State support for energy efficiency and electricity production from renewable energy sources, million UAH[430]

Program	Support mechanism	Indicator [431]	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Program of cheaper loans	direct transfer	CSE	n.a..[432]	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Energy efficiency program	direct transfer	CSE	11	282	57	n.a.	2	302	861	818	418	546	384	150
Energy Efficiency Fund	direct transfer	CSE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 500	1 219	n.a.	100
Total support for energy efficiency			**11**	**283**	**57**	n.a.	**2**	**302**	**861**	**818**	**1 918**	**1 765**	**384**	**250**
Exemption from corporate income tax for electricity producers who exclusively generate electricity from renewable energy sources	Tax exemption	PSE	-	-	468	450	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Exemption from corporate income tax for biofuel producers' income from biofuel sales	Tax exemption	PSE	120	-	15	15	15	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Exemption from corporate income tax for combined heat and power plants using biofuel and thermal energy using biofuel	Tax exemption	PSE	-	-	548	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Zero excise tax rate on bioethanol used for biofuel production and bioethanol and gasoline fuel blends	Tax exemption	PSE	1 153	-	752	788	183	776	1 663	532	569	-	-	-
Exemption from VAT for materials, equipment, and equipment for the production of renewable energy sources, production of electricity from renewable sources, as well as equipment for energy services, if identical goods are not produced in Ukraine	Tax exemption	PSE	-	-	-	-	-	-	-	-	-	-	-	-
Exemption from import duty for materials, equipment, and equipment for the production of renewable energy sources, production of electricity from renewable sources, as well as energy-saving equipment, if identical goods are not produced in Ukraine	Tax exemption	PSE	-	64	-	-	-	-	-	-	-	-	-	-
Total tax benefits			**1 273**	**64**	**1 783**	**1 253**	**198**	**776**	**1 663**	**532**	**569**	**-**	**-**	**-**
The 'green' tariff for electricity producers from renewable sources (wind, solar energy, biomass, small hydropower, etc.)	indirect transfer	PSE	119	271	700	3 029	4 322	5 973	5 946	6 624	9 136	14 915	39 033	-
Total support for electricity producers from RES			**1 392**	**336**	**3 484**	**4 282**	**4 520**	**6 748**	**7 610**	**7 156**	**9 706**	**14 915**	**39 033**	**-**
Total support for energy efficiency and RES			**1 402**	**618**	**3 540**	**4 282**	**4 523**	**7 050**	**8 471**	**7 974**	**11 624**	**16 680**	**39 416**	**250**

[430] Prepared based on previous estimates of subsidies for fossil fuels in Eastern Partnership countries published in the OECD report (2018), data from the Ministry of Finance of Ukraine (2020, 2018, 2017, 2014, 2013, 2010), NEURC (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), State Treasury Service of Ukraine (2021).

[431] PSE - producer support estimate, CSE - consumer support estimate

[432] n.a.: not applicable, -: no data available, p. - preliminary data

5. Impact assessment of planned policies and measures

5.1. Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals, including comparison to projections with existing policies and measures (as described in section 4).

i. Projections of the development of the energy system and GHG emissions and removals as well as, where relevant of emissions of air pollutants in accordance with Directive (EU) 2016/2284 under the planned policies and measures at least until ten years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant Union policies and measures.

The table below presents the main modeling and forecasting results obtained using the TIMES-Ukraine model and other modeling tools regarding GHG emissions in Ukraine under the scenario with additional (planned) policies and measures (WAM).

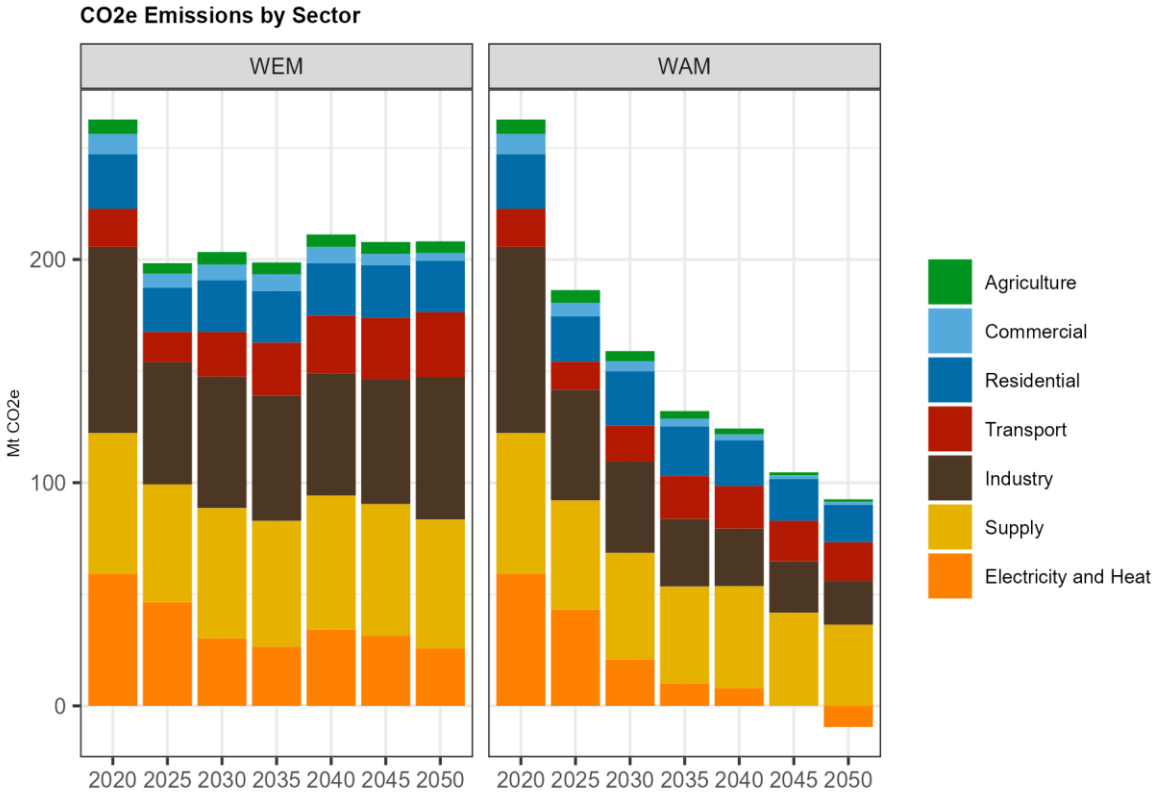
Table 5.1. Key modeling results of GHG emissions in Ukraine in the WAM scenario

Scenario with additional policies and measures (WAM)									
	1990	2015	2020	2025	2030	2035	2040	2045	2050
Total GHG emissions, Mt CO2-eq.	**911**	**334**	**318**	**?**	**?**	**?**	**?**	**?**	**?**
Energy, industrial processes and product use sectors	***844***	***267***	***264***	***186***	***159***	***132***	***124***	***102***	***77***
Agriculture	***87***	***39***	***42***	***37***	***41***	***44***	***45***	***47***	***48***
Land use, land-use change and forestry	***-31***	***20***	***-0,4***	***?***	***?***	***?***	***?***	***?***	***?***
Waste sector	***12***	***13***	***12***	***11***	***10***	***8***	***7***	***6***	***5***
Share of GHG emissions compared to 1990 level, %	**100**	**37**	**35**	**?**	**?**	**?**	**?**	**?**	**?**
Energy, industrial processes and product use sectors	*100*	*32*	*31*	*22*	*19*	*16*	*15*	*12*	*9*
Agriculture	*100*	*45*	*48*	*42*	*47*	*50*	*52*	*54*	*55*
Land use, land-use change and forestry	*100*	*265*	*199*	*?*	*?*	*?*	*?*	*?*	*?*
Waste sector	*100*	*101*	*99*	*88*	*78*	*67*	*58*	*50*	*41*
GHG emissions per capita									
t CO2-eq. per capita	17	7	8	?	?	?	?	?	?
Carbon intensity GDP									
t CO2-eq./ 1 000 USD GDP (in PPP)	**1,6**	**1,0**	**0,9**	**?**	**?**	**?**	**?**	**?**	**?**

Greenhouse gas emissions in the of 'Energy' and 'Industrial processes and product use' sectors

The forecast of greenhouse gas emissions until 2050 in the "Energy" and "Industrial processes and product use" (in terms of IPCC) sectors with two scenarios WEM and WAM using the TIMES-Ukraine model is shown below in the figure.

Fig. 5.1. Greenhouse gas emissions in the "Energy" and "Industrial processes and product use" sectors according to the WEM and WAM scenarios, Mt CO2-eq.



The modeling results show that even rapid economic recovery processes in Ukraine's post-war period, but under the approach of "build back better", implementation of energy efficiency measures, expansion of renewable energy use, other decarbonization measures and technological modernization of the energy sector can occur without increasing GHG emissions in the "Energy" and "Industrial processes and product use" sectors.

In the WEM scenario, GHG emissions in the “Energy” and “Industrial processes and product use” sectors could be reduced by almost 23% by 2030 compared to 2020, after which, without additional measures, their stabilization may occur by 2050 with economic growth. At the same time, the implementation of additional planned measures (WAM scenario) could lead to even further reduction of GHG emissions by 2030 (-39% compared to 2020) and further significant reduction by 2050 (-71% compared to 2020). Moreover, the WAM scenario allows for the possibility of achieving net-zero emissions in the electricity and heat production sector before 2050, achieving negative CO2 emissions through a combination of bioenergy technologies and carbon capture and storage (CCS) technologies.

Greenhouse gas emissions in the agriculture sector

The WAM scenario envisages the scaling up of a range of technologies and approaches in agriculture (see Table 5.2) that will contribute to the reduction of greenhouse gas emissions.

Table 5.2. Potential impact of policies on greenhouse gas emissions reduction in agriculture

Policy	Quantitative targets	Investment needs, million USD	Reduction of greenhouse gas emissions, t CO2-eq
Promoting the spread of minimum tillage technologies	5 million hectares	311	3000000
Promoting organic farming	2 million hectares	-	2000000
Use of nitrogen fertilizers with slow or controlled release of nutrients	-	355	300000
Use of information and communication technologies in crop production	-	4377	350000
Use of food additives that will contribute to reducing GHG emissions from enteric fermentation of livestock	-	1382	1500000

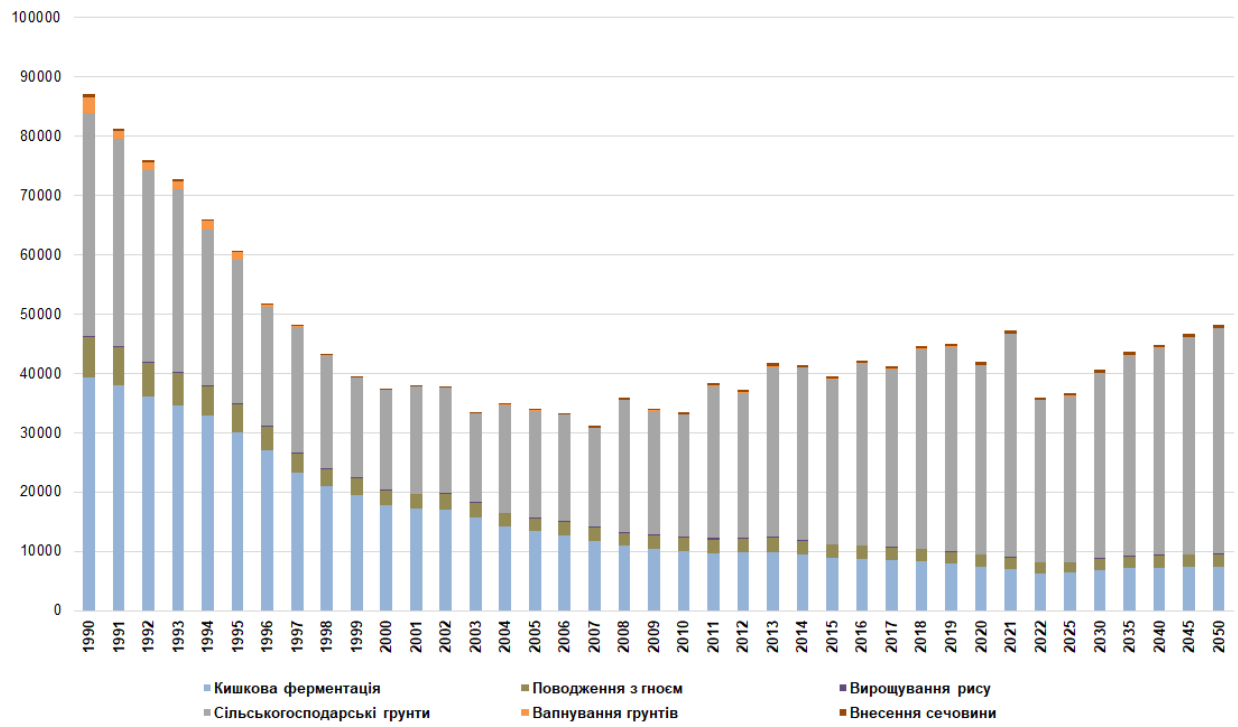
Taking into account the historical trend of agricultural development, as well as the uncertainty regarding the end of the war, it can be assumed that the spread of these practices and technologies will be low (Table 5.3). However, even partial utilization of their potential will have an impact on the reduction of GHG emissions in agriculture.

Table 5.3. Reduction of greenhouse gas emissions through the implementation of policies, t CO2-eq

Policy	2025	2030	2035	2040	2045	2050
Promoting the spread of minimum tillage technologies	315000	2100000	2173500	2205000	2272238	2327250
Promoting organic farming	186000	1240000	1289000	1310000	1340250	1365000
Use of nitrogen fertilizers with slow or controlled release of nutrients	31500	210000	217350	220500	227224	232725
Use of information and communication technologies in crop production	5250	35000	84000	105000	143500	175000
Use of food additives that will contribute to reducing GHG emissions from enteric fermentation of livestock	22500	150000	360000	450000	615000	750000

Thus, GHG emissions (not related to energy use) in agriculture under the WAM scenario in 2030, 2040, and 2050 will amount to 40631.1 thousand. t CO2-eq, 44,888.1 thousand t CO2-eq and 48,242.3 thousand t CO2-eq. Compared to the base year of 1990, forecasted GHG emissions under the WAM scenario in 2030, 3040, and 2050 will amount to 46.6%, 51.5%, and 55.4% respectively.

Fig. 5.2. Forecast of emissions from agricultural activities in Ukraine according to the WAM scenario, thousand tons of CO2-eq



Greenhouse gas emissions in the Waste sector

The WAM scenario is based on the successful implementation of policies and measures (and their intensity of implementation) of the WEM scenario. The WAM scenario takes into account the strict compliance with the recently adopted Waste Management Law in 2023, and the full implementation of the National Waste Management Plan of Ukraine until 2033[433] and the Action Plan of the National Waste Management Plan of Ukraine until 2033[434], which is planned to be approved in 2024. Furthermore, the WAM scenario envisages a reduction in the share of municipal solid waste landfilling to 30% by 2033 and to 20% by 2050; an increase in the share of landfill gas utilization to 23% by 2030 and 36% by 2050; the construction of new waste composting facilities with low specific emissions of CH4 and N2O; specific emissions of N2O caused by protein consumption by the population of Ukraine will reach typical values for EU countries; methane utilization from wastewater treatment will reach 41% by 2030 and 70% by 2050; specific water consumption per unit of GDP will decrease to 0.5 by 2050 compared to 2015. The full implementation of the WAM scenario will require the creation of an efficient modern wastewater management system, including sludge management and infrastructure for sludge treatment. The methodology for developing the WAM scenario, assessing GHG emissions and capital investments in the sector, is provided in Appendix 3.

[433] https://mepr.gov.ua/wp-content/uploads/2023/12/proyekt-Natsionalnyj-plan-upravlinnya-vidhodamy-23.11-002.docx
[434] https://mepr.gov.ua/wp-content/uploads/2023/12/Dodatok-1.-Plan-zahodiv-NPUV_23.11-1.docx

The list of key waste management policies within the WAM scenario is presented in Table 5.4. The implementation of these policies in the municipal solid waste management (MSW) sector is detailed in the draft of the National Waste Management Plan of Ukraine until 2033 and the draft of the Action Plan of the National Waste Management Plan of Ukraine until 2033.

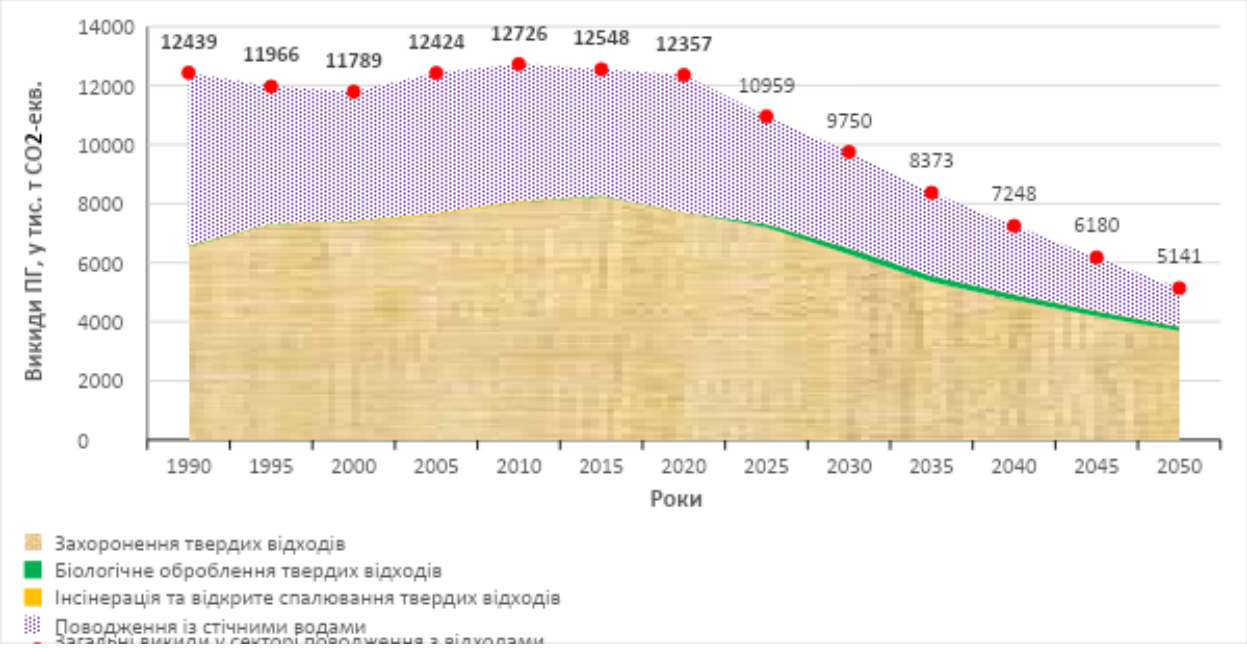
Table 5.4. Key policies and measures of the WAM scenario

№	Name of key policy	Quantitative indicator		
		2030	2033	2050
1	Scaling up of the practice of reusing components of the MSW	8 %* (full implementation of the planned policies)	10 %* (full implementation of planned policies)	10 %*
2	Promotion of the practice of recycling MSW	26 %* (full implementation of the planned policies)	34 %* (full implementation of planned policies)	35 %*
3	Promotion of the practice of composting organic components of MSW	12 %* (full implementation of the planned policies)	16 %* (full implementation of planned policies)	20 %*
4	Promotion of the practice of thermal treatment of MSW (with energy recovery)	8 %* (full implementation of the planned policies)	10 %* (full implementation of planned policies)	15 %*
5	Increasing the volume of utilization (recovery and flaring) of landfill gas at landfills and MSW disposal sites	23 %** (quantitative indicator not explicitly established by legislation)	29 %**	36 %**
6	Implementation of methane utilization (recovery and flaring) practices at wastewater management facilities	41 %** (quantitative indicator not explicitly established by legislation)	45 %**	70 %**

* - share of total waste generated;
** - share of total methane generated.

According to the WAM scenario, GHG emissions in the waste management sector will decrease intensively and reach 9.7 Mt CO2-eq in 2030, which is 22% lower than the emission level in 1990. In the future, emissions will continue to decrease and reach 5.9 Mt CO2-eq in 2050, which is 37% lower than the 1990 level. Detailed GHG emissions in the waste management sector until 2050 are shown in Figure 5.3.

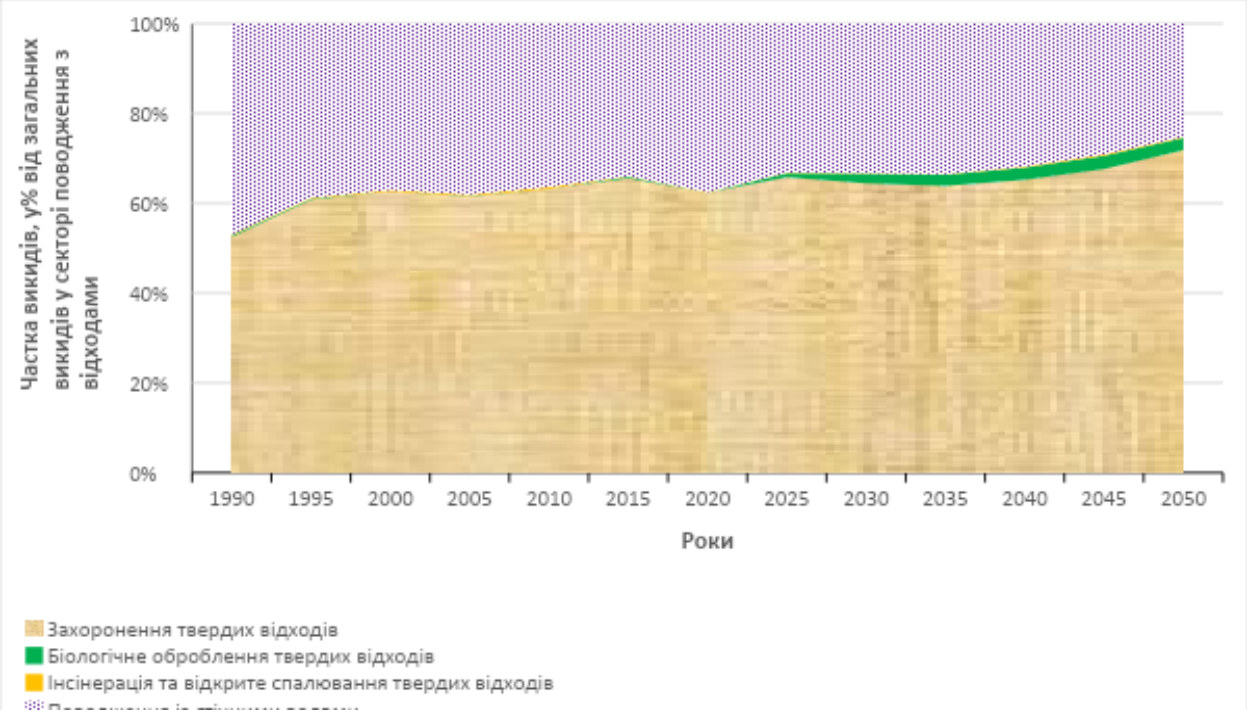
Fig. 5.3. GHG emissions in the waste management sector according to the WAM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - forecast data



According to the WAM scenario, the structure of emissions in the waste management sector undergoes significant changes. The main source of GHG emissions in the sector will still be solid waste disposal sites, but their share will increase from 62% in 2020 to 64% in 2030, and to 72% in 2050. These changes are associated with inevitable methane emissions resulting from the decomposition of MSW, which were previously buried in landfills and MSW disposal sites (before 2024). The share of emissions associated with wastewater management will decrease and will account for 33% in 2030 and 25% in 2050 compared to 38% in 2020. Just like in the WEM scenario, the only source in the WAM scenario that expects a significant increase in GHG emissions is the biological treatment of solid waste, emissions from which will increase from 7.5 thousand tons of CO2-eq. (0.1% of total sector emissions) in 2020 to 207.9 thousand tons of CO2-eq. in 2030, and then gradually decrease to 140.6 thousand tons of CO2-eq. (2.7% of total sector emissions) in 2050. Such a significant increase in emissions from the biological treatment of solid waste in the period until 2030 will be caused by the intensive spread of MSW composting practices for waste management in Ukraine.

The gradual reduction of GHG emissions from the biological treatment of solid waste after 2030 will be associated with the implementation of modern composting technologies for organic components of MSW with lower methane and nitrous oxide emission factors. Greenhouse gas emissions from thermal waste treatment methods (note: without energy recovery) will increase from 0.1% of total emissions in the waste management sector in 2020 to 0.3% in 2050. Although these emissions will not increase in absolute terms, the increase in the share of emissions in the sector will be caused by significant reductions in GHG emissions from other sources. The detailed structure of emissions by specific activities in the waste management sector until 2050 is shown in Figure 5.3.

Fig. 5.4. Structure of GHG emissions in the waste management sector according to the WAM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - forecast data



In the WAM scenario, the main factors determining the trends in GHG emissions in the waste management sector are:

- intensive reduction of the share of landfilling of MSW by 2033 with further moderate reduction by 2050;
- intensive deployment of technologies for the recovery and flaring of landfill gas by 2033 with further moderate increase in the recovery share
  by 2050;
- intensive deployment of technologies for the recovery of methane generated during centralized wastewater treatment;
- reduction of specific methane and nitrous oxide emissions during composting of MSW after 2033.

The key risks on the path to reducing GHG emissions according to the WAM scenario are:

- slow deployment of MSW treatment infrastructure;
- critically slow implementation of methane recovery technologies at wastewater treatment plants;
- low efficiency of flare and landfill gas recovery technologies at landfills and MSW facilities;
- implementation of technologies and practices for composting organic components of MSW with high specific emissions of methane and nitrous oxide.

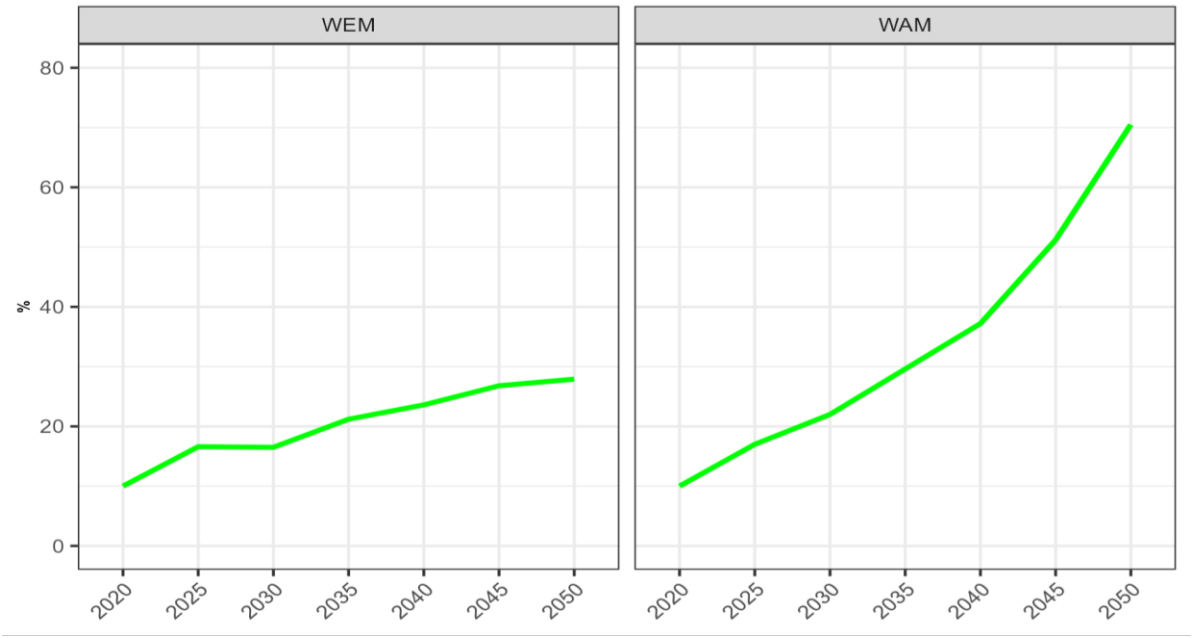
ii. Assessment of policy interactions (between existing policies and measures and planned policies and measures within a policy dimension and between existing policies and measures and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in

particular to establish a robust understanding of the impact of energy efficiency / energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply

Taking into account the current and potential consequences of Russia's full-scale military aggression against Ukraine, achieving the target of 27% RES in the structure of gross final energy consumption seems extremely ambitious. Modeling results for both WEM and WAM scenarios show that the share of RES will continue to increase, but the target indicator for 2030 may be unachievable, primarily due to low penetration of RES in industry and low rates of replacing natural gas with renewable energy sources for individual heating in residential and commercial sectors. At the same time, the draft National Renewable Energy Action Plan for the period up to 2030 is currently being reviewed by the Ministry of Energy and the Ministry of Infrastructure. In case of recalculating the targets and including new policies in the RES sector, the modeling results will be revised in the next stages of work on the NECP.

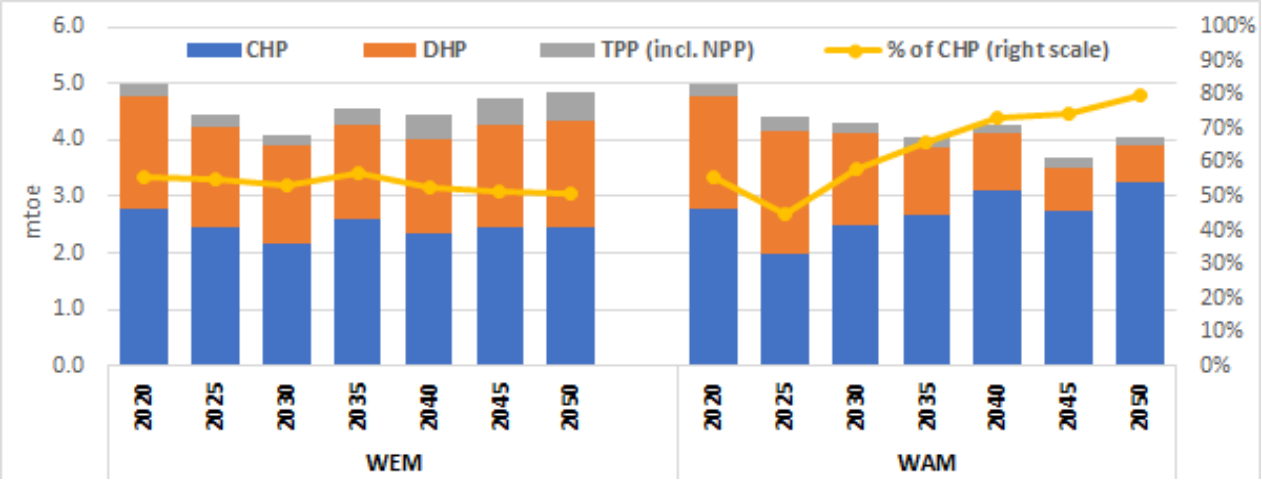
However, with the implementation of additional (to existing) measures to stimulate the development of renewables, the share of RES may significantly increase after 2030, reaching 70% in the gross final energy consumption by 2050 (see figure below).

Fig. 5.5. Share of RES in the gross final energy consumption, %



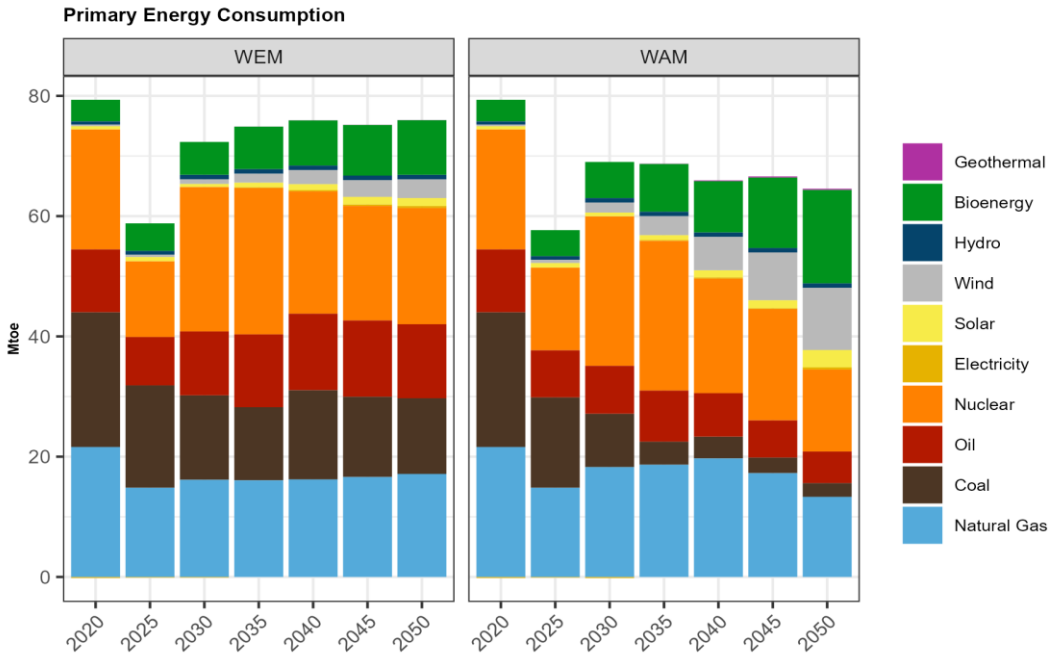
The results of modeling scenarios WEM and WAM using the TIMES-Ukraine model show that highly efficient cogeneration (CHP, especially based on RES) will increasingly compete with district heat plants (DHP)(see figure below).

Fig. 5.6. Production of district heat in scenarios WEM and WAM, mtoe.



In addition, the results of modeling under both scenarios (WEM and WAM) confirm that post-war economic recovery and reintegration of temporarily occupied territories of Ukraine will contribute to a significant increase in demand for energy resources, especially in the first 5-10 years. At the same time, existing policies and measures in the field of energy efficiency and renewable energy will not stabilize primary energy consumption, while additional measures may contribute to its reduction after 2030, with a significant share of natural gas remaining.

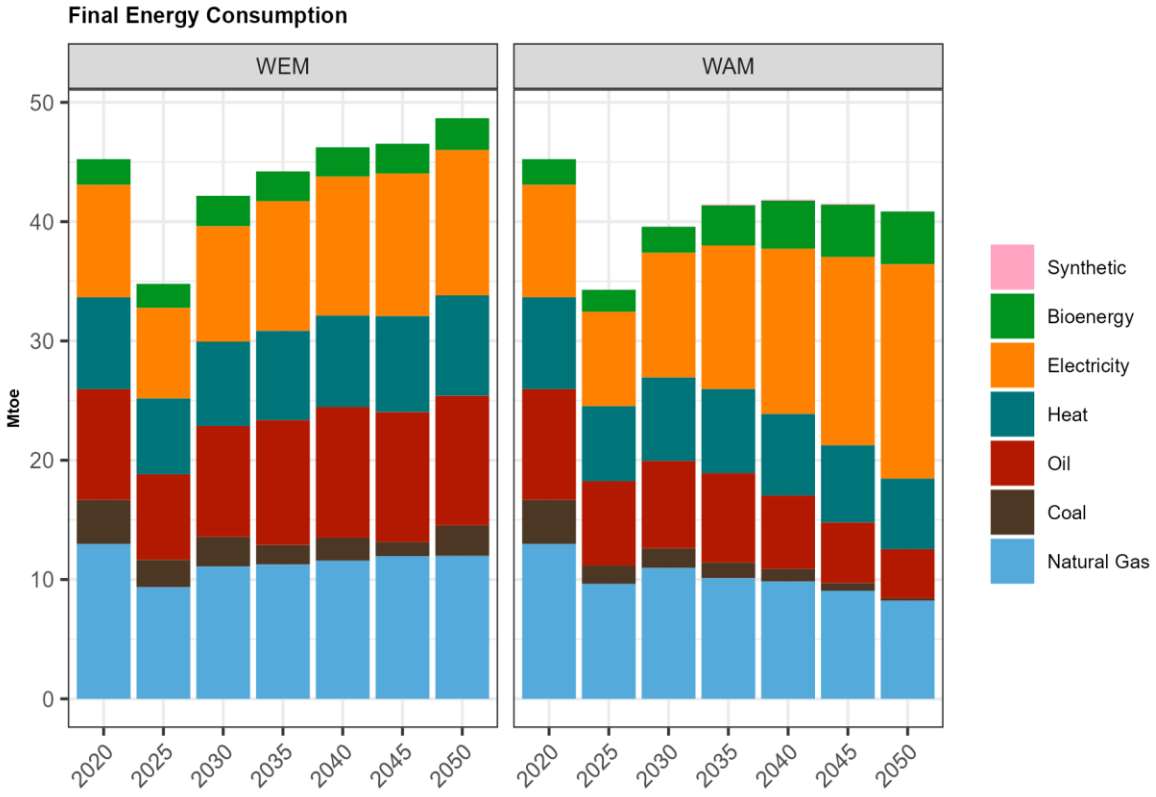
Fig. 5.7. Primary energy consumption, mtoe



The trajectory of final energy consumption is similar to the trajectory of primary energy consumption, but the growth rates in the WEM scenario are slightly higher, and in the WAM scenario, there is a stabilization of final energy consumption, indicating an increase in the efficiency of the energy transformation sector in both scenarios, primarily in the electricity and heat production sector. At the

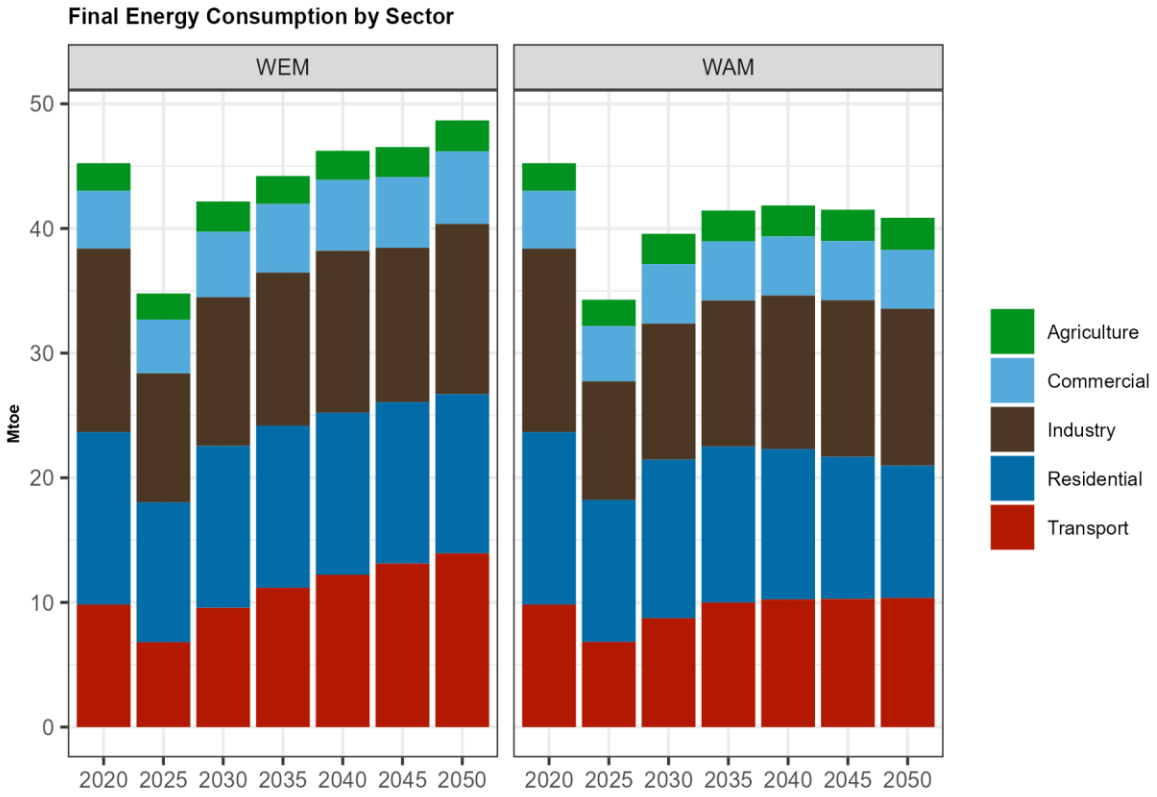
same time, in both scenarios, especially in WAM, there is also an increase in the share of electricity. However, synthetic fuels (hydrogen, biomethane) do not demonstrate competitiveness without special support measures.

Fig. 5.8. Final energy consumption by energy types, mtoe



After a drastic decrease in energy consumption in 2022 as a result of a full-scale war, there will be an increase in energy demand in all end-use sectors caused by economic recovery and reintegration of temporarily occupied territories, which will continue until 2030. At the same time, additional planned measures on energy efficiency, RES development, and other dimensions of the NECP will allow reducing energy needs in all sectors as well.

Fig. 5.9. Final energy consumption by sectors, mtoe



iii. Assessment of interactions between existing policies and measures and planned policies and measures, and between those policies and measures and Union climate and energy policy measures
[Planned for the next stages of work on the NECP]

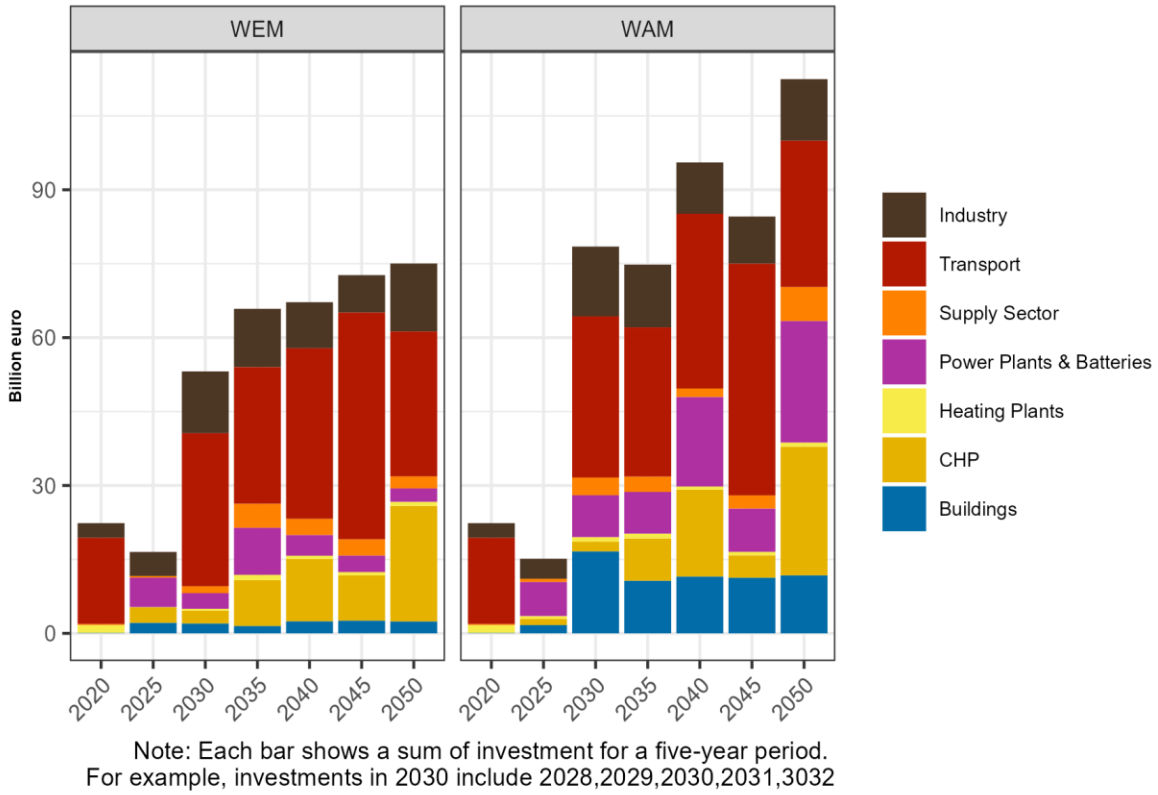
5.2. Macroeconomic and, to the extent feasible, the health, environmental, employment and education, skills and social impacts, including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in section 3 at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures
[Planned for the next stages of work on the NECP]

5.3. Overview of investment needs
i. existing investment flows and forward investment assumptions with regard to the planned policies and measures

Investment needs in the sectors of 'Energy' and 'Industrial processes and product use'

Overall investment needs are high in both WEM and WAM scenarios, but fairly comparable. In both scenarios, the largest investment needs are required for the renewal and decarbonization (electrification) of the vehicle stock (excluding household vehicles). Investments in electricity and heat generation facilities are also significant, however, due to higher rates of building thermal modernization, investment needs in cogeneration in the WAM scenario will be lower than in the WEM scenario.

Fig. 5.10. Investment needs for the implementation of WEM and WAM scenarios, bln Euro



Investment needs in the agriculture sector

Investment needs for the phased achievement of projected greenhouse gas emissions under the WAM scenario are provided in table 5.5.

Table 5.5. Investment needs for the implementation of agricultural development policies under the WAM scenario, million US dollars

Policy	2030	2040	2050
Promoting the spread of minimum tillage technologies	217,7	10,9	12,7
Promoting organic farming	-	-	-
Use of nitrogen fertilizers with slow or controlled release of nutrients	248,5	12,4	14,5
Use of information and communication technologies in crop production	437,7	875,4	875,4
Use of food additives that will contribute to reducing GHG emissions from enteric fermentation	138,2	276,4	276,4

of livestock			

Investment needs in the Waste sector

To implement the WEM scenario in the Waste sector, it is necessary to attract approximately 2.6 billion euros of capital investments during the period from 2024 to 2030 inclusive. Overall, the implementation of the WEM scenario will require attracting approximately 7.3 billion euros of capital investments in the waste management sector during the period from 2024 to 2050.

To implement the WAM scenario, it is necessary to attract about 3.6 billion euros during the period from 2024 to 2030 inclusive. Overall, the implementation of the WAM scenario will require the attraction of about 12.1 billion euros of capital. Table 5.5 and table 5.7 provide the need for capital investments for the implementation of the WEM and WAM scenarios, respectively, with a cumulative total from 2024 to 2050 and for specific periods.

Table 5.6. Capital investments for the implementation of WEM and WAM scenarios cumulatively up to 2050, in million euros

	2025	2030	2035	2040	2045	2050
Waste management sector, cumulatively						
WEM	563,6	1984,4	3284,1	4602,4	5936,1	7280,8
WAM	1037,8	3653,7	5756,4	7860,3	9961,7	12060,1

Table 5.7. Capital investments for the implementation of WEM and WAM scenarios for individual periods up to 2050, in million euros

	2024-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	Total
Waste management sector, per period							
WEM	563,6	1420,8	1299,7	1318,3	1333,7	1344,7	7280,8
WAM	1037,8	2615,9	2102,8	2103,9	2101,3	2098,4	12060,1

ii. sector or market risk factors or barriers in the national or regional context
[Planned for the next stages of work on the NECP]

iii. analysis of additional public finance support or resources to fill identified gaps identified under point ii
[Planned for the next stages of work on the NECP]

5.4. Impacts of planned policies and measures described in section 3 on other Member States and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

i. Impacts on the energy system in neighbouring and other Member States in the region to the extent possible
[Planned for the next stages of work on the NECP]

ii. Impacts on energy prices, utilities and energy market integration

Electricity market
[Planned for the next stages of work on the NECP]

Gas market
Planned policies and measures will enable conditions for cross-border gas movement (natural gas, biomethane) across Ukraine's borders with EU member states and the Energy Community. These include measures to remove export bans from Ukraine, establish a system of origin guarantees and sustainability confirmations, and so on. At the same time, ensuring unimpeded movement of these goods from Ukraine to the EU and considering their real value, including green components, will only be possible if necessary measures are taken by the EU and EU member states.

With the opening of gas exports to the EU, it can be expected that a significant portion of domestic production may be exported. This can be positive in terms of currency revenue and overall business integration, but it may carry risks in terms of the need to purchase necessary resource volumes from abroad (i.e. supply security and procurement prices). Accordingly, comfortable conditions for selling domestically produced gas within the country should be created in the domestic market. To achieve this, the planned measures include, on the one hand, liberalization of gas prices (simultaneously with the update of the housing subsidy system, creation of a system to protect vulnerable consumers, and monitoring and reduction of energy poverty), and on the other hand, improvement of sellers' access conditions to the functioning wholesale market and retail market (improvement of commercial accounting rules, balancing, and reform of gas distribution system operators).

In addition, the planned policies and measures will enable the existing energy infrastructure to adapt to new conditions, with a focus on deepening integration into political, research, design, and business processes in the EU. This, in turn, will reduce the burden of costs for the creation and transformation of infrastructure on Ukrainian consumers, as well as increase revenues from foreign buyers of energy infrastructure services.

Energy use in transportation
[Planned for the next stages of work on the NECP]

iii. Where relevant, impacts on regional cooperation
[Planned for the next stages of work on the NECP]

ANNEXES

ANNEX 1. Methodological basis for scenario modeling in accordance with the Regulation (EU) 2018/1999 (hereinafter referred to as the Regulation) and taking into account the peculiarities of public administration in Ukraine

For the purposes of the NECP, modeling is carried out using two mandatory scenarios:

1) with existing policies and measures (WEM);[435]
2) with planned policies and measures (WAM).[436]

The existing policies and measures include:[437]

a) implemented policies and measures;

b) adopted policies and measures.

The regulation specifically defines what is meant by 'implemented', 'adopted', and 'planned' policies and measures. These definitions are useful to consider in both English and Ukrainian languages:

Regulation 2018/1999[438]	Regulation 2018/1999 (translation available on the website of the Verkhovna Rada of Ukraine)[439]
‘implemented policies and measures ’ means policies and measures for which one or more of the following applies at the date of submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report : directly applicable Union or national law is in force, one or more voluntary agreements have been established, financial resources have been allocated, human resources have been mobilised;	"implemented policies and measures" means policies and measures that, as of the date of submission of the integrated national energy and climate plan or the integrated national progress report on energy and climate, have been subject to one or more of the following conditions: there is existing Union law or national law capable of direct application, one or more voluntary agreements have been concluded, financial resources have been allocated, human resources have been mobilized;[440]
‘adopted policies and measures’ means policies and measures for which an official government decision has been made by the date of submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report and there is a clear commitment to proceed with implementation;	'adopted policies and measures' means policies and measures for which, as of the date of submission of the integrated national energy and climate plan or the integrated national progress report on energy and climate, an official government decision has been adopted and there is a clear commitment to further implementation;[441]
‘planned policies and measures ’ means options that	'planned policies and measures' means options that are

[435] Regulation, art.8(1).
[436] Regulation, art.8(2).
[437] Regulation, art.2(2).
[438] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R1999-20230516
[439] https://zakon.rada.gov.ua/laws/show/984_030-18#Text
[440] Regulation, art.2(3).
[441] Regulation, art.2(4).

are under discussion and that have a realistic chance of being adopted and implemented after the date of submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report;	under discussion and have a real chance of being adopted and implemented after the date of submission of the integrated national energy and climate plan or the integrated national progress report on energy and climate;[442]

These definitions will be applied taking this into account.

Firstly, considering that integrated national reports on progress in the field of energy and climate are developed and approved based on the adopted NECP,[443] as well as the ongoing preparation of Ukraine's first NECP, the indicative date of NECP submission will be used for the purposes of qualifying measures in accordance with the above definitions. In this regard, based on the terminology of the English version of the Regulation, it refers to the submission of the draft or final version of the NECP to the European Commission, and in the case of Ukraine - to the Secretariat of the Energy Community.

Secondly, the phrase 'the current law of the Union [Energy Community] or national law that is directly applicable' should be interpreted taking into account that EU law understands direct applicability.[444] Directly applicable norms are norms that can be a legal basis for claims by individuals and legal entities regarding the recognition of their rights both against the state (vertical direct applicability) and against other persons (horizontal direct applicability). A directly applicable norm can be contained in a law, a subordinate act, and in some cases, an international treaty. However, not every norm of a law, subordinate act, or international treaty is a directly applicable norm. A norm has direct applicability if it is specific, clear, unconditional, and does not require additional implementation measures by the state. The status of a direct applicability norm is determined by analyzing the specific norm against the mentioned criteria. In the context of Ukraine, an example of a direct applicability norm can be a provision of the law on the application of the principle of non-discrimination in relations between subjects of energy markets. Norms that define goals or general tasks of the state, its bodies, or other persons, that allow for a wide range of discretion in their application, or that require additional implementation actions, are not norms of direct applicability.

Thirdly, considering the relatively small number of norms directly applicable in Ukraine's energy legislation, as well as the legal uncertainty regarding the direct application of norms from Energy Community acts, the implemented policies and measures will primarily include policies and measures that:

a) "are based on one or more voluntary agreements" (meaning that the policy or measure is not based on compliance with legislation, but on the fulfillment of a concluded agreement), or

b) 'allocated financial resources' (i.e. corresponding expenses included in the tariffs of regulated market entities, allocated from the state budget or from international financial assistance, etc.), or

c) mobilized human resources.

Regarding concluded agreements, only agreements are taken into account, not memoranda of understanding or intentions.

Regarding the allocation of financial resources, the existence of an adopted, sufficiently clear financing mechanism for relevant policies or measures is taken into account, which can serve as a basis for the formation of legal requirements for the parties (e.g. funds included in the tariff, the right to conclude a green tariff purchase and sale agreement / tax reduction / reduced tax rate, as defined by legislation, and there are no regulatory restrictions on its implementation, etc.). Issues with the implementation of such

[442] Regulation, art.2(5).

[443] Regulation, art.17(1).

[444] https://eur-lex.europa.eu/EN/legal-content/summary/the-direct-effect-of-european-union-law.html

mechanisms (e.g. non-payment by parties, accumulation of debts, etc.) may be taken into account for the recognition of the status of policies and measures only in exceptional cases.

Implemented policies and measures are closely related to adopted policies and measures, as they are united within a single group of existing policies and measures. The criteria for adopted policies and measures are: a) 'official government decision has been adopted' and b) 'there is a clear commitment to further implementation'.

Considering that the executive branch of power usually adopts specific policies and measures, and the government represents it, referring to the existence of a government decision does not imply a restriction on the decision-making body (i.e. not only the government can make such a decision), but rather indicates the specificity and realism of the policies and measures belonging to the group of adopted and, accordingly, existing policies and measures. At the same time, the adoption of a norm by the parliament on its own initiative (in the absence of government initiative) may indicate that the policy or measure cannot be considered adopted and existing, particularly in case of non-compliance with the second criterion.

The criterion for the presence of a 'clear commitment to further implementation' is interpreted as follows: if there is a legal basis for the corresponding policy and measure, the necessary actions and resources for its implementation are clearly defined, and there is an understanding that these resources should be allocated. Close connection with implemented policies and measures indicates that in the case of adopted policies and measures, there is indeed a clear commitment to allocate financial resources, mobilize human resources, or readiness to enter into voluntary agreements.

Fourthly, it should be noted that the planned policies and measures refer to "options" (rather than "policies and measures" as in the case of previous definitions).

These options are subject to two criteria: a) being in the discussion stage; and b) having a "real chance of being adopted and implemented after the submission date". Considering the terminology of the English version, discussions do not refer to formal public discussions, but mostly to the presence of discussion on the respective option in public circles. The presence of discussion is assumed if it concerns policies and measures planned in response to an already adopted act of higher legal force (law).

The second criterion has a limiting nature in terms of the range of all possible options being discussed. In this case, several cases are considered, which indicate the realism ("real chance") of the options. The first case is the level of announcement of the option: it is taken into account that policies and measures can be considered realistic if officially announced by significant officials of the state (President, Prime Minister, Vice Prime Ministers, Minister, Head or Deputy Heads of the Presidential Office), provided they are sufficiently detailed and objectively realistic. The second case is the presence of specific external factors that clearly encourage the implementation of policies and measures. These external factors can be both part of Ukraine's international obligations and be contained in the legislation of other countries. To identify such external factors, it is not enough for them to be part of Ukraine's international obligations. In addition to formal obligations, a factor of high risk of sanctions or other negative consequences from non-compliance with obligations or other external conditions (such as non-provision of funds, refusal to purchase products, etc.) should be added. Examples of the second case can be CBAM, EU requirements for green hydrogen, sustainability of biofuels, etc.

Fifthly, considering that the planned policies and measures are options, several such options can be used during modeling, forming several scenarios with the planned measures. In section 5 of the NECP, the macroeconomic impact should be described, if possible - the impact from the point of view of health, environment, labor requirements and social impact, the ability to attract funding for implementation, as well as the significance in terms of achieving the principle of climate neutrality of the planned policies and measures or their groups, which will allow for proper and comprehensive analysis of such options.

It should be noted that policies / measures are considered policies / measures adopted at the state level. Policies / measures at the company level, including state-owned ones, are not distinguished as separate policies / measures for the purposes of the first NECP of Ukraine, but are adopted to determine the extent of achieving the goals of state policies / measures.

The TIMES-Ukraine model, developed by the State Institution "Institute of Economics and Forecasting of the NAS of Ukraine", improved and updated to the latest software in July 2023 thanks to the global initiative Net Zero World, is used to model NECP scenarios. The applicable model covers the sectors of "Energy" and "Industrial processes and product use" (as understood by the Intergovernmental Panel on Climate Change, IPCC). Other modeling tools will be used for the remaining sectors ("Agriculture", "LULUCF", "Waste").

Modeling for the purposes of the NECP is carried out in order to assess to what extent existing and planned policies and measures allow for the achievement of goals set at the EU or Energy Community level. Due to the lack of time to prepare the first NECP of Ukraine, the impact of individual existing and planned measures is not investigated, and it is assumed that the measures identified as existing or planned are sufficiently realistic and effective to achieve the impact envisaged for them by the developers. Modeling for the purposes of the NECP differs from other approaches, such as goal-based modeling, where a specific goal is set as an assumption, and the aim of modeling is to determine the optimal path to achieve the fixed goal.

The modeling process for the NPEC consists of several stages:

1) forming a set of assumptions, common to all NPEC scenarios, including key macroeconomic indicators, future demographic situation, prices on external markets, cost of technologies, area of residential and non-residential buildings, minimum or maximum values of individual energy indicators;
2) distribution of all policies and measures described in the NECP among scenarios, as well as on scenario parameters and indicators; the main criteria for distribution among parameters and indicators are: a) parameters have a higher likelihood of impact that can be included in the NECP; b) parameters do not compete with other policies and measures within the same scenario;
3) formation of scenarios as combinations of assumptions and selected parameters;
4) obtaining the first modeling results;
5) consideration of the first modeling results by experts, as well as their discussion through technical consultations or public discussions with various stakeholders;
6) taking into account the results of the discussions and expert assessment, and adjusting the scenarios and, if necessary, the goals, policies, and measures for conducting further modeling and updating the descriptive part of the NECP.

ANNEX 2. Assumptions regarding the main parameters of agricultural development

Category	Units of measurement	NDC (2030)	2022	2030	2040	2050
Total cattle in Ukraine	thousand heads	3697	2 682,92	2 984,64	3 305,36	3 508,01
Cattle in agricultural enterprises	thousand heads		1 011,43	1 112,58	1 246,08	1 345,77
Cows in agricultural enterprises	thousand heads		423,82	466,20	522,15	563,92
Cattle in household farms	thousand heads		1 671,49	1 872,07	2 059,28	2 162,24
Cows in household farms	thousand heads		1 127,79	1 263,12	1 389,43	1 458,90
Tota lsheep in Ukraine	thousand heads		770,920	801,757	841,845	858,682
Ewes and rams aged 1 year and older in all forms of ownership	thousand heads		524,790	545,781	573,070	584,532
Total number of pigs in Ukraine	thousand heads		5 531,71	6 125,36	6 272,92	6 301,64
Pigs in agricultural enterprises	thousand heads		3 507,30	3 858,03	4 050,93	4 212,97
Main breeding sows in agricultural enterprises	thousand heads		220,42	242,46	254,58	264,76
Pigs aged 2 to 4 months in agricultural enterprises	thousand heads		1 005,89	1 106,48	1 161,80	1 208,28
Pigs for fattening in agricultural enterprises	thousand heads		1 317,69	1 449,46	1 521,93	1 582,81
Pigs in household farms	thousand heads		2 024,41	2 267,34	2 221,99	2 088,67
Main sows in household farms	thousand heads		118,29	132,48	129,83	122,04
Pigs aged 2 to 4 months in household farms	thousand heads		445,37	498,81	488,84	459,51

Pigs for fattening in household farms	thousand heads		656,84	735,67	720,95	677,70
Total number of horses in Ukraine	thousand heads		174,661	178,15	179,94	176,34
Total number of goats in Ukraine	thousand heads		501,196	521,24	526,46	521,19
Total number of buffaloes in Ukraine	thousand heads		0,095	0,30	0,32	0,35
Total number of rabbits in Ukraine	thousand heads		4 551,996	4 734,08	4 686,73	4 639,87
Total number of poultry in Ukraine	thousand heads	257300	203 020,248	221 003,699	222 549,752	222 878,396
Poultry in agricultural enterprises	thousand heads		115 928,719	125 203,02	127 707,08	128 984,15
Chickens and roosters in agricultural enterprises	thousand heads		113 849,339	122 957,29	125 416,43	126 670,60
Geese in agricultural enterprises	thousand heads		46,715	50,45	48,94	48,45
Ducks in agricultural enterprises	thousand heads		255,378	268,15	260,10	257,50
Turkeys in agricultural enterprises	thousand heads		822,220	863,33	854,70	846,15
Poultry in household farms	thousand heads		87 091,530	95 800,68	94 842,68	93 894,25
Chickens and roosters in household farms	thousand heads		72 488,059	79 736,86	78 939,50	78 150,10
Geese in household farms	thousand heads		3 563,229	3 812,65	3 774,53	3 736,78
Ducks in household farms	thousand heads		9 818,918	10 604,43	10 498,39	10 393,40
Turkeys in household farms	thousand heads		801,279	821,31	813,10	804,97
Milk yield from one cow on agricultural enterprises	kg/day per head		17,32	17,50	18,00	18,20
Milk yield from one cow in household farms	kg/day per head		12,89	13,00	13,30	13,40

Annual milk production from one ewe in farms of all forms of ownership	kg/year per head		135,5	139,0	141,0	143,0
Average fleece weight per head in all categories of farms	kg/year		3,04	3,09	3,17	3,20
Total nitrogen fertilizers applied in Ukraine	kg N / year		1 365 800 988,14	1,769.9 thousand tons	1,858.4 thousand tons	1,951.3 thousand tons
Input under field crops (excluding rice), *(expert estimates)*	kg N / year		1 365 545 488,14	1 800 000 000,00	2 200 000 000,00	2 500 000 000,00
Input under rice, *(expert estimtes)*	kg N / year		255 500,00	4 500 000,00	4 750 000,00	4 800 000,00
Annual amount of urea used as fertilizer	t		486 232,00	698423,3	733344,5	770011,7
Annual amount of applied lime flour	thousand tons		294 000,00	308700	324135	340341,7
Total harvested area in Ukraine	thousand hectares	29245	25 693,06	28 580,9	30 009,9	31 510,4
grains	thousand hectares		12 973,38	15 948,4	16 745,8	17 583,1
wheat	thousand hectares		6 052,63	7 090,2	7 444,7	7 816,9
rye	thousand hectares		103,89	171,6	180,2	189,2
barley	thousand hectares		2 038,79	2 472,1	2 595,7	2 725,5
corn for grain	thousand hectares		4 410,92	5 481,8	5 755,9	6 043,7
rice	thousand hectares		1,40	10,1	10,6	11,1
legumes	thousand hectares		210,55	310,7	326,2	342,5
technical	thousand hectares		8 817,32	9 244,5	9 706,7	10 192,1
sugar beet	thousand hectares		184,29	226,6	237,9	249,8
sunflower	thousand hectares		5 750,42	6 665,1	6 998,4	7 348,3
soybean	thousand hectares		1 571,17	1 322,9	1 389,0	1 458,5
rapeseed	thousand hectares		1 219,57	1 004,5	1 054,7	1 107,5

energy crops	thousand hectares		2,50	1,1	1,2	1,2
root crops and tuber crops, open field vegetable and garden food crops	thousand hectares		1 748,32	1 800,3	1 890,3	1 984,8
potatoes	thousand hectares		1 282,07	1 283,2	1 347,4	1 414,7
total open and closed field vegetables	thousand hectares		424,30	460,8	483,8	508,0
garden food crops	thousand hectares		41,34	61,8	64,9	68,1
feed	thousand hectares		1 943,48	1 535,0	1 611,8	1 692,3
root crops	thousand hectares		166,80	227,8	239,2	251,1
feed corn	thousand hectares		204,71	216,4	227,2	238,6
annual grasses (hay)	thousand hectares		154,53	190,6	200,1	210,1
annual grasses (green fodder)	thousand hectares		56,10	72,3	75,9	79,7
perennial grasses (hay)	thousand hectares		648,80	694,1	728,8	765,2
perennial grasses (green fodder)	thousand hectares		113,66	109,2	114,7	120,4
legumes for hay	thousand hectares		536,67	675,2	709,0	744,4
legumes for green fodder	thousand hectares		5,88	6,6	6,9	7,3
Organic farming	thousand hectares	1000	264 (data provided by the Ministry of Agrarian Policy and State Statistics)	1 240*	1 310	1 365
Technologies low till and no till	thousand hectares	2200		3 500**	3 675	3 858,75
Crop yield increase	%	10% from 2016-2019		Data from the State Statistics for 2021	5% of indicators by 2030	5% of indicators by 2040

Annual area of arable/drainable organic soils (data from the water agency)	ha		471 602,000	471 602,000	470,000	470,000
Manure utilization for biogas	tons (16%)	16				

Notes: *The indicator is provided by the National Economic Strategy for the period up to 2030, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 03.03.2021 No. 179
** Taken from the table of indicators Forecast (possible targets) of the National Economic Strategy (data from the Ministry of Economy 2030).

ANNEX 3. Methodology for forecasting greenhouse gas emissions in the solid waste management sector

The assessment of GHG emissions in the waste management sector was carried out in accordance with the principles and methodologies of the 2006 IPCC Guidelines for National Gas Inventories[445] (hereinafter referred to as the 2006 IPCC Guidelines), therefore the sources of GHG emissions correspond to categories recommended in the aforementioned methodologies (IPCC categories) in the "Waste" sector. Accordingly, emissions from agricultural waste management and relevant GHG reduction policies were taken into account either in the LULUCF sector or in the energy sector if such policies were accompanied by beneficial energy production. GHG emissions associated with beneficial energy use during waste treatment, such as landfill gas recovery and methane from wastewater, as well as energy production from waste incineration plants and waste incineration in cement production, were considered in the Energy sector, but the reduction effect of GHG emissions resulting from these activities was taken into account in the Waste sector. The assessment of GHG emissions in the Waste sector was carried out in strict accordance with the methods and taking into account the emission factors used by Ukraine for reporting[446] national GHG emissions under the UN Framework Convention on Climate Change and the Paris Agreement. For example, the assessment of methane emissions from the disposal of solid waste in landfills was conducted using the first-order decay method, as recommended in the 2006 IPCC Guidelines.

General assumptions and methodological principles for determining data on the waste sector activity. The following indicators and trends were used in modeling the waste sector, with specific indicators for the sector highlighted in italics.:

Solid waste disposal: population, specific volumes of MSW (municipal solid waste) generation per capita, waste management practices (share of disposal, reuse, recycling, composting, incineration), population coverage by centralized waste collection system, construction of new sanitary (deep controlled) MSW landfills, MSW composition, share of flare combustion and landfill gas recovery.

To ensure transparency, the model of the waste balance in the MSW sector during the modeling of GHG emissions is presented in Fig. D2.1, from which the following basic principles of mathematical modeling arise:

1. The total amount of generated MSW corresponds to the sum of officially and illegally buried MSW[447]. The input data for estimating the volumes of MSW generation are: population, population coverage by the centralized MSW collection system, specific volumes of MSW generation per resident.

2. After assessing the volumes of MSW formation, these volumes are divided into separate streams of MSW components, the magnitude of which is determined based on their component (morphological) composition. These streams include: paper and cardboard, food waste, garden and park waste, wood, personal hygiene products, rubber and leather, textiles and non-biodegradable components (including ferrous metals, non-ferrous metals, glass, plastic, hazardous and other inorganic materials). In cases where MSW is not covered by the centralized collection system, it is disposed of in uncontrolled shallow landfills.

[445] https://www.ipcc-nggip.iges.or.jp/public/2006gl/

[446] https://unfccc.int/documents/628276#main-content

[447] Undefined practice (e.g., on-site composting, recycling under the gray scheme, etc.) of handling MSW that is not covered by the centralized collection system is excluded from the mass balance because it does not result in significant GHG emissions.

3. Food and garden components in the mixed MSW stream form a composting stream (biological treatment) whose volume is determined by the overall composting share.

4. Glass forms a stream for reuse, the volume of which is determined by the reuse share.

5. Paper, cardboard, and non-biodegradable components (including plastic and metals) form a recycling stream, the volume of which is determined by the overall recycling share.

6. The remaining part of MSW is divided into two streams: incineration and burial, which are determined by the incineration fraction.

7. The distribution by types of burial sites is determined by the construction of new sanitary landfills for MSW.

Biological treatment (composting) of solid waste: population, indicators of industrial and agricultural sectors development, per capita MSW generation rates, composting fraction and composting technologies.

Incineration and open waste burning: GDP growth, industrial sector development indicator, specific legislation (prohibition of incineration of MSW without energy recovery).

Wastewater treatment and discharge: population, urban and rural population share, sector development indicators (energy, black metallurgy, agriculture, food industry, etc.), treatment and discharge share; consumption of meat products, dairy products and fruits per capita, technology development, share of flare combustion and methane recovery from wastewater treatment.

Fig. D2.1. General scheme of the MSW mass balance model (mass flows)